Astronomical Institute
Slovak Academy of Sciences

Summary report

January 1, 2012 - December 31, 2015

Tatranská Lomnica, July 30, 2016

Questionnaire
Summary of the main activities of a research institute of the Slovak Academy of Sciences

Period: January 1, 2012 - December 31, 2015

1. Basic information on the institute:

1.1. Legal name and address

Astronomical Institute of the Slovak Academy of Sciences
05960 Tatranská Lomnica, Slovakia

1.2. URL of the institute web site

https://www.astro.sk/

1.3. Executive body of the institute and its composition

Directoriat	Name	Age	Years in the position
Director	RNDr. Aleš Kučera, CSc.	61	2009 -
Deputy director	Doc. RNDr. Ján Svoreň, DrSc.	67	2009 -
Scientific secretary	Mgr. Martin Vaňko, PhD.	39	2013 -
Scientific secretary	RNDr. Drahomír Chochol, DrSc.	69	2009-2013

1.4. Head of the Scientific Board

RNDr. Theodor Pribulla, CSc.

1.5. Basic information on the research personnel

1.5.1. Number of employees with university degrees (PhD students included) engaged in research projects, their full time equivalent work capacity (FTE) in 2012, 2013, 2014, 2015, and average number of employees in the assessment period

	2012		2013		2014		2015		total		
	number	FTE	number	FTE	number	FTE	number	FTE	number	averaged number per year	averaged FTE
Number of employees with university degrees	37,0	33,610	39,0	33,800	36,0	31,150	38,0	32,180	**150,0**	**37,5**	**32,685**
Number of PhD students	7,0	6,660	4,0	3,250	5,0	5,000	5,0	4,500	**21,0**	**5,3**	**4,853**
Total number	44,0	40,270	43,0	37,050	41,0	36,150	43,0	36,680	**171,0**	**42,8**	**37,538**

1.5.2. Institute units/departments and their FTE employees with university degrees engaged in research and development

Research staff	2012		2013		2014		2015		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
Institute in whole	37,0	33,610	39,0	33,800	36,0	31,150	38,0	32,180	**37,5**	**32,685**
Solar Department	10,0	9,130	10,0	9,370	10,0	8,520	10,0	8,060	**10,0**	**8,770**
Department of Interplanetary Matter	13,0	10,980	14,0	11,120	12,0	9,880	13,0	10,790	**13,0**	**10,693**
Stellar Department	14,0	13,500	15,0	13,310	14,0	12,750	15,0	13,330	**14,5**	**13,223**

1.6. Basic information on the funding of the institute

Institutional salary budget and others salary budget

Salary budget	2012	2013	2014	2015	average
Institutional Salary budget *[thousands of EUR]*	515,515	517,518	517,783	529,030	519,962
Other Salary budget *[thousands of EUR]*	26,780	25,532	18,604	13,573	21,122

1.6. Mission Statement of the Institute as presented in the Foundation Charter

[1] Astronomical Institute of the Slovak Academy of Sciences (AISAS) is focused on observations and basic research in the group of sciences “Natural sciences” sub-group “Physical sciences”, branches “Astronomy”, “Astrophysics”, “Plasma physics” and “Environmental Physics”, with emphasis on research of the Sun, interplanetary matter, stars and stellar systems.

[2] AISAS provides consulting and other expertise services relating to its main specialization.

[3] AISAS organizes the postgraduate (PhD) study in astronomy and astrophysics and ensures the participation of the staff of the Institute in teaching at universities.

[4] AISAS publishes the results of its scientific activity in journals as well as in non-periodical prints and popularizes the results in media.

1.7. Summary of R&D activity pursued by the institute during the assessment period in both national and international contexts, (recommended 5 pages, max. 10 pages)

Scientific achievements and results gained at AISAS have been published mostly in top high ranked international scientific journals, presented at prestigious international conferences and significantly cited by the scientific community. This documents quality of incorporation of AISAS in European Research Area as well as in international scientific community and it emphasizes correct orientation of the AISAS in the scientific field.

AISAS consists of three scientific departments. Research activities and achievements in 2012-2015 are summarized separately for each department.

In terms of right of freedom in scientific research, several significant results were achieved during the assessed period by our scientists also in interdisciplinary research connected with fundamental astrophysical theories. These results are given at the end of this summary.

1.7.1. Stellar department - RESEARCH AREAS:

a) study and search of exoplanets, determination of basic parameters of exoplanets and development of theoretical tools for analysis, search for young exoplanets in open galactic clusters, search for circumbinary exoplanets,
b) study of binaries and multiple systems of stars, determination of the absolute parameters of the components of eclipsing binaries using ground-based and satellite photometric, spectroscopic, and interferometric data, study of close binaries focusing on the mass transfer and mass loss, study of cycles of stellar activity and spots,
c) study of pre-main-sequence (T Tauri) multiple and single stars to constrain models of stellar evolution,
d) study of the structure of active components in symbiotic stars, ionization, scattering and mass outflow by the stellar wind and jets, multifrequency observations of classical novae, determination of their orbital periods, study of the structure of their expanding envelopes using the spectroscopic observations and direct optical and radio images

SELECTED RESULTS PUBLISHED IN THE PERIOD 2012-2015

a) EXOPLANETS

Computation and tabulation of fundamental parameters of exoplanets.
Calculations and analysis of non-isotropic phase functions, asymmetry parameter (mean cosine of the scattering angle), absorption and scattering opacities, single scattering albedos, equilibrium temperatures, and radiative accelerations of dust grains relevant for extrasolar planets are presented. We assume spherical grains, Deirmendjian particle size distribution, and Mie theory. Several species: corundum/alumina, perovskite, olivines with 0 and 50 % iron content, pyroxenes with 0, 20, and 60 % iron content, pure iron, carbon at two different temperatures, water ice, liquid water, and ammonia are considered. The tables cover the wavelength range of 0.2-500 μm and modal particle radii from 0.01 to 100 μm. Equilibrium temperatures and radiative accelerations assume irradiation by a non-blackbody source of light with temperatures from 7000 to 700 K seen at solid angles from 2π to 10^{-6} sr. **[1]**

Study of peculiar exoplanetary system
A peculiar exoplanetary system KIC 12557548b showing a long comet-like tail was studied using the SHELLSPEC code. The light curve has a prominent pre-transit brightening and a less prominent post-transit brightening. Both are caused by the forward scattering and are a strong function of the particle size. This feature enabled us to estimate a typical particle size (radius) in the dust tail of about 0.1-1 micron. However, there is an indication that the particle size decreases along the tail. The dust density in the tail is a steep decreasing function of the distance from the planet, which indicates a significant tail destruction caused by the star-planet interaction. Several possible combinations of other dust properties are tabulated. We reveal interesting periodic long-term evolution of the tail on a time scale of about 1.3 years and also argue that the "planet" does not show a uniform behaviour, but may have at least two constituents. **[2]**

b) CLASSICAL BINARY AND MULTIPLE STARS

First time determination of metalicity of 90 binaries (W UMa type)
About 4500 spectra collected at the David Dunlap Observatory were analysed to determine metallicity of 90 W UMa type binaries for the first time. The logarithmic relative metallicities, [M/H], for the F-type sub-sample indicate metal abundances roughly similar to the solar metallicity, but with a large scatter which is partly due to combined random and systematic errors. A parallel study of kinematic data, utilizing the most reliable and

recently obtained proper motion and radial velocity data for 78 binaries of the full sample, shows that the F-type sub-sample binaries (44 stars with both velocities and metallicity determinations) have similar kinematic properties to solar-neighbourhood, thin-disk dwarfs. FU Dra with a large spatial velocity, V = 197 km/s and [M/H] = -0.6 ± 0.2, appears to be the only thick-disk object in the F-type sub-sample. The kinematic data indicate that the F-type EW binaries are typical, thin-disk population stars with ages about 3-5.5 Gyr. **[16]**

(c) PRE-MAIN SEQUENCE STARS

Strong constraints on the third light (reflection nebula + stellar components) in eclipsing TY CrA system

Hierarchical eclipsing system TY CrA system is observed photometrically in the visual range (VYSOS6) and in the near-infrared (SOFI, REMIR) in Chile. The infrared observations show the secondary minimum and enable reliable parameter determination and set strong constraints on the third light (reflection nebula + stellar components). The absolute parameters of the inner eclipsing binary agree very well with previous work except of the primary radius (1.46±0.15 $R_{\odot}$) and luminosity (40±10 $L_{\odot}$) which are clearly smaller. While the parameters of the secondary are well understood when assuming an age of about 3-5 Myr, the primary seems considerably undersized. Low metallicity cannot explain the parameters of the primary. **[26]**

(d) SYMBIOTIC STARS AND CLASICAL NOVAE

Introducing of a new method for determining the mass-loss rate from symbiotic binaries via the Raman scattering on atomic hydrogen

The mass-loss rate from Mira variables represents a key parameter in our understanding of their evolutionary tracks. We introduce a method for determining the mass-loss rate from the Mira component in D-type symbiotic binaries via the Raman scattering on atomic hydrogen in the wind from the giant. Using our method, we investigated Raman HeII λ1025 → λ6545 conversion in the spectrum of the symbiotic Mira V1016 Cyg. We determined its efficiency to 10.2 and 14.8% and using the ionization model of symbiotic stars we determined the corresponding mass-loss rate of $2.0(+0.1/-0.2)\times10^{-6}$ and $2.7(+0.2/-0.1)\times10^{-6}$ $M\odot$ per year from our spectra on 2006 April and 2007 July, respectively. Our values of the mass-loss rate that we derived from Raman scattering are comparable with those obtained independently by other methods. Applying the method to other Mira–white dwarf binary systems can help us in modelling evolutionary tracks of the cool giants during their late stages of evolution at the asymptotic branch of the H-R diagram. **[24]**

Determination of ionization structure of hot components in symbiotic binaries during active phases

During active phases of symbiotic binaries, an optically thick medium in the form of a flared disk develops around their hot stars. During quiescent phases, this structure is not evident. In this paper we aimed to explain how such a formation can be created during active phases. Our concept is based on the fact that during active phases the mass loss rate from the hot star (i.e. the white dwarf – WD) increases by a factor of ~10 and the assumption that the WD can rotate fast. The fast rotation of the source of the stellar wind causes its compression to the equatorial plane, where it can form a neutral disk-like region flared from its centre. The remainder of the sphere above/below the disk is ionized. Basic parameters of the model (the mass-loss rate, emission measure of the ionized zone and the hydrogen column density of the neutral zone) are in a good agreement with those derived independently from observations. During quiescent phases, the neutral disk-like structure cannot be created, because the mass-loss rate and thus the compression are insufficient. This mechanism probably represents a common origin of warm pseudophotospheres, indicated in the spectrum of active symbiotic binaries. **[4]**

1.7.2. Solar department - *RESEARCH AREAS*:

a) study of the solar photosphere and chromosphere and active events in them, using modern spectro-polarimetric, spectroscopic and photometric observations acquired with top level solar telescopes base at the Canary Islands (GREGOR, VTT, SST, THEMIS), and with space-borne satellites under own joint observing proposals,
b) study of the solar corona and structures in it (prominences, coronal holes, coronal condensations) and Sun-Earth relations using data acquired with modern infrastructure at our Lomnicky Peak Observatory, with space-borne satellites and from VSO – Virtual Solar Observatory (unique access to data from space- and ground-based observations of the Sun) and using data from solar total eclipses observations,
c) study of evolution of fast and very powerful events in the solar atmosphere (flares, coronal mass ejections, active prominences, jets) using multiple observations from ground based and space-borne instruments,

SELECTED RESULTS PUBLISHED IN THE PERIOD 2012-2015

a) PHOTOSPHERE AND CHROMOSPHERE

Evidence of coupling of emerging small-scale magnetic flux in photosphere with chromospheric activity

We investigated the temporal evolution of magnetic flux emergence in the quiet-Sun atmosphere close to disk centre. We combined high-resolution satellite SoHO/MDI magnetograms with satellite TRACE observations taken in the 1216 Å channel to analyze the temporal evolution of an emerging small-scale magnetic loop and its traces in the chromosphere. We find signatures of flux emergence very close to the edge of a supergranular network boundary located at disk center. The new emerging flux appeared first in the MDI magnetograms in form of an asymmetric bipolar element. The patch with negative polarity was roughly twice as weak as the corresponding patch with opposite polarity. The average values of magnetic flux and magnetic flux densities reached 1.6×10^{18} Mx - 8.5×10^{17} Mx, and 55 Mx cm^{-2} -30 Mx cm^{-2}, respectively. The spatial distance between the opposite polarity patches of the emerged feature increased from about 2.5 to 5.0 arcseconds during the lifetime of the loop, which was 36 min. The chromospheric response to the emerged magnetic dipole occurred ~9 min later than in the photospheric magnetograms. It consisted of a quasi-periodic sequence of time-localized brightenings visible in the 1216 Å TRACE channel for ~14 min that were co-spatial with the axis connecting the two patches of opposite magnetic polarity. Thus, we identify the observed event as a small-scale magnetic loop emerging at photospheric layers that subsequently rose to the chromosphere. The fluctuations detected in the chromospheric emission probably reflect magnetic-field oscillations which propagate to the chromosphere in the form of waves. **[5]**

New parameters of G-band bright points introduced and analysed

So called G-band bright points (GBPs), derived from G-band images of solar photosphere represent locations of enhanced magnetic field. Our study of them is based on four diagnostics (effective velocity, change in the effective velocity, change in the direction angle, and centrifugal acceleration). Additionally, two new ones (rate of motion and time lag between recurrences of GBPs) were introduced by us. The results concerning the commonly used parameters showed the effective velocity of ≈0.9 km s^{-1}, whereas we found a deviation of the effective velocity distribution from the expected Rayleigh function for velocities in the range from 2 to 4 km s^{-1}. The change in the effective velocity distribution is consistent with a Gaussian one with FWHM=0.079 km s^{-2}. The distribution of the centrifugal acceleration exhibits a highly exponential nature. Two new parameters were defined by us: i) the real displacement between appearance and disappearance of GBPs (rate of motion) and the frequency of their recurrence at the same locations (time

lag). The locations of the tracked GBPs mainly cover the boundaries of supergranules representing the network, and there is no significant difference in the locations of GBPs with small (m<1) and large (m>2) values of the rate of motion. The time lags mostly lie within the interval of ≈ 2 - 3 min, with those up to ≈ 4 min being more abundant than longer ones. Results for both new parameters indicate that the locations of different dynamical types of GBPs (stable/farther traveling or with short/long lifetimes) are bound to the locations of more stable and long-living magnetic field concentrations. Thus, the disappearance/reappearance of the tracked GBPs cannot be perceived as the disappearance/reappearance of their corresponding magnetic field concentrations. **[3]**

Theoretical transmission profiles of the DOT Hα Lyot filter

Accurate knowledge of the spectral transmission profile of a Lyot filter is important, in particular in comparing observations of the solar chromosphere with simulated data. We summarized available facts about the transmission profile of the Dutch Open Telescope (DOT) Hα Lyot filter pointing to a discrepancy between sidelobe-free Gaussian-like profile measured spectroscopically and signatures of possible leakage of parasitic continuum light in DOT Hα images. We computed wing-to-center intensity ratios resulting from convolutions of Gaussian and square of the sinc function with the Hα atlas profile and compare them with the ratios derived from observations of the quiet Sun chromosphere at disk centre. We interpret discrepancies between the anticipated and observed ratios and the sharp limb visible in the DOT Hα image as an indication of possible leakage of parasitic continuum light. A method we suggested can be applied also to indirect testing of transmission profiles of other Lyot filters. We suggest two theoretical transmission profiles of the DOT Hα Lyot filter which should be considered as the best available approximations. Conclusive answer can only be given by spectroscopic re-measurement of the filter. **[9]**

b) SOLAR CORONA AND PROMINENCES

New multiwavelength analysis and modelling of physical parameters of solar prominences

i) Total masses of six solar prominences were estimated using prominence multi-spectral observations (in EUV, X-rays, Hα, and Ca II H). The observations were made during the observing campaign from April through June 2011. We applied a complex method for the prominence mass estimations that can be used later for other prominences observed during the observing campaign. Our method is based on the fact that intensity of the EUV solar corona at wavelengths below 912 Å is reduced by the absorption in resonance continua of hydrogen and helium (photoionisation) and at the same time also by a deficit of the coronal emissivity in volume occupied by the cool prominence plasma. Both mechanisms contribute to intensity decrease simultaneously. The observations in X-rays allow us to separate these mechanisms from each other. Coronal emission behind a prominence is not estimated by any temporal or spatial interpolation, but by using a new method based on comparing the ratio of the optical thickness at 193 Å and 211 Å determined from the observations with the theoretical ratio. Values of the total mass estimated for six prominences are between 2.9×10^{11} and 1.7×10^{12} kg. The column density of hydrogen is of the order of 10^{18}-10^{19} cm^{-2}. The method is now ready to be used for all 30 prominences observed during the campaign. Thus, it will be possible to obtain a statistics of the total mass of quiescent solar prominences. **[21]**

ii) We performed a detailed statistical analysis of the spectral Lyman-line observations of the quiescent prominence observed on May 18, 2005. We used a profile-to-profile comparison of the synthetic Lyman spectra obtained by 2D single-thread prominence fine-structure model as a starting point for a full statistical analysis of the observed Lyman spectra. We employed 2D multi-thread fine-structure models with random positions and line-of-sight velocities of each thread to obtain a statistically significant set of synthetic Lyman-line profiles. We used for the first time multi-thread models composed of non-identical threads and viewed at line-of-sight angles different from perpendicular to the magnetic field. We investigated the plasma properties of the prominence observed with

the SoHO/SUMER spectrograph on May 18, 2005 by comparing the histograms of three statistical parameters characterizing the properties of the synthetic and observed line profiles. In this way, the integrated intensity, Lyman decrement ratio, and the ratio of intensity at the central reversal to the average intensity of peaks provided insight into the column mass and the central temperature of the prominence fine structures. **[20]**

iii) We investigated the soft X-ray (SXR) signatures of a prominence. The X-ray observations were obtained by the satellite Hinode/X-Ray Telescope using two different filters. Both of them have a pronounced peak of the response function around 10 Å. The observed darkening in both of these filters has a very large vertical extension. The position and shape of the darkening correspond nicely with the prominence structure seen in satellite SDO/AIA images. Detailed calculations of the optical thickness in this spectral range show clearly that the darkening is not caused by X-ray absorption. Therefore, we suggested that presence of an extended region with a large emissivity deficit, which can be caused by the presence of cool prominence plasmas within an otherwise hot corona. To reproduce the observed darkening, one needs a very large extension along the line of sight of the region amounting to around 10^5 km. We interpret this region as the prominence spine, which is also consistent with SDO/AIA observations in EUV. **[22]**

iv) A quiescent prominence observed in the H-alpha line by the COMP-S instrument at the Lomnicky Peak Observatory

A prominence above the NEE limb was observed by the COMP-S instrument attached to the ZEISS coronagraph located at the Lomnicky Peak Observatory. The filter of the instrument was tuned during measurements sequentially in five wavelengths within the profile of the Hα line: 0, ±1, ±2 Å around 6563 Å. FWHM of the transmission function of the filter was ≈0.4Å at these wavelengths. Data were fitted using a simple cloud model (1D geometry, a complete frequency redistribution, a source function independent of the optical depth) to diagnose the prominence plasma. Five positions at the prominence were chosen for simulation using the cloud model and groups of different models were found for each position. Simulating observations using three different finer wavelength scales it was found that the wavelength scale with a step of 0.3 Å and even more finer in the line core (step of 0.1 Å) is already suitable for more precise and unambiguous plasma diagnostics. We also show that for correct plasma diagnostics it is crucial to take into account an effect of a finite width of the transmission function of the filter. If observed data were fitted irrespectively of this important effect, an error in estimated model parameters could exceed even 100 %, except for the Doppler velocities, for which the error would be much smaller, e.g. for velocities up to 20 km s^{-1} the error is below 1 %. **[23]**

Coronal motion and dynamics over the solar-activity cycle,

Continuing our series of observations of coronal motion and dynamics over the solar-activity cycle, we observed from sites in Queensland, Australia, during the 2012 November 13 (UT)/14 (local time) total solar eclipse. The corona took the low-ellipticity shape typical of solar maximum (flattening index ε = 0.01), a change from the composite coronal images we observed and analyzed here and elsewhere for the 2006 and 2008-2010 eclipses. Our results include velocities of a coronal mass ejection (CME; during the 36 minutes of passage from the Queensland coast to a ship north of New Zealand, we measured 413 km s^{-1}) and we analyzed its dynamics. We analyzed the shapes and positions of several types of coronal features seen on our higher-resolution composite coronal images, including many helmet streamers, very faint bright and dark loops at the bases of helmet streamers, voids, and radially oriented thin streamers. We compared our eclipse observations with models of the magnetic field, confirming the validity of the predictions, and relate the eclipse phenomenology seen with the near-simultaneous images from NASA's Solar Dynamics Observatory (SDO/AIA), NASA's Extreme Ultraviolet Imager on Solar Terrestrial Relations Observatory, ESA/Royal Observatory of Belgium's Sun Watcher with Active Pixels and Image Processing (SWAP) on PROBA2, and Naval Research Laboratory's Large Angle and Spectrometric Coronagraph Experiment on ESA's Solar and Heliospheric Observatory. **[14]**

c) FAST AND VERY POWERFUL EVENTS IN THE SOLAR ATMOSPHERE

Magnetoacoustic waves in solar flares.
Currently, there is a common endeavour to detect magnetoacoustic waves in solar flares. We contributed to this topic using an approach of numerical simulations. We studied a spatial and temporal evolution of impulsively generated fast and slow magnetoacoustic waves propagating along the dense slab and Harris current sheet using two-dimensional magnetohydrodynamic numerical models. Wave signals computed in numerical models were used for computations of the temporal and spatial wavelet spectra for their possible comparison with those obtained from observations. It is shown that these wavelet spectra allow us to estimate basic parameters of waveguides and perturbations. We found that the wavelet spectra of waves in the dense slab and current sheet differ in additional wavelet components that appear in association with the main tadpole structure. While in the dense slab this additional component is always delayed after the tadpole head, in the current sheet this component always precedes the tadpole head. It could help distinguish a type of the waveguide in observed data. We presented a technique based on wavelets that separates wave structures according to their spatial scales. This technique shows not only how to separate the magnetoacoustic waves and waveguide structure in observed data, where the waveguide structure is not known, but also how propagating magnetoacoustic waves would appear in observations with limited spatial resolutions. Thus, new possibilities to detect magnetoacoustic waves in observed data are open. **[11]**

First time evidence of rotational motions in a tornado-like prominence.
Su et al. proposed a new explanation for filament formation and eruption, where filament barbs are rotating magnetic structures driven by underlying vortices on the surface. Such structures have been noticed as tornado-like prominences when they appear above the limb. They may play a key role as the source of plasma and twist in filaments. However, no observations have successfully distinguished rotational motion of the magnetic structures in tornado-like prominences from other motions such as oscillation and counter-streaming plasma flows. Here we report firs time evidence of rotational motions in a tornado-like prominence. The spectroscopic observations in two coronal lines were obtained from a specifically designed Hinode/EIS observing program. The data revealed the existence of both cold and million-degree-hot plasma in the prominence leg, supporting the so-called prominence-corona transition region. The opposite velocities at the two sides of the prominence and their persistent time evolution, together with the periodic motions evident in SDO/AIA dark structures, indicate a rotational motion of both cold and hot plasma with a speed of ~5 km s^{-1}. **[25]**

1.7.3. Department of interplanetary matter - *RESEARCH AREAS*:

a) investigation of populations of small bodies in the Solar System, study of transfer orbits, interrelations and evolution among different populations regarding near-Earth objects, study of the structure of the outer part of the Oort cloud and the Edgeworth-Kuiper belt;
b) investigation of the activity of selected cometary nuclei and its influence on physical and dynamical evolution of these bodies, photometry of asteroids and comets;
c) study of structure and dynamics of meteoroid streams and evolution of their parent bodies, description of the distribution of meteoroid particles in the inner Solar System, search for meteoroid streams of asteroidal origin, search for hyperbolic and interstellar meteoroids, operation of the all-sky photographic cameras within the European Fireball Network; study of meteorite properties.
d) study of the physical and chemical properties of surfaces of small bodies in the Solar System and their relevant terrestrial analogs, simulation of effects of space weathering in laboratory conditions, formation of molecules due to ion irradiation of ices relevant to Solar System bodies.

SELECTED RESULTS PUBLISHED IN THE PERIOD 2012-2015

(a) POPULATIONS OF SMALL BODIES

Investigation of the outer parts of the Solar System

Investigation of the outer parts of the Solar System is essential for a better understanding of the processes which formed of our planetary system. Modern simulations using a large number of theoretical bodies – points are performed at AISAS.

Modelling the formation of the ice giants Uranus and Neptune has been a challenging problem in planetary science for along time. Owing to gas-drag, collisional damping, and resonant shepherding, the planetary embryos repel the planetesimals from their reach and that is why they stop growing. This problem persists independently of whether the accretion took place at the current locations of the ice giants or closer to the Sun. Instead of trying to push the runaway/oligarchic growth of planetary embryos up to 10^{-15} Earth masses, we envision the possibility that the planetesimal disk could generate a system of planetary embryos of only 1−3 Earth masses. Then we investigate whether these embryos could have collided with each other and grown enough to reach the masses of current Uranus and Neptune. We performed several series of numerical simulations. The dynamics of a considered set of embryos is influenced by the presence of Jupiter and Saturn, assumed to be fully formed on non-migrating orbits in 2:3 resonance, and also by gravitational interactions with the gas disk. Our results point to two major problems. First, there is typically a large difference in mass between the first- and the second-most massive core formed and retained beyond Saturn. Second, in many simulations the final planetary system has more than two objects beyond Saturn. The growth of a major planet from a system of embryos requires strong damping of eccentricities and inclinations from the gas disk. But strong damping also enables embryos and cores to find a stable resonant configuration, so that systems with more than two surviving objects are found. In addition to these problems, it is necessary to assume that the surface density of the gas was several times higher than that of the minimum-mass solar nebula to achieve substantial accretion among embryos. However, this contradicts the common idea that Uranus and Neptune formed in a gas-starving disk, which is suggested by the relatively small amount of hydrogen and helium contained in the atmospheres of these planets. Only one of our simulations serendipitously reproduced the structure of the outer Solar System successfully. However, we point out that models of formation of Uranus and Neptune have non-trivial problems, which cannot be ignored and have to be addressed in future work. **[7]**

(b) COMETS AND ASTEROIDS

Impacts of stream meteoroids on the nuclei of comets

We attempt to answer two questions concerning the impacts of stream meteoroids on the nuclei of Comets 9P/Tempel 1 and 81P/Wild 2: firstly, how many streams cross the orbits of both comets and, secondly, what is the index of the differential mass distribution of impactors, s , when we assume that a prevailing number of the craters on the surfaces of cometary nuclei were created by stream meteoroids? We found that 110 and 129 potential streams originating from comets likely cross the orbits of 9P and 81P, respectively (and 103 potential streams cross the orbit of 1P/Halley, for comparison). If we consider the more compact streams originating from asteroids, the 9P and 81P pass through such streams 15 664 and 65 368 times. Neither these large numbers of passages imply, however, enough large impactors to excavate the whole observed variety of craters on studied comets. For all craters on 9P and 81P, s=2.09±0.01 and s=2.25±0.03, respectively. The craters on 81P seem to be, however, excavated by the impactors from four discernible sources. For two numerous enough sources we find s=5.6±0.2 and s=5.2±0.5. The difference between the indices for the set of all craters and the sets of their partial groups obviously implies an unknown cosmogonic consequence. **[6]**

Binary asteroid population in main-belt of Solar System
Our photometric observations of 18 main-belt binary systems in more than one apparition revealed a strikingly high number of 15 having positively re-observed mutual events in the return apparitions. Our simulations of the survey showed that it cannot be due to an observational selection effect and that the data strongly suggest that poles of mutual orbits between components of binary asteroids in the primary size range 3–8 km are not distributed randomly: The null hypothesis of anisotropic distribution of the orbit poles is rejected at a confidence level greater than 99.99%. Binary orbit poles concentrate at high ecliptic latitudes, within 30° of the poles of the ecliptic. We propose that the binary orbit poles oriented preferentially up/down-right are due to either of the two processes: (i) the YORP tilt of spin axes of their parent bodies toward the asymptotic states near obliquities 0 and 180°(pre-formation mechanism), or (ii) the YORP tilt of spin axes of the primary components of already formed binary systems toward the asymptotic states near obliquities 0 and 180°(post-formation mechanism). The alternative process of elimination of binaries with poles closer to the ecliptic by the Kozai dynamics of gravitational perturbations from the sun does not explain the observed orbit pole concentration as in the close asteroid binary systems the J_2 perturbation due to the primary dominates the solar-tide effect. **[15]**

(c) METEOROIDS

Structure of the complex of meteoroid particles released from comet 96P/Machholz
The structure of the complex of meteoroid particles released from comet 96P/Machholz is studied to reveal a relationship among the meteor showers observed in the Earth's atmosphere that belong to this complex. For eight perihelion passages of the parent comet in the past, we model theoretical streams associated with comet 96P and follow their dynamical evolution until the present. Subsequently, we analyze the orbital characteristics of the streams, especially of their parts approaching the Earth's orbit. The dynamics of the stream is controlled by Jupiter, which changes the initial orbits of the particles into the orbits situated within several specific corridors. It thus creates a filamentary structure of the complex. Six filaments approach the orbit of the Earth producing four well-known meteor showers and two showers, whose identification with κ-Velids and α-Cetids is not certain. The known showers, in order of the predicted abundance of meteors, are daytime Arietids, Southern δ-Aquarids, Quadrantids, and Northern δ-Aquarids. The filaments corresponding to the Arietids, δ-Aquarids S and N, and possibly α-Cetids constitute the ecliptical lcomponent and those corresponding to the Quadrantids and possibly κ-Velids constitute the toroidal component of the complex. **[12]**

Mineralogy, petrology, and geochemistry of the Košice meteorite
The Košice meteorite was observed to fall on 28 February 2010 at 23:25 UT near the city of Košice in eastern Slovakia and its mineralogy, petrology, and geochemistry are described. The characteristic features of the meteorite fragments are fan-like, mosaic, lamellar, and granular chondrules, which were up to 1.2 mm in diameter. The fusion crust has a black-gray color with a thickness up to 0.6 mm. The matrix of the meteorite is formed mainly by forsterite (Fo80.6); diopside; enstatite (Fs16.7); albite; troilite; Fe-Ni metals such as iron and taenite; and some augite, chlorapatite, merrillite, chromite, and tetrataenite. Plagioclase-like glass was also identified. Relative uniform chemical composition of basic silicates, partially brecciated textures, as well as skeletal taenite crystals into troilite veinlets suggest monomict breccia formed at conditions of rapid cooling. The Košice meteorite is classified as ordinary chondrite of the H5 type which has been slightly weathered, and only short veinlets of Fe hydroxides are present. The textural relationships indicate an S3 degree of shock metamorphism and W0 weathering grade. Some fragments of the meteorite Košice are formed by monomict breccia of the petrological type H5. On the basis of REE content, we suggest the Košice chondrite is probably from the same parent body as H5 chondrite Morávka from Czech Republic. Electron-microprobe analysis (EMPA) with focused and defocused electron beam, whole-rock analysis (WRA), inductively coupled plasma mass and optical emission spectroscopy

(ICP MS, ICP OES), and calibration-free laser induced breakdown spectroscopy (CF-LIBS) were used to characterize the Košice fragments. The results provide further evidence that whole-rock analysis gives the most accurate analyses, but this method is completely destructive. Two other proposed methods are partially destructive (EMPA) or nondestructive (CF-LIBS), but only major and minor elements can be evaluated due to the significantly lower sample consumption. **[13]**

(d) SPACE WEATHERING IN THE SOLAR SYSTEM

Asteroid surface space weathering investigated both observationally and experimentally

Surfaces of atmosphere-less small bodies in the Solar System, which are not protected by magnetic field, are continuously affected by processes of space wheathering.

Asteroid surface space weathering has been investigated both observationally and experimentally, mostly focusing on the effects on the visible–near infrared (VNIR, 0.4–2.5 μm) spectral range. Here we present laboratory near-ultraviolet (NUV, 200–400 nm) reflectance spectra of ion irradiated (30–400 keV) silicates and meteorites as a simulation of solar wind ion irradiation. These results show that the induced alteration can reproduce the spread observed in the VNIR vs. NUV slope diagram for S-type asteroids. In particular, the well-known spectral reddening effect induced in the VNIR range is accompanied by a less known but stronger bluing effect at NUV wavelengths. Such trend was previously identified by Hendrix and Vilas (Hendrix, A.R., Vilas, F. [2006]. Astron. J., 132, 1396–1404) but only based on the comparison between observations and laboratory spectra of lunar materials. We attribute the NUV bluing, analogously to the VNIR reddening, to the formation of iron nanoparticles accompanied by structural modifications (amorphization) of surface silicates. We expect the evidence of weathering processes in the NUV part of spectra before these effects become observable at longer wavelengths, thus searching for the space weathering effects in the NUV range would allow establishing the extent of space weathering for very young asteroidal families. It will be important to include in future studies the NUV range both in the observations of specific classes of objects (e.g., the Vestoids) and in the laboratory spectra of meteorites and terrestrial analogues before and after space weather processing. **[8]**

1.7.4. Inter-discipline fundamental research

Employing the structure of the split Cayley hexagon of order two, a distinguished subgeometry of the symplectic polar space W(5, 2) of the three-qubit Pauli group, we got an intriguing finite-geometric insight into the nature of a couple of `magic' three-qubit configurations proposed recently by Waegell and Aravind **[17]**. Mermin's pentagram, a specific set of ten three-qubit observables used to provide a very simple proof of the Kochen-Specker theorem, was also shown to be isomorphic to an ovoid (elliptic quadric) of the three-dimensional projective space of order two**[18]**. The geometry of the real four-qubit Pauli group, being embodied in the structure of the symplectic polar space W(7,2), was analyzed in terms of ovoids of a hyperbolic quadric of the seven-dimensional projective space of order two. The quadric was selected in such a way that it contains all 135 symmetric elements of the group. Under such circumstances, the third element on the line defined by any two points of an ovoid is skew-symmetric, as is the nucleus of the conic defined by any three points of an ovoid. The strategy we employed was completely novel and unique in its nature, as were the results obtained **[19].** We further invoked some ideas from finite geometry to map bijectively 135 heptads of mutually commuting three-qubit observables into 135 symmetric four-qubit ones. After labeling the elements of the former set in terms of a seven-dimensional Clifford algebra, we presented the bijective map and most pronounced actions of the associated symplectic group on both sets in explicit forms. This formalism was then employed to shed novel light on recently-discovered structural and cardinality properties of an aggregate of three-qubit Mermin's 'magic' pentagrams. Moreover, some intriguing connections with the so-called black-hole--qubit correspondence were also pointed out **[10].**

2. Partial indicators of main activities:

2.1. Research output

2.1.1. Principal types of research output of the institute: basic research/applied research, international/regional (ratios in percentage)

basic research/applied = **100 / 0**, international/regional = **100 / 0**

2.1.2 List of selected publications documenting the most important results of basic research. The total number of publications listed for the assessment period should not exceed the average number of employees with university degrees engaged in research projects. The principal research outputs (max. 5, including Digital Object Identifier - DOI) should be underlined

[1] BUDAJ, Ján- KOCIFAJ, Miroslav - SALMERON, Raquel - HUBENY, Ivan. Tables of phase functions, opacities, albedos, equilibrium temperatures, and radiative accelerations of dust grains in exoplanets.In Monthly Notices of the Royal Astronomical Society, 2015, vol. 454, p. 2-27.(**5.107 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0035-8711.**DOI: 10.1093/mnras/stv1711**

[2] BUDAJ, Ján. Light-curve analysis of KIC 12557548b: an extrasolar planet with a comet-like tail. In Astronomy and Astrophysics, 2013, vol. 557, article no. A72, p. 1-10. (**5.084 - IF2012**).(2013 - Current Contents, SCOPUS, NASA ADS). ISSN 0004-6361.

[3] BODNÁROVÁ, Marcela - UTZ, Dominik - RYBÁK, Ján. On dynamics of G-band bright points. In *Solar Physics*, 2014, vol. 289, p. 1543-1556. (**3.805 - IF2013**). (2014 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0038-0938.

[4] CARIKOVÁ, Zuzana - SKOPAL, Augustín. Ionization structure of hot components in symbiotic binaries during active phases. In Astronomy and Astrophysics, 2012, vol. 548, article no. A21, p. 1-10. (**4.587 - IF2011**). (2012 - Current Contents, SCOPUS, NASA ADS). ISSN 0004-6361.

[5] GÖMÖRY, Peter - BALTHASAR, Horst - PUSCHMANN, Klaus Gerhard. Evidence of quiet-Sun chromospheric activity related to an emerging small-scale magnetic loop. In *Astronomy and Astrophysics*, 2013, vol. 556, article no. A7, p. 1-6. (**5.084 - IF2012**). (2013 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-6361.

[6] IVANOVA, Oleksandra - NESLUŠAN, Luboš - SVOREŇ, Ján - SEMAN KRIŠANDOVÁ, Zuzana. Crater-diameter distribution on Comets 9P and 81P and potential meteoroid streams crossing their orbits. In *Icarus*, 2015, vol. 254, p. 92-101. (**3.038 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0019-1035.

[7] JAKUBÍK, Marián - MORBIDELLI, Alessandro - NESLUŠAN, Luboš - BRASSER, Ramon. The accretion of Uranus and Neptune by collisions among planetary embryos in the vicinity of Jupiter and Saturn. In *Astronomy and Astrophysics*, 2012, vol. 540, article no. A71, p. 1-16. (**4.587 - IF2011**). (2012 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-6361.

[8] KAŇUCHOVÁ, Zuzana - BRUNETTO, Rosario - FULVIO, Daniele - STRAZZULLA, Giovanni. Near-ultraviolet bluing after space weathering of silicates and meteorites. In *Icarus*, 2015, vol. 258, p. 289-296. (**3.038 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0019-1035.

[9] KOZA, Július - HAMMERSCHLAG, Robert H. - RYBÁK, Ján - GÖMÖRY, Peter - KUČERA, Aleš - SCHWARTZ, Pavol. Transmission profile of the Dutch Open Telescope H_alpha Lyot filter. In *Astronomische Nachrichten*, 2014, vol. 335, no. 4, p. 409-416. (**1.119 - IF2013**). (2014 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-6337.

[10] LÉVAY, Péter - PLANAT, Michel - SANIGA, Metod. Grassmannian connection between three- and four-qubit observables, Mermin's contextuality and black holes. In Journal of High Energy Physics, 2013, no. 09, article no. 037, p. 1-34. (**5.618 - IF2012**). (2013 - Current Contents, WOS, SCOPUS). ISSN 1126-6708.

[11] MÉSZÁROSOVÁ, Hana - KARLICKÝ, Marian - JELÍNEK, Petr - RYBÁK, Ján. Magnetoacoustic waves propagating along a dense slab and Harris current sheet and their wavelet spectra. In The Astrophysical Journal, 2014, vol. 788, article no. 44, p. 1-10. (**6.280 - IF2013**). (2014 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-637X.

[12] NESLUŠAN, Luboš - KAŇUCHOVÁ, Zuzana - TOMKO, Dušan. The meteor-shower complex of 96P/Machholz revisited. In *Astronomy and Astrophysics*, 2013, vol. 551, article no. A87, p. 1-14. (**5.084 - IF2012**). (2013 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-6361. **DOI: 10.1051/0004-6361/201220299**

[13] OZDÍN, Daniel - PLAVČAN, Jozef - HORŇÁČKOVÁ, Michaela - UHER, Pavel - PORUBČAN, Vladimír - VEIS, Pavel - RAKOVSKÝ, Jozef - TÓTH, Juraj - KONEČNÝ, Patrik - SVOREŇ, Ján. Mineralogy, petrography, geochemistry, and classification of the Košice Meteorite. In *Meteoritics and Planetary Science*, 2015, vol. 50, no. 5, p. 864-879. (**3.104 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 1086-9379.

[14] PASACHOFF, Jay M. - RUŠIN, Vojtech - SANIGA, Metod - BABCOCK, Bryce A. - LU, Muzhou - DAVIS, Allen B. - DANTOWITZ, Ronald - GAINTATZIS, Pavlos - SEIRADAKIS, John H. - VOULGARIS, Aris - SEATON, Daniel B. - SHIOTA, Kazuo. Structure and dynamics of the 2012 November 13/14 eclipse white-light corona. In *The Astrophysical Journal*, 2015, vol. 800, article no. 90, p. 1-19. (**5.993 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-637X.

[15] PRAVEC, Petr - SCHEIRICH, Petr - VOKROUHLICKÝ, David - HARRIS, Alan W. - KUŠNIRÁK, Peter - HORNOCH, Kamil - PRAY, Donald P. - HIGGINS, David - GALÁD, Adrián - VILÁGI, Jozef - GAJDOŠ, Štefan - KORNOŠ, Leoš - OEY, Julian - HUSÁRIK, Marek - COONEY, Walter R. Jr. - GROSS, John - TERRELL, Dirk - DURKEE, Russ - POLLOCK, Joseph - REICHART, Daniel - IVARSEN, Kevin - HAISLIP, Josh - LA CLUYZE, Aaron - KRUGLY, Yurij N. - GAFTONYUK, Ninel - STEPHENS, Robert D. - DYVIG, Ron - REDDY, Vishnu - CHIORNY, Vasilij - VADUVESCU, Ovidiu - LONGA-PEÑA, Penélope - TUDORICA, Alexandru - WARNER, Brian D. - MASI, Gianluca - BRINSFIELD, James - GONCALVES, Rui - KRZEMINSKI, Zbigniew - GERASHCHENKO, Oleg - SHEVCHENKO, Valeri - MOLOTOV, Igor - MARCHIS, Franck. Binary asteroid population. 2. Anisotropic distribution of orbit poles of small, inner main-belt binaries. In *Icarus*, 2012, vol. 218, p. 125-143. (**3.385 - IF2011**). (2012 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0019-1035.

[16] RUCINSKI, Slavek M. - PRIBULLA, Theodor - BUDAJ, Ján. Spectroscopic metallicity determinations for W UMa-type binary stars. In The Astronomical Journal, 2013, vol. 146, article no. 70, p. 1-20. (**4.965 - IF2012**). (2013 - Current Contents, SCOPUS, NASA ADS). ISSN 0004-6256.

[17] SANIGA, Metod - PLANAT, Michel - PRACNA, Petr - LÉVAY, Péter. 'Magic' configurations of three-qubit observables and geometric hyperplanes of the smallest Split Cayley Hexagon. In Symmetry, Integrability and Geometry: Methods and Applications, 2012, vol. 8, article no. 083, p. 1-9. (**1.071 - IF2011**). (2012 - Current Contents, SCOPUS). ISSN 1815-0659.

[18] SANIGA, Metod - LÉVAY, Péter. Mermin's pentagram as an ovoid of PG(3,2). In EPL - Europhysics Letters, 2012, vol. 97, article no. 50006, p. 1-3. (**2.171 - IF2011**). (2012 - Current Contents, SCOPUS). ISSN 0295-5075.

[19] SANIGA, Metod - LÉVAY, Péter - PRACNA, Petr. Charting the real four-qubit Pauli group via ovoids of a hyperbolic quadric of PG(7,2). In Journal of Physics A: Mathematical and Theoretical, 2012, vol. 45, article no. 295304, p. 1-16. (**1.564 - IF2011**). (2012 - Current Contents, WOS, SCOPUS). ISSN 1751-8113.

[20] SCHWARTZ, Pavol - GUNÁR, Stanislav - CURDT, Werner. Non-LTE modelling of prominence fine structures using hydrogen Lyman-line profiles. In Astronomy and Astrophysics, 2015, vol. 577, article no. A92, p. 1-10. (**4.378 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-6361.

[21] SCHWARTZ, Pavol - HEINZEL, Petr - KOTRČ, Pavel - FÁRNÍK, František - KUPRYAKOV, Yurij Alexejevič - DELUCA, Edward E. - GOLUB, Leon. Total mass of six quiescent prominences estimated from their multi-spectral observations. In Astronomy and Astrophysics, 2015, vol. 574, article no. A62, p. 1-18. (**4.378 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-6361.

[22] SCHWARTZ, Pavol - JEJČIČ, S. - HEINZEL, Petr - ANZER, Ulrich - JIBBEN, Patricia R. Prominence visibility in HINODE/XRT images. In The Astrophysical Journal, 2015, vol. 807, article no. 97, p. 1-9. (**5.993 - IF2014**). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-637X. **DOI: 10.1088/0004-637X/807/1/97**

[23] SCHWARTZ, Pavol - RYBÁK, Ján - KUČERA, Aleš - KOZÁK, Matúš - AMBRÓZ, Jaroslav - GÖMÖRY, Peter. A quiescent prominence observed in the H-alpha line by the COMP-S instrument at the Lomnicky Peak Observatory. In Contributions of the Astronomical Observatory Skalnaté Pleso, 2012, vol. 42, p. 135-146. (**0.152 - IF2011**). (2012 - WOS, SCOPUS, NASA ADS). ISSN 1335-1842.

[24] SEKERÁŠ, Matej - SKOPAL, Augustin. Mass-loss rate by the Mira in the symbiotic binary V1016 Cygni from Raman scattering. In The Astrophysical Journal, 2015, vol. 812, article no. 162, p. 1-8. (**5,993 – IF2014**). (2015 – Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-637X. **DOI: 10.1088/0004-637X/812/2/162**

[25] SU, Yang - GÖMÖRY, Peter - VERONIG, Astrid - TEMMER, Manuela - WANG, Tongjiang - VANNINATHAN, Kamalam - GAN, Weiqun - LI, YouPing. Solar magnetized tornadoes: rotational motion in a tornado-like prominence. In *The Astrophysical Journal Letters*, 2014, vol. 785, article no. L2, p. 1-6. (**5.602 - IF2013)**. (2014 - Current Contents, SCOPUS, WOS, NASA ADS). ISSN 2041-8205. **DOI: 10.1088/2041-8205/785/1/L2**

[26] VAŇKO, Martin - AMMLER-VON EIFF, Matthias - PRIBULLA, Theodor - CHINI, Rolf - COVINO, Elvira - NEUHÄUSER, Ralph. The eclipsing binary TY CrA revisited: what near-IR light curves tell us.In Monthly Notices of the Royal Astronomical Society, 2013, vol. 431, p. 2230-2239.(**5.521 - IF2012**). (2013 - Current Contents, SCOPUS, NASA ADS). ISSN 0035-8711.

2.1.3 List of monographs/books published abroad

2.1.3.1. Chapters in monographs

[1] BECCIANI, Ugo - SCIACCA, Eva - COSTA, Alessandro - MASSIMINO, Piero - VITELLO, Fabio - CASSISI, Santi - PIETRINFERNI, Adriano - CASTELLI, Giuliano - KNAPIC, Cristina - SMAREGLIA, Riccardo - TAFFONI, Giuliano - VUERLI, Claudio - JAKUBÍK, Marián - NESLUŠAN, Luboš - KROKOS, Mel - ZHAO, Gong-Bo. Creating gateway alliances using WS-PGRADE/gUSE. In Science Gateways for Distributed Computing Infrastructures : Development Framework and Exploitation by Scientific User Communities. - Cham : Springer International Publishing, 2014, p. 255-270. ISBN 978-3-319-11267-1.

[2] SANIGA, Metod. Geometry of Psychological Time. In Direction of Time. - New York: Springer International Publishing, 2014, p. 171-186. ISBN 978-3-319-02797-5.

2.1.4. List of monographs/books published in Slovakia

2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items

[1] Our camera station of the European bolide network at Stara Lesná was complemented by a new pair of digital bolide cameras. This easternmost station of European bolide network covers the territory of Slovakia, Hungary, southern Poland and western Ukraine. Digital cameras allow the immediate processing of observation in the case of a recorded meteorite fall and are also less sensitive to light pollution. The first results have been presented at an international conference in the Netherlands.

[2] The IAU MDC database of precise meteor orbits long-term coordinated by AISAS was complemented by the database of meteor showers. This part of the database is also handled by AAS (in collaboration with the University of Poznan, Poland).

[3] AISAS provide long term "*Catalogue of H-alpha prominences"* made from observations performed at Lomnicky Peak Observatory and Kanzelhöhe observatory, Austria

[4] AISAS introduced and provide calculations of "Coronal Index", the measure of solar coronal activity.

2.1.6. List of patents, patent applications, and other intellectual property rights registered abroad, incl. revenues

AISAS is the organisation exclusively aimed at a basic research and it, therefore, does not have any patents.

2.1.7. List of patents, patent applications, and other intellectual property rights registered in Slovakia, incl. revenues

AISAS is the organisation exclusively aimed at a basic research and it, therefore, does not have any patents.

2.1.8. Table of research outputs (as in annual reports).

Papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately.

Scientific publications	2012			2013			2014			2015			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad *(AAA, ABA)*	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	**0,0**	**0,0**	**0,000**	**0,000**
Scientific monographs and monographic studies in journals and proceedings published in Slovakia *(AAB, ABB)*	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	**0,0**	**0,0**	**0,000**	**0,000**
Chapters in scientific monographs published abroad *(ABC)*	0,0	0,000	0,000	0,0	0,000	0,000	2,0	0,057	0,004	0,0	0,000	0,000	**2,0**	**0,5**	**0,014**	**0,001**
Chapters in scientific monographs published in Slovakia *(ABD)*	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	**0,0**	**0,0**	**0,000**	**0,000**
Scientific papers published in journals registered in Current Contents Connect *(ADCA, ADCB, ADDA, ADDB)*	38,0	1,016	0,074	27,0	0,715	0,052	29,0	0,820	0,056	39,0	1,063	0,074	**133,0**	**33,3**	**0,904**	**0,064**
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS *(ADMA, ADMB, ADNA, ADNB)*	14,0	0,374	0,027	11,0	0,291	0,021	30,0	0,848	0,058	9,0	0,245	0,017	**64,0**	**16,0**	**0,435**	**0,031**
Scientific papers published in other foreign journals (not listed above) *(ADEA, ADEB)*	7,0	0,187	0,014	7,0	0,185	0,014	5,0	0,141	0,010	5,0	0,136	0,009	**24,0**	**6,0**	**0,163**	**0,012**
Scientific papers published in other domestic journals (not listed above) *(ADFA, ADFB)*	9,0	0,241	0,017	9,0	0,238	0,017	3,0	0,085	0,006	0,0	0,000	0,000	**21,0**	**5,3**	**0,143**	**0,010**
Scientific papers published in foreign peer-reviewed proceedings *(AEC, AECA)*	18,0	0,481	0,035	7,0	0,185	0,014	10,0	0,283	0,019	0,0	0,000	0,000	**35,0**	**8,8**	**0,238**	**0,017**
Scientific papers published in domestic peer-reviewed proceedings *(AED, AEDA)*	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	**0,0**	**0,0**	**0,000**	**0,000**
Published papers (full text) from foreign and international scientific conferences *(AFA, AFC, AFBA, AFDA)*	2,0	0,053	0,004	1,0	0,026	0,002	4,0	0,113	0,008	5,0	0,136	0,009	**12,0**	**3,0**	**0,082**	**0,006**
Published papers (full text) from domestic scientific conferences *(AFB, AFD, AFBB, AFDB)*	3,0	0,080	0,006	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	**3,0**	**0,8**	**0,020**	**0,001**

- **Supplementary information and/or comments on the scientific outputs of the institute.**

  [1] Scientists in AISAS are strongly encouraged and motivated to publish mainly in the top ranked international journals with high impact factors. This brings high acceptance and citations in the international scientific community.

  [2] AISAS contributes to astronomical databases with an observational data acquired with its instruments (solar data, meteors, asteroids and comets positions and photometry, stellar photometry)

2.2. Responses to the research outputs (citations, etc.)

2.2.1. Table with citations per annum.

Citations, reviews	2011		2012		2013		2014		total		
	number	No. / FTE	number	No. / FTE	number	No. / FTE	number	No. / FTE	number	averaged number per year	av. No. / FTE
Citations in Web of Science Core Collection (1.1, 2.1)	555,0	13,782	558,0	15,061	515,0	14,246	539,0	14,695	**2167,0**	**541,8**	**14,432**
Citations in SCOPUS (1.2, 2.2) if not listed above	20,0	0,497	6,0	0,162	18,0	0,498	46,0	1,254	**90,0**	**22,5**	**0,599**
Citations in other citation indexes and databases (not listed above) (3.2,4.2,9,10)	46,0	1,142	25,0	0,675	41,0	1,134	151,0	4,117	**263,0**	**65,8**	**1,752**
Other citations (not listed above) (3, 4, 3.1, 4.1)	11,0	0,273	3,0	0,081	17,0	0,470	10,0	0,273	**41,0**	**10,3**	**0,273**
Reviews (5,6)	0,0	0,000	0,0	0,000	2,0	0,055	1,0	0,027	**3,0**	**0,8**	**0,020**

2.2.2. List of 10 most-cited publications, with number of citations, in the assessment period (2011 – 2014).

CEPLECHA, Zdeněk - BOROVIČKA, Jiří - ELFORD, William G. - REVELLE, Douglas O. - HAWKES, Robert L. - PORUBČAN, Vladimír - ŠIMEK, Miroslav. Meteor phenomena and bodies. In Space Science Reviews, 1998, vol. 84, p. 327-471. ISSN 0038-6308. **Citations: 104**

BURROWS, Adam - HUBENY, Ivan - BUDAJ, Ján - HUBBARD, Wiliam. Possible solutions to the radius anomalies of transiting giant planets. In The Astrophysical Journal, 2007, vol. 661, no. 1, Part 1, p. 502-514. (6.119 - IF2006). (2007 - Current Contents, SCOPUS, NASA ADS). ISSN 0004-637X. **Citations: 91**

BURROWS, Adam - BUDAJ, Ján - HUBENY, Ivan. Theoretical spectra and light curves of close-in extrasolar giant planets and comparison with data. In The Astrophysical Journal, 2008, vol. 678, p. 1436-1457. (6.405 - IF2007). (2008 - Current Contents, SCOPUS, NASA ADS). ISSN 0004-637X. **Citations: 61**

PRIBULLA, Theodor - RUCINSKI, Slavek M. Contact binaries with additional components. I. The extant data. In The Astronomical Journal, 2006, vol. 131, p. 2986-3007. (5.377 - IF2005). (2006 - Current Contents). ISSN 0004-6256. **Citations: 49**

BURROWS, Adam - HUBENY, Ivan - BUDAJ, Ján - KNUTSON, Heather A. - CHARBONNEAU, David. Theoretical spectral models of the planet HD 209458b with a thermal inversion and water emission bands. In The Astrophysical Journal, 2007, vol. 668, p. L171-L174. (6.119 - IF2006). (2007 - Current Contents, SCOPUS, NASA ADS). ISSN 0004-637X. **Citations: 48**

TEMMER, Manuela - VERONIG, Astrid - VRŠNAK, Bojan - RYBÁK, Ján - GÖMÖRY, Peter - STOISER, Sigrid - MARIČIČ, Darije. Acceleration in fast halo CMEs and synchronized flare HXR bursts. In The Astrophysical Journal, 2008, vol. 673, p. L95-L98. (6.405 - IF2007). (2008 - Current Contents, SCOPUS, NASA ADS). ISSN 0004-637X. **Citations: 43**

TEMMER, Manuela - RYBÁK, Ján - BENDÍK, Pavol - VERONIG, Astrid - VOGLER, Franz - OTRUBA, Wolfgang - PÖTZI, Werner - HANSLMEIER, Arnold. Hemispheric sunspot numbers Rn and Rs from 1945-2004: catalogue and N-S asymmetry analysis for solar cycles 18-23. In Astronomy and Astrophysics, 2006, vol. 447, p.735-743. (4.223 - IF2005). (2006 - Current Contents). ISSN 0004-6361. **Citations: 38**

BOTTICELLA, Maria-Teresa - PASTORELLO, Andrea - SMARTT, Stephen J. - MEIKLE, W. Peter S. - BENETTI, Stefano - KOTAK, Rubina - CAPPELLARO, Enriko - CROCKETT, R.Mark - MATTILA, Seppo - SERENO, Mauro - PATAT, Ferdinando - TSVETKOV, Dmitry Yu. - VAN LOON, Jacco Th. - ABRAHAM, Douglas - AGNOLETTO, Irene - ARBOUR, Ron - BENN, Chris - DI RICO, Gianluca - ELIAS-ROSA, Nancy - GORSHANOV, Dmitry L. - HARUTYUNYAN, Artak - HUNTER, Deidre - LORENZI, Vania - KEENAN, Francis P. - MAGUIRE, Kate - MENDEZ, Jeffrey - MOBBERLEY, Martin - NAVASARDYAN, Hripsime - RIES, Christoph - STANISHEV, Vallery - TAUBENBERGER, Stefan - TRUNDLE, Carol - TURATTO, Massimo - VOLKOV, Igor. SN 2008S: an electron-capture SN from a super AGB progenitor. In Monthly Notices of the Royal Astronomical Society, 2009, vol. 398, p. 1041-1068. (5.185 - IF2008). (2009 - Current Contents, SCOPUS, NASA ADS). ISSN 0035-8711. **Citations: 36**

RUCINSKI, Slavek M. - PRIBULLA, Theodor - VAN KERKWIJK, Marten H. Contact binaries with additional components. III. A search using adaptive optics. In The Astronomical Journal, 2007, vol. 134, p. 2353-2365. (4.854 - IF2006). (2007 - Current Contents). ISSN 0004-6256. **Citations: 32**

PRIBULLA, Theodor - KREINER, Jerzy - TREMKO, Jozef. Catalogue of the field contact binary stars. In Contributions of the Astronomical Observatory Skalnaté Pleso, 2003, vol. 33, no. 1, p. 38-70. (2003 - Current Contents, NASA ADS). ISSN 1335-1842. **Citations: 25**

2.2.3. List of most-cited authors from the Institute (at most 10 % of the research employees with university degree engaged in research projects) and their number of citations in the assessment period (2011– 2014).

[1] Pribulla Theodor ***511 citations***
[2] Budaj Ján ***337 citations***
[3] Rybák Ján ***281 citations***
[4] Chochol Drahomír ***241 citations***
[5] Vaňko Martin ***209 citations***

- **Supplementary information and/or comments on responses to the scientific output of the institute.**

[1] We show in the two subsequent Figures very positive trends in both, the 10 most-cited publications and the most-cited authors.

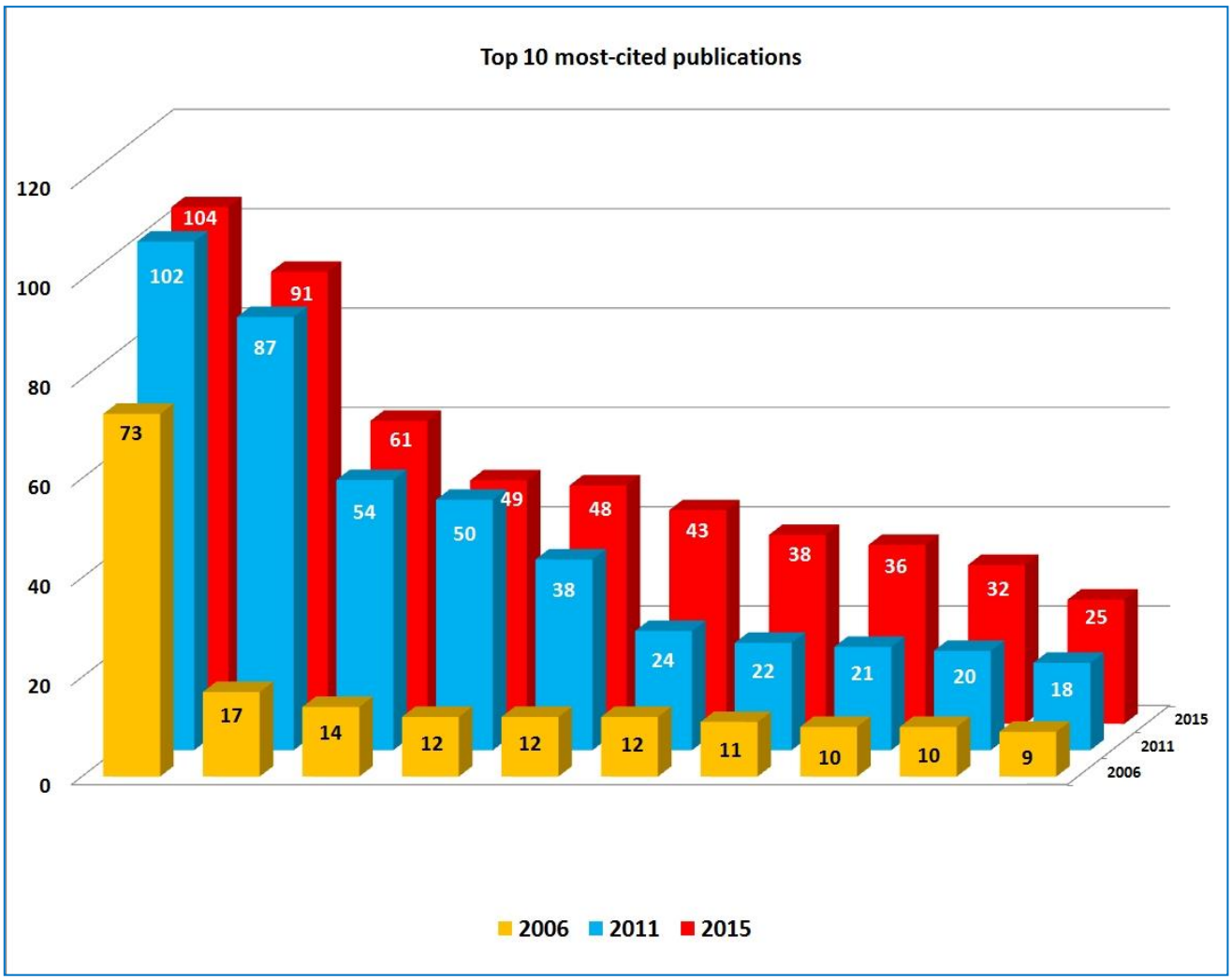

Figure 1: *Concerning the 10 most-cited publications, the Figure 1 demonstrates the results for the last two and present accreditations (2006, 2011, 2015). It documents very positive trends in both, the higher number of citations of the three most cited publications and also enhancement and better distribution of the rest of most cited publications. While there was only one publication in 2006 cited more than 20 times, now even the last one of ten is cited 25 times.*

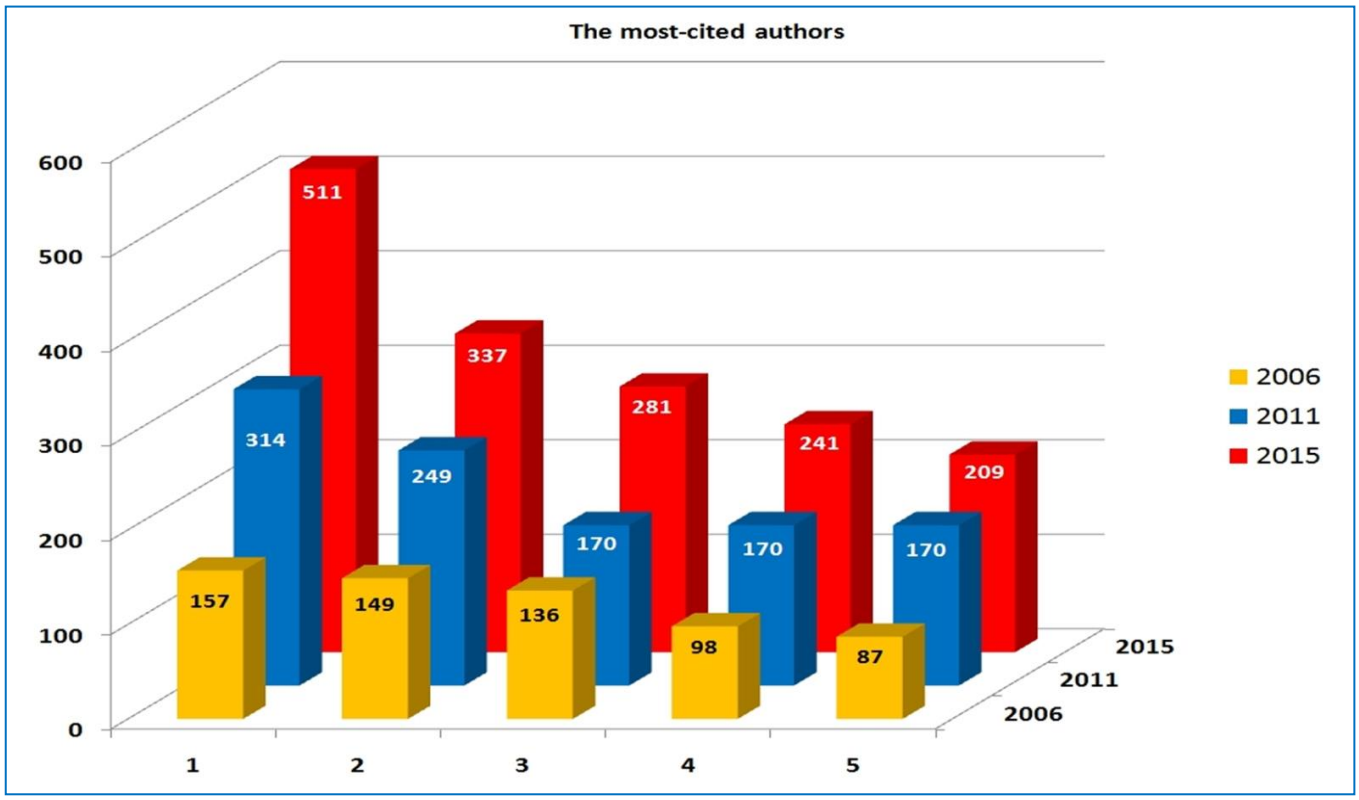

Figure 2: *Demonstration of rapid enhancement of citations of the most-cited authors of AISAS by comparing the last two and present accreditations (2006, 2011, 2015).*

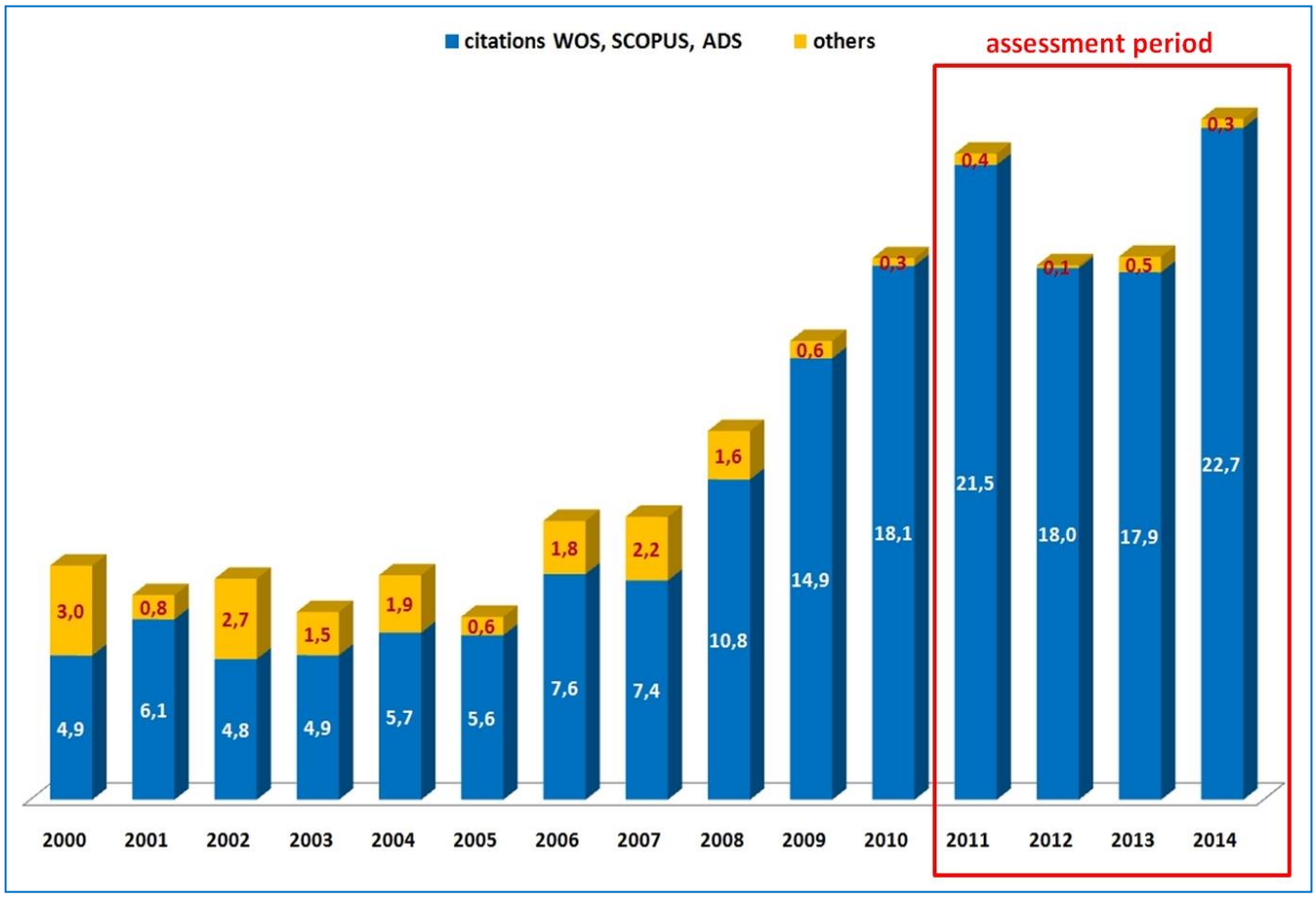

Figure 3: Positive trend in responses to the research outputs of AISAS document also very high average numbers of quality citations per one scientist (WOS, SCOPUS, ADS) in the assessment period (around 20/FTE/year), while the "other" less important citations decreased**.**

[2] We would like also to point out, that for astronomy, the database SAO/NASA Astrophysics Data System (ADS) is the most relevant citation database, and that most of citations from it appears later in WOS database. Therefore, even our Institute has enough big amount of citations in WOS it is necessary to add to them also the ADS citations to evaluate the output as a whole in the assessment period.

2.3. Research status of the institute in international and national contexts

- **International/European position of the institute**

2.3.1. List of the most important research activities demonstrating the international relevance of the research performed by the institute, incl. major projects (details of projects should be supplied under Indicator 2.4). Max. 10 items.

[1] AISAS is a member of the EST project (European Solar Telescope - An advanced telescope for observing the Sun and its magnetic activity) which was in 2015 approved and in 2016 officially introduced as one of six new infrastructures **in ESFRI ROAD MAP** (European Strategy Forum on Research Infrastructures) in section "Physical Sciences and Engineering". Funding of the EST is estimated for 200 mil EUR and operation start – 2026. See **Annex 1** of this Questionnaire and also: http://www.esfri.eu/roadmap-2016 and http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri-roadmap

[2] In the assessment period AISAS obtained 5 grants in the frame of FP7 EU and 2 COST projects. The major project among these was the SOLARNET- High-Resolution Solar Physics Network FP7-INFRA-312495SP4-Capacities. In the frame of the project, AISAS acts in WPs: a) "*Solar physics networking"* b) *"Solar Physics Research Integrated Network Group (SPRING)"*, and c) *"Integrated operation and exploitation of solar physics facilities and coordination with other research infrastructures".*Further, in the assessment period, AISAS has run in total 27 international and multilateral projects. It represents wide acceptance of AISAS in the European Research Area.

[3] AISAS is a founding member of the "Consortium EAST – European Association for Solar Telescopes". *"The goal of the EAST is to ensure access of European solar astronomers to world-class high-resolution ground-based observing facilities"*. As it follows from the goal of the EAST the membership of AISAS in the Consortium documents at one side high credibility of AISAS in the European solar research and on other hand it guarantees to AISAS an access to the top level telescopes and technique for solar research for long time. (http://www.astro-east.org/index.php?id=214).

[4] AISAS ranks among the institutions with high credibility in the field of meteor research and cometary - asteroidal research. Therefore, AISAS coordinates the IAU Meteor Data Center, which is a central depository and database summarizing all precise meteors orbits and both accepted and potential meteor showers. (http://www.ta3.sk/IAUC22DB/MDC2007/)

[5] AISAS acts as an associate member of ASTRONET. *"ASTRONET" was created by a group of European funding agencies in order to establish a strategic planning mechanism for all of European astronomy"*. The membership in this organisation documents, that AISAS is a relevant partner in European Research Area for planning the major European astronomical infrastructures and strategies, as, for example, the project EST (The large aperture European Solar Telescope). (http://www.astronet-eu.org/?lang=en).

[6] In the assessment period, AISAS has extended examined scientific topics to experimental laboratory astrophysics. Surfaces of atmosphere-less small bodies in the Solar System (asteroids and comets) are studied in collaboration with Catania Astrophysical Observatory, Italy.

[7] AISAS participated on major international scientific Solar eclipses expeditions, namely in Norway (2015), Gabon (2013) and Australia (2012). This documents high credibility of AISAS in research of the solar corona from eclipses' observations. Interpretations from observations of white and coronal emission of these eclipses were published in papers in high impacted journal (The Astrophysical Journal).

[8] AISAS organized five important international events in the assessment period.
   a) Workshop "Observing techniques, instrumentation and science for metre-class telescopes",
   b) International School "2nd SOLARNET School: "Ground- and space- based solar instruments",
   c) International workshop "2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics",
   d) Conference "Light Pollution: Theory, Modelling, and Measurements" and
   e) Meeting "2nd SPRING (Solar Physics Research Integrated Network Group)".

[9] Permanently, 3-5 employees of AISAS are every year accepted for long-time stays (longer than 60 days) at renowned astronomical institutions (Italy, Germany, Australia, France Austria).

[10] AISAS has been Coordinator of a multi-site observing campaign Dwarf aimed at detection of circumbinary planets around eclipsing binary stars. Although the project is not formal it ensued in a bi-lateral collaboration with Thueringen Landessternwarte Tautenburg, Germany (project DFG HA 3279/9-10). Further, AISAS participate in a multi-site observing campaign YETI (Young Exoplanet Transit Initiative) focused at a detection of transiting exoplanets in young open clusters. The campaign is coordinated by Astrophysikalisches Institut FSU Jena, Germany. CCD photometric observations at Stará Lesná observatory were used in PhD thesis of a student and lead to several discoveries published in refereed journals.

2.3.2. List of international conferences (co)organised by the institute.

[1] ***Workshop "Observing techniques, instrumentation and science for metre-class telescopes",*** September 23-26, 2013, Tatranská Lomnica, Slovakia,
Organizer: Astronomical Institute of the Slovak Academy of Sciences
98 participants from 21 countries: (Europe, USA, Australia, India, China, Philippines, Mexico)
https://www.astro.sk/APST2013/

[2] ***Conference "Light Pollution: Theory, Modelling, and Measurements",*** 15-18 April, 2013, Smolenice, Slovakia
Organizer: Astronomical Institute of the Slovak Academy of Sciences
44 participants from 15 countries (Europe, Canada, USA, Asia)
http://cegepsherbrooke.qc.ca/~aubema/LPTMM/index.php/Site/LPTMM-2013

[3] ***School "2nd SOLARNET School: "Ground- and space- based solar instruments"***, 5-16 October, 2014, Tatranská Lomnica Slovakia,
Organizer: Astronomical Institute of the Slovak Academy of Sciences,
Co-organizers: European Association for Solar Telescopes (EAST) and SOLARNET-High-Resolution Solar Physics Network project 7 RP/FP7-INFRA-312495
20 participants from 12 countries (Europe, Asia, USA)
https://www.astro.sk/SOLARNET_2ND_SCHOOL/solarnet

[4] ***Workshop "2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*****,** 2-16, October, 2014, Tatranská Lomnica,
Organizer: Astronomical Institute of the Slovak Academy of Sciences,
Co-organizers: European Association for Solar Telescopes (EAST) and SOLARNET-High-Resolution Solar Physics Network project 7 RP/FP7-INFRA-312495
26 participants from 14 countries (Europe, Asia, USA)
https://www.astro.sk/SOLARNET_2ND_WORKSHOP/

[5] ***Workshop "Finite-Geometrical Aspects of Quantum Theory",*** 23-27 February, 2015, Vienna, Austria,
Organizer: Vienna University of Technology, Vienna, Austria
Co-organizer: Astronomical Institute of the Slovak Academy of Sciences
12 participants from Europe
http://readgur.com/doc/192295/february-23%E2%80%9327--2015

Other international regional conferences and meetings organized by AISAS

[6] ***Conference "Achievements of Stellar Astronomy" Bezovec 2015***, 5-7-July, 2015, Bezovec, Slovakia, (32 participants from 6 countries)

[7] ***"International conference on research of variable stars", KOLOS 2015***, 03-05 December, 2015, Stakčín, Kolonica, Slovakia,, (35 participants)

[8] ***"Summer School on Magnetohydrodynamics in Astrophysics"*** 18-22 July, 2014 Tatranská Lomnica, Slovakia, (8 participants)

[9] ***Meeting "Research on Interplanetary Matter",*** 2-6 June, 2014, Modra, Slovakia, (32 participants)

[10] ***Conference "Achievements of Stellar Astronomy" Bezovec 2013***, 7-9 June, 2013, Bezovec, Slovakia, (44 participants)

[11] ***"School on Solar Spectro-Polarimetry",*** 3-7 June, 2013, Tatranská Lomnica, Slovakia, (15 participants)

[12] ***Meeting "Research on Interplanetary Matter"***, 16-20 April, 2012, Modra, Slovakia,(32 participants)

[13] ***Conference "Achievements of Stellar Astronomy" Bezovec 2012***, 15-17 June, 2012, Bezovec, Slovakia, (35 participants)

[14] ***Slovak-Italian workshop "Platform SHIWA for Simulations"***, 12-13 December, Bratislava, Slovakia, (5 participants)

2.3.3. List of edited proceedings from international scientific conferences.

T. Pribulla, R. Komžík: *"Observing techniques, instrumentation, and science for metre-class telescopes"*, proceedings of the workshop held on September 23-26, 2013 at Tatranská Lomnica, Slovakia, published in Contributions of the Astronomical Observatory Skalnaté Pleso, vol. 43, Number 3, 384 pages

2.3.4. List of journals edited/published by the institute:

2.3.4.1. WOS (IF of journals in each year of the assessment period)

2.3.4.2. SCOPUS

Scientific journal ***Contributions of the Astronomical Observatory Skalnaté Pleso*** (CAOSP) is edited and published by AISAS. (http://www.ta3.sk/caosp.html)
CAOSP is a scientific astronomical journal in English language published three times a year. CAOSP has international identifiers as follows: ISSN - 1336-0337 (online edition), ISSN - 1335-1842 (printed edition), CODEN - CAOPF8.
CAOSP journal has been covered/indexed::

[1] **by WOS:** covered all individual articles published since 2007 (and a significant part of previous papers). In the assessment period the impact factor was as follows:
2011 IF 0,152
2012 IF 0,200
2013 IF 0,312
2014 IF 0,591

[2] **by SCOPUS:** indexed since 2008

[3] **by ISI:**
Due to the fact that CAOSP is published three times a year, it can be found among books, not journals within ISI service.

a) continuously since its volume 22 (year 1992) However, it is covered in:
Index to Scientific Book Contents (ISBC)
CC/Physical, Chemical & Earth Sciences / Current Book Contents
b) since volume 37 No. 1 (Jan 2007) the journal has been indexed and abstracted in.
Science Citation Index Expanded (also known as SciSearch)
Journal Citation Reports/Science Edition
c) since volume 39 (2009) you can find the journal impact factor
d)

CAOSP Editorial board:

Scientific editor:	Ján Svoreň
Executive editor:	Richard Komžík
Members:	Drahomír Chochol
	Bernhard Fleck (USA)
	Arnold Hanslmeier (Austria)
	Marian Karlický (Czech Republic)
	Július Koza
	Aleš Kučera
	Vladimír Porubčan
	Theodor Pribulla
	Tanya Ryabchikova (Russia)
	Giovanni Battista Valsecchi (Italy)
	Jan Vondrák (Czech Republic)

Electronic archive with abstracts and full text versions is available at:
http://www.ta3.sk/caosp/index.html
The full text version is also available on-line within the ADS article service:
http://adsabs.harvard.edu/article_service.html.

- **National position of the institute**

2.3.5. List of selected projects of national importance

The most important national projects in the assessment period were definitely the projects of Structural Funds.

"*Center of space research: Influences of the space weather"*

"*Center of space research: Influences of the space weather – the second phase"*

"*Center of space research – building of technical infrastructure"*

Detail list of them is given under **2.4.6.**

Other important national projects:

[1] ***Variability of the temporal evolution of the magnetic structures in the solar atmosphere and their physical models***

Coordinator:	Aleš Kučera
Duration:	1.1.2012 / 31.12.2015
Project number:	VEGA 2/0108/12
Funding in assessment period (EUR):	63 785 €

Aim: *The project deals with complex study of the solar atmosphere by means of advanced observing and interpretation methods. A significant part of the project will involve an extensive using of polarimetric data obtained from our new, world-unique "Coronal multi-channel polarimeter" installed on the coronagraph at Lomnicky Peak Observatory in 2011. Such measurements bring fundamentally new, world-unique results on temporal evolution of the velocity and magnetic fields in the solar corona. High-quality data, i.e. high-resolution spectra of the solar atmosphere, polarimetric measurements, and imaging at various regions of electromagnetic spectrum, are an experimental basis of the project. The main aim is an analysis of time evolution of physical parameters of the solar plasma in the quiet solar atmosphere and in the active structures. The project objectives mainly focuse on the study of magnetic and velocity fields throughout the solar atmosphere and the transport of energy from the photosphere up to the corona*

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[2] ***The dynamics of the trans-Neptunian population and other groups of small bodies in the Solar System***

Coordinator:	Luboš Neslušan
Duration:	1.1.2010 / 31.12.2013
Project number:	VEGA 2/0011/10
Funding in assessment period (EUR):	14 766 €

Aim: *The ongoing discoveries of new objects beyond the Neptune bring a new knowledge of the structures in the Edgeworth-Kuiper (EK) belt and scattered disc. There is a permanent need to explain the new observed facts and, thus, to support the future discoveries. Specifically, the abrupt decrease in the concentration of bodies in the classical EK belt beyond 50 AU distance from the Sun is still not explained. Either, the resonant component of the EK belt is not well mapped. It is not clear if the distant 3:1 resonance with Neptune exists. And, several other questions remain opened. Within the project, we would perform another extensive simulation (for Gyrs period) of the dynamics of a large number of test particles (utilizing hundreds of CPUs), which would represent the bodies of trans-Neptunian population. We would answer several open questions. As well, we would improve our knowledge of dynamical properties of another small-bodies groups, especially the SOHO-comet streams and asteroids on high-inclination orbits*.

[3] ***Modeling of close binaries and multiple systems: from classical binaries to planetary systems***

Coordinator:	Theodor Pribulla
Duration:	1.1.2011 / 31.12.2013
Project number:	VEGA 2/0094/11
Funding in assessment period (EUR):	23 342 €

Aim: *The principal intention of the project is: 1. better understanding of the structures and processes in interacting binaries, and multiple stellar systems, 2. more precise determination of absolute stellar parameters such as masses, radii, and luminosities especially for late-type stars 3. detection and study of substellar companions to solar and early-type stars 4. improving software to study close interacting binaries.*

[4] ***Physical processes in symbiotic stars and novae***

Coordinator:	Augustín Skopal
Duration:	1.1.2013 / 31.12.2016
Project number:	VEGA 02/0002/13
Funding in assessment period (EUR):	49 152 €

Aim: *The aim of this project is a better understanding of the physical processes, which are responsible for effects observed in symbiotic binaries and novae, especially during their outbursts. Fulfillment of this aim is based upon: 1. obtaining new observations with telescopes of the Astronomical Institute SAS by the method of classical photoelectric and CCD photometry, which will be combined with spectroscopic observations from archives and actually obtained within the international cooperation, 2. disentangling of the composite spectrum of the symbiotic binaries from X-ray to mid infrared region of the spectra, 3. new diagnostic of the photometric measurements of these systems, 4. research of the circumstellar environment by the method of Raman, Rayleigh, and Thompson scattering, 5. determining of the ionization and geometrical structure of the hot component in the binary during outbursts, 6. modelling of the structural mass outflows during outbursts, estimation of the amount of the outflowing matter.*

[5] **Evolution and physical characteristics of the solid component of the interplanetary matter in the vicinity of the Earth**

Coordinator:	Ján Svoreň
Duration:	1.1.2010 / 31.12.2013
Project number:	VEGA 2/0022/10
Funding in assessment period (EUR):	25 315 €

Aim: *This scientific project is intended to the study of the meteoroid-stream structure, including the analysis of results determined by two methods - our statistical method of indices and dynamical modeling of the cloud of particles ejecting from the cometary nucleus. In terms of completing the observational databases and obtaining other precise orbits of bolides, we will operate autonomous bolide camera in the High Tatras in co-operation with Astronomical Institute of the Academy of Sciences of the Czech Republic and follow in maintaining, completing and periodical publishing of the database of precise photographic orbits of meteors. We will perform long-term observations of selected comets using CCD camera in the Skalnaté Pleso Observatory to pursue a goal of the reason of sudden outbursts of comets and study the influence of the solar activity to the cometary brightness. We will explore main-belt asteroids and NEA using photometrical methods, create shape models and search for binary NEAs.*

[6] ***Finite Geometries Reconciling Quantum Information with Astrophysics***

Coordinator: Metod Saniga
Duration: 1.1.2013 / 31.12.2015
Project number: VEGA2/0003/13
Funding in assessment period (EUR): 10 767 €

Aim: *Recently, striking multiple relations have been discovered between quantum information theory and the physics of stringy black hole solutions. The project aims at getting deeper insights into the mathematical nature of this correspondence by invoking finite geometries. Alongside with geometries (polar spaces) tied to symplectic and orthogonal polarity, we also plan to employ finite Hermitian varieties, tilde geometries and related combinatorial structures (Hadamard designs, Steiner triple systems, etc.) and also their Veldkamp spaces. The basic strategy is to identify charges in the entropy formula with points, and individual terms in the expansion of the entropy formula with the lines of a certain finite geometry, and then to relate this latter geometry to some multi-qudit system. Successful accomplishments of the project's tasks should provide us with a sort of unified fine-geometric view of the known black hole entropy formulas and a deeper understanding of entanglement of more than three-qubits.*

[7] ***Selected problems of the origin of some small-body groups in the Solar System***

Coordinator: Luboš Neslušan
Duration: 1.1.2014 / 31.12.2017
Project number: VEGA 2/0031/14
Funding in assessment period (EUR): 16 909 €

Aim: *Project will contribute to solving of some essential problems of the Solar-System cosmogony. Within the our project it is necessary to work out a well acceptable model of the growth of Uranus and Neptune from the stage of planetary embryos up to their current masses. In relation to the model, a simulation of subsequent migration of both planets to their current orbits is desirable. Also, we would follow if the trans-Neptunian population is formed at this process and if its final structure is consistent with the current one. In extension, we will analyse the Dynamics of Centaurs aiming to find out and prove their source regions. In a shorter distance and time scales, there is an analogous problem: the formation of meteoroid streams by a release of particles from the parent bodies. Here, we would want to go on with the looking for such parents, that have their orbit in a relatively large distance from the Earth's orbit, but anyway the associated shower meteors are observed in Earth's atmosphere.*

[8] ***Physical processes in interacting binaries and extrasolar planetary systems***

Coordinator: Theodor Pribulla
Duration: 1.1.2014 / 31.12.2017
Project number: VEGA 2/0143/14
Funding in assessment period (EUR): 27 795 €

Aim: *This research project is aimed at the understanding of physical processes in interacting binaries and extrasolar planetary systems. The principal goals are accurate determination of the absolute parameters of binaries (masses, radii and luminosities) but also detection and study of substellar companions to single and binary stars. The project is related to two international observing campaigns: YETI and Dwarf.*

[9] ***Analysis of dynamic and physical characteristics of interplanetary bodies in the vicinity of the Earth's path***

Coordinator:	Ján Svoreň
Duration:	1.1.2014 / 31.12.2017
Project number:	VEGA 2/0032/14
Funding in assessment period (EUR):	VEGA: 23 250 €

Aim: *This project is intended to the study of small bodies in the Solar System around the Earth's path. Scientific goals change continuously from the study of structures in meteoroid streams to changes on their parent bodies. The results will be obtained by comparing observations with statistical processing and computer modeling. Asteroids and comets will be observed using the telescopes of the Skalnaté Pleso Observatory: 0,61-m Newton and new 1,3-m Cassegrain-Nasmyth, which will be the largest specialized device for observing of Near-Earth Asteroids in Europe. We will analyze meteoroids in the orbit of 1P/Halley, on a base of our statistical method of indices and dynamical modeling of particles ejecting from the cometary nucleus. We will perform long-term observations of selected comets using CCD camera in the Skalnaté Pleso Observatory to pursue a goal of the reason of sudden outbursts of comets. We will create shape models of asteroids and analyze their possibilities as parent bodies of meteor streams*

2.3.6. Projects of the Slovak Research and Development Agency (APVV)

Only major APVV projects are listed. (all APVV projects are given in Table 2.4.4.)

[1] Solar corona: investigation of physical processes

Coordinator:	Ján Rybák
Duration:	1.7.2012 / 31.12.2015
Project number:	APVV-0816-11
Funding in assessment period (EUR):	112 511 €

Aim: *Solar activity influences remarkably heliosphere including technological infrastructure of our civilization. Magnetic and velocity fields in the solar corona have an essential importance for generation and propagation of solar activity manifestations into planetary space and to vicinity of the Earth. Investigation of temporal evolution of these fields has not provided clear results so far due to absence of technologically demanding measurements of the velocity and magnetic fields in the outer solar atmosphere. Using a new, world-wide unique instrument „Coronal multi-channel polarimeter" (CoMP/S), installed at the* Lomnicky Peak Observatory *in 2011, we can measure these fields with very high precision and with high spatial and temporal resolution. Project is aiming to contribute significantly to next development of physics of the solar corona by methods of spectropolarimetry, spectroscopy, and by modelling. Observations of flares, large-scale waves, spicules, prominences and coronal mass ejections will be performed by the CoMP-S instrument and with a help of coordinated campaigns on satellites and solar ground-based telescopes. For interpretation of observations modern astrophysical methods will be used - programs for inversion and numerical simulations of solar plasma - which allow unique interpretation of observational results of the solar corona.*

[2] From interacting binaries to exoplanets

Coordinator:	Ján Budaj, Luboš Neslušan
Duration:	1.7.2012 / 31.12.2015
Project number:	APVV-0158-11
Funding in assessment period (EUR):	91 582 €

Aim: *Extrasolar planets (exoplanets) and brown dwarfs represent a new research field. First exoplanet was discovered in 1992 by Wolszczan & Frail. First exoplanet around the main sequence star was discovered in 1995 by Mayor & Queloz and first bona fide brown*

dwarf was discovered in 1995 by Nakajima et al. Since that time this field experiences a rapid progress. Primary intention of this project is to shift the primary focus of our research group from interacting binaries to extrasolar planets and brown dwarfs. In the framework of this project we will explore atmospheres and interiors of these objects, planet-star interaction, exoplanet transits, and fundamental planetary parameters. We will search for new exoplanets and brown dwarfs and search for the variability of brown dwarfs and brown dwarfs in binary systems. We will contribute to the understanding and unravelling of the key physical processes and parameters in the atmospheres of exoplanets like transport of energy from day to the night side of the planet, planet albedo, cooling of the planetary interior, magnetic and gravitation influence of the planet on the atmosphere of the host star, radii and orbital elements of exoplanets

2.3.10. List of journals (published only in the Slovak language) edited/published by the institute:

2.3.10.4. Not included in databases

a) Journal**: *Meteorické správy (Meteor News)***

Journal fully edited by AISAS. Scientific articles in Slovak language are supplemented by extended English abstracts.

b) Journal for popularization of astronomy: ***Kozmos*.**

Three scientists of AISAS are members of the editorial board of the Kozmos, journal for popularization of astronomy.

- **Position of individual researchers in an international context**

2.3.11. List of invited/keynote presentations at international conferences, as documented by programme or invitation letter

D. Chochol, S. Shugarov, N. Katysheva, I. Volkov: "Classical nova V339 Del (Nova Del 2013) – a short review" (Invited), "The Golden Age of Cataclysmic Variables and Related Objects III", September 7–12, 2015, Palermo, Italy

Z. Kaňuchová: "Steps towards a global response campaign roadmap" ***(Invited),*** "International workshop in the frame of ACM 2014 Helsinki: Strategical and scientific aspects of the asteroid impact threat: The NEOShield perspective", July 3, 2014, Helsinki, Finland

J. Koza: *"How to write a scientific paper"*. **(Invited),** 2nd SOLARNET School: "Ground- and space- based solar instruments", November 5-16, 2014, Tatranská Lomnica Slovakia

A. Kučera: *"404 years of solar photosphere research"* ***(Invited Review)****,* XIIIth Hvar Astrophysical Colloquium, September 22-26, 2014, Hvar, Croatia

A. Kučera: *"European Solar Organizations: EAST, JOSO, CESRA, SPS-EPS"* **(Invited)**, 2nd SOLARNET School: "Ground- and space- based solar instruments", November 5-16, 2014, Tatranská Lomnica, Slovakia

V. Rušin: *"Do we need scientific observations of the solar corona during total solar eclipses?"* ***(Invited)***, Solar Eclipse Conference 2014, October 23-26, 2014, Sacramento Peak Observatory/Cloudcroft, USA

M. Saniga: "*From real Cayley-Dickson algebras to combinatorial Grassmannians"*. ***(Invited),*** Current Mathematical Methods of Quantum Information, September 25, 2014, Belfort, France

M. Saniga: *"A polygonal structure of geometric hyperplanes of the split Cayley hexagon of order two"* ***(Invited),*** Finite-Geometrical Aspects of Quantum Theory, February 23-27, 2015, Vienna, Austria

2.3.12. List of researchers who served as members of the organising and/or programme committees

a) SOC Committees

J. Budaj: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (SOC member), https://www.astro.sk/APST2013/

D. Chochol: *"The Present and Future of Small and Medium Size Telescopes"* (SMT-2015), October 19-22, 2015, Nizhnij Arkhyz, Russian federation (SOC member), https://www.sao.ru/hg/lon/ConfSite/main-en.html

Z. Kaňuchová: *"International workshop in the frame of ACM 2014 Helsinki: Strategical and scientific aspects of the asteroid impact threat: The NEOShield perspective"*, July 3, 2014, Helsinki, Finland (SOC member)
http://www.helsinki.fi/acm2014/NEOShield

Z. Kaňuchová: *"COST TD-1308: Habitability in the Universe: from the Early Earth to Exoplanets "*, March 22-27, 2015, Porto, Portugal (SOC member)
http://www.iastro.pt/research/conferences/life-origins2015/

Z. Kaňuchová: *"COST TD-1308: Missions to Habitable Worlds"*, October 28-29, 2015, Budapest, Hungary (SOC member)
http://life-origins2015.csfk.mta.hu/organizing_committee.html

M. Kocifaj: *"Light Pollution: Theory, Modelling, and Measurements",* April 15-18 2013, Smolenice, Slovakia, (SOC chair, LOC chair),
http://cegepsherbrooke.qc.ca/~aubema/LPTMM/index.php/Site/LPTMM-2013

A. Kučera: *"XIIth Hvar Astrophysical Colloquium – The Sun and Heliosphere"*, September 3-7, 2012, Hvar, Croatia (SOC member)
http://oh.geof.unizg.hr/index.php/en/meetings/xiith-hac

A. Kučera: *"12th Potsdam Thinkshop: The Dynamic Sun – Exploring the Many Facets of Solar Eruptive Events"*, October 26-29, 2015, Potsdam, Germany (SOC member), https://thinkshop.aip.de/12/cms/

A. Kučera: *"Coimbra Solar Physics Meeting „Ground based Solar Observations in the Space Instrumentation Era"*, October 5–9, 2015, University of Coimbra, Coimbra, Portugal (SOC co-chair), http://www.mat.uc.pt/~cspm2015/overview.html

A. Kučera: "*XIIIth Hvar Astrophysical Colloquium - Physics of the Solar Atmosphere"*, September 22–26, 2014, Hvar, Croatia (SOC member),
http://oh.geof.unizg.hr/index.php/en/xivth-hac/136-xiii-hac

A. Kučera: *"2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*, October 12-16, 2014, Tatranská Lomnica, Slovakia (SOC co-chair, LOC chair), https://www.astro.sk/SOLARNET_2ND_WORKSHOP/

A. Kučera: "*2nd SOLARNET School: "Ground- and space- based solar instruments"*, October 5-16, 2014, Tatranská Lomnica, Slovakia (SOC - chair, LOC - chair) https://www.astro.sk/SOLARNET_2ND_SCHOOL/

T. Pribulla: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (SOC chair), https://www.astro.sk/APST2013/

T. Pribulla: "Living together: Planets, Host Stars, and Binaries", September 8-12, 2014, Litomyšl, Czech Republic (SOC member), http://kopal2014.physics.muni.cz/

J. Rybák: "The magnetic corona as revealed by polarimetry", September 4-6, 2014, Toulouse, France, (SOC member), http://www.polarization.eu/index.php/meetings/previous-meetings/10-meetings/128-themagneticsolarcoronapolarimetry

M. Saniga: "Finite-Geometrical Aspects of Quantum Theory", February 23–27, 2015 Vienna University of Technology, Vienna, Austria, (SOC chair, LOC Chair), http://readqur.com/doc/192295/february-23%E2%80%9327--2015

b) LOC Committees

M. Bodnárová: *"2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*, October 12-16, 2014, Tatranská Lomnica, Slovakia (LOC member) https://www.astro.sk/SOLARNET_2ND_WORKSHOP/

M. Bodnárová: "*2nd SOLARNET School: "Ground- and space- based solar instruments"*, October 5-16, 2014, Tatranská Lomnica, Slovakia (LOC member), https://www.astro.sk/SOLARNET_2ND_SCHOOL/

P. Gömöry: *"2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*, October 12-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

P. Gömöry: "*2nd SOLARNET School: "Ground- and space- based solar instruments"*, October 5-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

Ľ. Hambálek: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (LOC member) https://www.astro.sk/APST2013/

L. Hric: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (LOC member)

M. Husárik: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (LOC member)

M. Jakubík: *"2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*, October 12-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

M. Jakubík: "*2nd SOLARNET School: "Ground- and space- based solar instruments"*, October 5-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

Z. Kaňuchová: *"COST Action CM0805: THE CHEMICAL COSMOS, Understanding Chemistry in Astronomical Environments"*, September 2-10, 2012, Catania, Italy (LOC member)

R. Komžík: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (LOC member)

J. Koza: *"2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*, October 12-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

J. Koza: "*2nd SOLARNET School: "Ground- and space- based solar instruments"*, October 5-16, 2014, Tatranská Lomnica, Slovakia, (LOC member)

J. Rybák: *"2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*, October 12-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

J. Rybák: "*2nd SOLARNET School: "Ground- and space- based solar instruments"*, October 5-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

M. Sekeráš: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (LOC member)

P. Schwartz: *"2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and "2nd SPRING meeting"*, October 12-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

P. Schwartz: "*2nd SOLARNET School: "Ground- and space- based solar instruments"*, October 5-16, 2014, Tatranská Lomnica, Slovakia (LOC member)

M. Vaňko: *"Workshop Observing techniques, instrumentation and science for metre-class telescopes"*, September 23-26, 2013, Tatranská Lomnica, Slovakia (LOC chair)

- **Position of individual researchers in a national context**

2.3.13. List of invited/keynote presentations at national conferences, as documented by programme or invitation letter

J. Koza: "Nové poznatky z výskumu slnečnej chromosféry", ***(Invited)***, 22. celoštátny slnečný seminár, May 26-30, 2014, Nižná nad Oravou, Slovakia

A. Kučera: "Slnečná fotosféra" ***(Invited)***, Celoštátny slnečný seminár, May 26-30, 2014, Nižná nad Oravou, Slovakia

V. Rušin: *"Vedecké práce dr. M. R. Štefánika a dnešná astronómia"*. ***(Invited),*** MUŽ SLNKA, June 4-5, 2015, Spoločnosť Milana Rastislava Štefánika so sídlom v Brezovej pod Bradom, Piešťany, Slovakia

V. Rušin: *"Perspektívy fotonických technológií v astrofyzike", **(Invited)*** Deň Fotoniky/Day of Photonics, October 21, 2015, Medzinárodné laserové centrum, Bratislava, Slovakia

.

V. Rušin: "*Slnečná koróna včera a dnes" **(Invited)***, 1. česko-slovenské setkaní pozorovatelů Slunce v rámci program: Se Sluncem společne. October 4–6, 2013, Valašské Meziříčí, Czech Republic

V. Rušin: "*Čo sa zmenilo na Slnku od roku 1959?" **(Invited),*** Slavnostní seminář 60 let od otevření hvězdárny, October 7, 2015, Hvězdárna Valašské Meziříčí, Czech Republic

M. Saniga: *"Finite geometries with a quantum physical flavour"*. ***(Invited),*** 14. konferencia košických matematikov, April 5, 2013, Herľany, Slovakia

2.3.14. List of researchers who served as members of organising and programme committees of national conferences

P. Gömöry: *"School on Solar Spectro-Polarimetry"*, June 3-7, 2013, Tatranská Lomnica, Slovakia (LOC member) www: https://www.astro.sk/~gomory/SPECTRO/

L. Hric: *"Conference about successes of stellar astronomy"*, June 15-17, 2012, Bezovec, Slovakia (SOC chair)

L. Hric: *"Conference about successes of stellar astronomy"*, June 7-9, 2013, Bezovec, Slovakia (SOC chair)

L. Hric: *"Conference about successes of stellar astronomy"*, June 5-7, 2015, Bezovec, Slovakia (LOC/SOC chair)

L. Hric: *"KOLOS 2015",* December 3-5, 2015, Stakčín, Kolonica Observatory, Slovakia (LOC/SOC co-chair)

M. Jakubík: *"School on Solar Spectro-Polarimetry"*, June 3-7, 2013, Tatranská Lomnica, Slovakia (LOC member)

J. Koza: *"*21. celoštátny slnečný seminár", June 18-22, 2012 Stará Turá, Slovakia (SOC member)

J. Koza: *"*22. celoštátny slnečný seminár", May 26-30, 2014, Nižná nad Oravou, Slovakia (SOC member)

J. Koza: "Summer school - Magnetohydrodynamics in astrophysics", August 18-22, 2014, Tatranská Lomnica, Slovakia (LOC member) https://www.astro.sk/~koza/mhd/

J. Koza: *"School on Solar Spectro-Polarimetry"*, June 3-7, 2013, Tatranská Lomnica, Slovakia (LOC member)

V. Porubčan, Czech and Slovak meteor conference, June 2-6, 2014, Modra, Slovakia (SOC and LOC)

V. Porubčan, Czech and Slovak meteor conference, April 16-20, 2012, Modra, Slovakia (SOC and LOC)

J. Rybák: *"School on Solar Spectro-Polarimetry"*, June 3-7, 2013, Tatranská Lomnica, Slovakia (LOC member)

- **Supplementary information and/or comments documenting the international and national status of the Institute**

INTERNATIONAL STATUS

High credibility and international status of AISAS can be documented by the active membership in important international scientific bodies (e.g. boards, committees, editorial boards of scientific journals etc).

a) Editorial boards of international scientific journals abroad

[1] L. Hric, member of the American Journal of Space Science

[2] D. Chochol, member of the editorial board of the Astronomical and Astrophysical Transactions

[3] M Kocifaj, member of the editorial board of the Journal of Solar Energy

[4] A.Kučera, member of the editorial board of the Central European Astrophysical Bulletin

[5] V. Porubčan, member of the editorial board of the Earth, Moon, Planets

[6] T. Pribulla, member of the editorial board of the Journal of Astrophysics

[7] M. Saniga, member of the editorial board of the Frontier Perspectives
member of the editorial board of the ISRN Geometry
member of the editorial board of the Symmetry: Culture and Science

[8] A. Skopal, member of the editorial board of the top ranking journal Astronomy and Astrophysics

b) Selected memberships in international scientific committees and boards

Among the voting membership of 26 scientists of AISAS in the IAU - International Astronomical Union, there are other important memberships and functions of our scientists:

[1] L. Hric, member of International board of IOAA (International Olympiad for Astronomy and astrophysics

[2] D. Chochol, member of European Astronomical Society

[3] M. Jakubík, member of American Astronomical Society (AAS)

[4] Z. Kaňuchová, secretary of the Management committee COST Action TD 1308

[5] M. Kocifaj, member of International Solar Energy Society
member of Optical Society of America

[6] A. Kučera, member of Consortium EAST- European Association for Solar Telescopes
member of "Steering Committee for COSMO Project". (COronal Solar Magnetism Observatory), funded from NSF USA for Cconsortium of: NCAR High Altitude Observatory Boulder, University of Hawaii and University of Michigan.

[7] V. Porubčan, International Astronomical Union, member of Meteor Shower Nomenclature of IAU Commission 22

[8] T. Pribulla, vice-president of *Commission n. 42 Close Binary stars*
member of tbe board of of the *Commission n. 42 Close Binary stars* of the International Astronomical Union

[9] V. Rušin, member of WG Solar Eclipses of the International Astronomical Union
member of American Geophysical Union
member of Česká astronomická společnosť
member of European Astronomical Society

[10] J. Rybák, national representative in ASTRONET

[11] M. Saniga member of American Mathematical Society / Mathematical Reviews
member of American Physical Society/UniPHY
member of European Mathematical Society / Zentralblatt MATH
member of European Science Foundation (Pool of Reviewers, by invitation)
member of International Symmetry Association

[12] A. Skopal, member of The Royal Astronomical Society

[13] M. Vaňko, national representative in ASTRONET

[14] J. Žižňovský, member of WG „CP and Related Stars“ of the International Astronomical Union

c) International awards

T. Pribulla, Award of : "Canadian Space Agency"
Given by: *Gilles Leclerc - Director General. Space Exploration*
Description: *Award for outstanding contribution and scientific results to cosmic mission "Microvariability and Oscillation of Stars"*

d) Editorial boards of international scientific journals in Slovakia

[1] D. Chochol, member of the editorial board of the Contributions of the Astronomical Observatory Skalnaté Pleso

[2] R. Komžík, executive editor of the Contributions of the Astronomical Observatory Skalnaté Pleso

[3] J. Koza, member of the editorial board of the Contributions of the Astronomical Observatory Skalnaté Pleso

[4] A. Kučera, member of the editorial board of the Contributions of the Astronomical Observatory Skalnaté Pleso

[5] V. Porubčan, member of the editorial board of the Contributions of the Astronomical Observatory Skalnaté Pleso

[6] T. Pribulla, member of the editorial board of the Contributions of the Astronomical Observatory Skalnaté Pleso

[7] J. Svoreň, scientific editor of the Contributions of the Astronomical Observatory Skalnaté Pleso

e) supplementary information and comments on exchange of scientists and referees

Scientists of AISAS:

a) attended *108* international scientific conferences and meetings in Europe Asia, Africa, and USA

b) presented *274* contributions at international scientific conferences and meetings

c) refereed *172* scientific articles in scientific journals,

d) evaluated *47* international grants and projects,

e) done *194* visits in Europe, Australia, USA, Indonesia, Africa, Asia and South America in total duration of *1853* days

f) hosted *94* scientists from *16* countries (USA, Europe, Japan, Africa) in total of *2349* days.

NATIONAL STATUS

AISAS is leading organization in Slovakia concerning science and organizational tasks in astronomy and astrophysics. Scientists of AISAS are members of important bodies including those at Slovak Academy of Sciences, play crucial role in editing and publishing national journals and act in national committees of international unions and in Slovak Astronomical Society.

Several selected activities, memberships and awards in the assessment period:

[1] Eighteen scientists of AISAS are members of the Slovak Astronomical Society - SAS, and L. Hric is president of SAS.

[2] Six of seven members of Slovak National Committee of IAU - International Astronomical Union are from AISAS and A. Kučera is president of SNC.

[3] Seven scientists form AISAS evaluated overall 12 national grants and projects in the assessment period.

[4] Award of the Slovak Academy of Sciences for Development of infrastructure was given to J. Svoreň, A. Bobulová, A. Kučera and T. Pribulla in 2015

[5] Medal for top science team at Slovak Academy of Sciences given to V. Rušin, M.Saniga and J Žižňovský

[6] Awards for outstanding scientists at 60-th aniversary of Slovak Academy of Sciences were given to V. Rušin and J. Svoreň

[7] Award of the Slovak Academy of Sciences for "Popularization of science" given to J. Svoreň.

2.4. Tables of project structure, research grants and other funding resources

- **International projects and funding**

2.4.1. Major projects within the European Research Area and other important project – Framework Programmes of the EU, ERA-NET, European Science Foundation, NATO, COST, INTAS, etc. (here and in items below please specify: type of project, title, grant number, duration, total funding and funding for the institute, responsible person in the institute and his/her status in the project, e.g. coordinator "C", work package leader "W", investigator "I"),

There are given in Tables total durations also of those projects which exceeded the assessment period, for clarity.

Year	Project title	Type/ Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute/ Responsible person
2012	Polarization as a tool to study the Solar System and beyond	MPNS COST Action MP1104	2 11/2012-11/2015	0	Partner- Coordinator for Slovakia/ A. Kučera - scientist in charge
	Investigation of emerging magnetic flux in the quiet photosphere of the Sun	DFG - Germany BA 1875/7-1	6 07/2011-06/2012	2100	Partner/ P. Gömöry - scientist in charge
	Understanding the evolution of the very young stars -- multiple data sets solution of the young eclipsing binary TY CrA	DFG - Germany AM 158/3-1	12 01/2012-12/2012	6300	Partner/ M. Vaňko- scientist in charge
	Multiwavelength modeling the spectral energy distribution of the supersoft X-ray sources	Alexander von Humboldt Foundation SLA/1039115	1 0/2012-04/2012	2300	Coordinator A. Skopal
	Multifaceted observations of the solar corona during the 13 November 2012 total eclipse in Australia	National Geographic Society NGS-3139-12	1 11/2012-11/2012	17306	Coordinator V. Rušin
2013	SOLARNET- High-Resolution Solar Physics Network	7 RP/ FP7-INFRA-312495	9 04/2013-03/2017	3899	Partner/ A. Kučera - scientist in charge
	Dynamics and magnetic field topology of small-scale loops.	7 RP SOLARNET Trans-nat. access programe: VTT - Ref. nr.: 13-05	1 10/2013-10/2013	38508	Coordinator / P. Gömöry
	Polarization as a tool to study the Solar System and beyond	MPNS COST Action MP1104	12 11/2012-11/2015	4103	Partner- Coordinator for Slovakia/ A. Kučera - scientist in charge
	Total Solar Eclipse in Gabon at Sunspot-Cycle maximum	National Geographic Society NGS-9312-13	3 10/2013-12/2013	3700	Coordinator V. Rušin

2014	SOLARNET- High-Resolution Solar Physics Network	7 RP/ FP7-INFRA-312495	12 04/2013-03/2017	27470	Partner/ A. Kučera - scientist in charge
	Topology and physical parameter of the magnetic fields in solar filaments.	7 RP SOLARNET Trans-nat. access programe: VTT - Ref. nr.: 14-08	1 09/2014-09/2014	49020	Coordinator / P. Gömöry
	Coordinated three-site observations of quiescent prominencess.	7 RP SOLARNET Trans-nat. access programe: Ref. nr.: 14-07	1 07/2014-08/2014	41949	Coordinator / J. Koza
	Polarization as a tool to study the Solar System and beyond	MPNS COST Action MP1104	12 11/2012-11/2015	5205	Partner- Coordinator for Slovakia/ A. Kučera - scientist in charge
	Origins and evolution of life on Earth and in the Universe	COST Action TD 1308	7 05/2014- 05/2018	3085	Partner- Coordinator for Slovakia/ Z. Kaňuchová - scientist in charge
	Mapping the fireball stage of the Nova Del 2013 (V339 Del) by the method of multiwavelength modelling its SED	Alexander von Humboldt Foundation SLA/1039115	1 03/2014-04/2014	3000	Coordinator A. Skopal
2015	SOLARNET- High-Resolution Solar Physics Network	7 RP/ FP7-INFRA-312495	12 04/2013-03/2017	6078	Partner/ A. Kučera - scientist in charge
	Topology and physical parameter of the magnetic fields in solar filaments.	7 RP SOLARNET Trans-nat. access programe: GREGOR - Ref. nr.: 15-07	1 051/2015-05/2015	37730	Coordinator / P. Gömöry
	Polarization as a tool to study the Solar System and beyond	MPNS COST Action MP1104	11 11/2012-11/2015	3667	Partner- Coordinator for Slovakia/ A. Kučera - scientist in charge
	Origins and evolution of life on Earth and in the Universe	COST Action TD 1308	12 05/2014- 05/2018	5175	Partner- Coordinator for Slovakia/ Z. Kaňuchová - scientist in charge
	Two suns in the sky: search for circumbinary planets with the TEST telescope	DFG/ DFGHA 3279/9-1	12 01/2015- 12/2017	0	Partner/ T. Pribulla
	Exploring the accretion process in the symbiotic system CH Cygni during its transition from quiescence to the present (2014-15) active phase	Alexander von Humboldt Foundation SLA/1039115	1 03/2015-04/2015	3000	Coordinator A. Skopal

2.4.2. Other international projects, incl. total funding and funding for the institute

Year	Project title	Type/ Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute/ Responsible person
2012	Impulsively generated waves in radio and X-ray ranges of the electromagnetic spectrum detected in the solar corona	MAD SK-CZ	12 01/2012-12/2014	300	Coordinator / J. Rybák
	Studying the nature of outbursts of symbiotic stars	MAD SK-BG-0015-10	12 01/2012-12/2013	1171	Coordinator / A. Skopal
2013	Impulsively generated waves in radio and X-ray ranges of the electromagnetic spectrum detected in the solar corona	MAD SK-CZ	12 01/2012-12/2014	300	Coordinator / J. Rybák
	Plasma diagnostics of EIT waves and flares on the Sun.	MVD APVV SK-AT-0003-12 SK 16/2013	12 01/2013-12/2014	2000	Coordinator / P. Gömöry
	Studying the nature of outbursts of symbiotic stars	MAD SK-BG-0015-10	12 01/2012-12/2013	400	Coordinator / A. Skopal
	Finite Geometries Behind the Black–Hole–Qubit Correspondence	MFO-RiP-2013-LPS	1 02/2013-03/2013	4000	Coordinator / M. Saniga
2014	Impulsively generated waves in radio and X-ray ranges of the electromagnetic spectrum detected in the solar corona	MAD SK-CZ	12 01/2012-12/2014	567	Coordinator / J. Rybák
	Plasma diagnostics of EIT waves and flares on the Sun.	MVD APVV SK-AT-0003-12 SK 16/2013	12 01/2013-12/2014	2000	Coordinator / P. Gömöry
	Study of stellar explosions in interacting binaries	MAD Č:1/2014	3 10/2014-12/2016	0	Coordinator / D. Chochol
	The magnetic vector field in solar filaments	MAD DAAD DAAD 57065721	12 01/2014-12/2015	5717	Partner / P.Schwartz
	The Dwarf project: Eclipsing binaries – precise clocks to discover exoplanets	MAD Č: 2/2014	3 08/2014-12/2016	0	Coordinator / M. Vaňko
2015	The magnetic vector field in solar filaments	MAD DAAD DAAD 57065721	12 01/2014-12/2015	6232	Partner / P.Schwartz
	The study of interplanetary matter in the Earth's vicinity	MAD SAV-AV ČR 15-17	12 01/2015-12/2017	885	Coordinator / M. Husárik
	Study of stellar explosions in interacting binaries	MAD Č:1/2014	12 10/2014-12/2016	0	Coordinator / D. Chochol
	The Dwarf project: Eclipsing binaries – precise clocks to discover exoplanets	MAD Č: 2/2014	12 08/2014-12/2016	0	Coordinator / M. Vaňko

2.4.3. Other important, international projects and collaborations without direct funding (max. 10 projects)

Year	Project title	Type/ Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute/ Responsible person
2014	Observing Coronal Eruptions and Spectra at the 2015 Arctic Solar Eclipse	Bilateral/ Nat. Geographic's Committee on Research and Exploration, USA 9616-14	7 06/2014-12/2015	0	Partner/ V. Rušin
	Finite-Geometrical Aspects of Quantum Theory	Bilateral/ FWF-M1564-N27l access and service programe: VTT - Ref. nr.: 14-08	10 03/2014-06/2015	0	Coordinator / M. Saniga
2015	Observing Coronal Eruptions and Spectra at the 2015 Arctic Solar Eclipse	Bilateral/ Nat.Geographic's Committee on Research and Exploration, USA 9616-14	12 06/2014-12/2015	0	Partner/ V. Rušin
	Finite-Geometrical Aspects of Quantum Theory	Bilateral/ FWF-M1564-N27l access and service programe: VTT - Ref. nr.: 14-08	6 03/2014-06/2015	0	Coordinator / M. Saniga
	Exploring the Geometry of Generalized Pauli Groups	Bilateral RECH-MOB15-000007	4 09/2015-06/2016	0	Coordinator / M. Saniga

- **National projects and their funding**

2.4.4. Projects supported by the Slovak Research and Development Agency (APVV) Role of the Institute e.g. coordinator “C”, investigator “I”.

Year	Project title	Type/ Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute/ Responsible person
2012	From interacting binaries to exoplanets	APVV 0158-11	6 07/2012-12/2015	16276	Coordinator/ J. Budaj
	Solar corona: investigation of physical processes	APVV 0816-11	6 07/2012-12/2015	18599	Coordinator/ J. Rybak
	Investigation of Slovak meteorites	APVV 0516-10	12 05/2011-10/2014	2310	Investigator/ J. Svoreň

2013	From interacting binaries to exoplanets	APVV 0158-11	12 07/2012-12/2015	29098	Coordinator/ L. Neslušan
	Solar corona: investigation of physical processes	APVV 0816-11	12 07/2012-12/2015	33636	Coordinator/ J. Rybak
	Investigation of Slovak meteorites	APVV 0516-10	12 05/2011-10/2014	2310	Investigator/ J. Svoreň
	Model of meteoroid population in the close vicinity of the Earth	APVV 0517-12	3 01/2014-12/2017	1159	Investigator/ M. Hajduková
2014	From interacting binaries to exoplanets	APVV 0158-11	12 07/2012-12/2015	25985	Coordinator/ L. Neslušan
	Solar corona: investigation of physical processes	APVV 0816-11	12 07/2012-12/2015	29659	Coordinator/ J. Rybak
	Investigation of Slovak meteorites	APVV 0516-10	10 05/2011-10/2014	1910	Investigator/ J. Svoreň
	Model of meteoroid population in the close vicinity of the Earth	APVV 0517-12	12 01/2014-12/2017	3592	Investigator/ M. Hajduková
2015	From interacting binaries to exoplanets	APVV 0158-11	12 07/2012-12/2015	20223	Coordinator/ L. Neslušan
	Solar corona: investigation of physical processes	APVV 0816-11	12 07/2012-12/2015	30617	Coordinator/ J. Rybak
	Model of meteoroid population in the close vicinity of the Earth	APVV 0517-12	12 01/2014-12/2017	4396	Investigator/ M. Hajduková

2.4.5. Projects supported by the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA) for each year, and their funding

VEGA	2012	2013	2014	2015
Number	9	8	8	8
Funding in the year (EUR)	65903	78569	78554	77108

[1]

- **Summary of funding from external resources**

2.4.6. List of projects supported by EU Structural Funds

[1] Title: "*Center of space research: Influences of the space weather*"

Coordinator: *Ján Svoreň*
Duration: *24.4.2009 / 15.6.2013*
Number: *ITMS 26220120009*
Coordinator: *Astronomický ústav SAV*
Number of institutions: *3 - AISAS, UEF SAV, UPJŠ*
Total financing for AISAS in assessed period: *115 921 EUR*

[1] Excluding projects for the popularisation of science

[2] Title: "*Center of space research: Influences of the space weather – the second phase"*

Coordinator: *Ján Svoreň*

Duration: *1.3.2010 / 31.8.2014*

Number: *ITMS 26220120029*

Coordinator: *Astronomický ústav SAV*

Number of institutions: *3 - AISAS, UEF SAV, UPJŠ*

Total financing for AISAS in assessed period: *1 874 064 EUR*

[3] Title: "*Center of space research – building of technical infrastructure"*

Coordinator: *Ján Svoreň*

Duration: *19.10.2012 / 30.9.2015*

Number: *ITMS 26210120018*

Coordinator: *Astronomický ústav SAV*

Number of institutions: *1 - AISAS*

Total financing for AISAS in assessed period: *2 871 154 EUR*

2.4.7. Summary of external resources of the EU Structural Funds (ERDF/ESF)

Role of the Institute in the project, e.g. coordinator "C", work package leader "W", investigator "I".

Year	Project title	Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute
2012	Center of space research: Influences of the space weather	26220120009	10	115 921	C
	Center of space research: Influences of the space weather – the second phase	26220120029	12	355 754	C
	Center of space research –Technical Infrastructure Development	26210120018	3	0	C
2013	Center of space research: Influences of the space weather – the second phase	26220120029	12	632 921	C
	Center of space research –Technical Infrastructure Development	26210120018	12	265 678	C
2014	Center of space research: Influences of the space weather – the second phase	26220120029	8	858 389	C
	Center of space research –Technical Infrastructure Development	26210120018	12	1 401 898	C
2015	Center of space research –Technical Infrastructure Development	26210120018	9	1 203 578	C

External resources	2012	2013	2014	2015	total	average
External resources (milions of EUR)	0,472	0,899	2,260	1,204	**4,835**	**1,209**
External resources transfered to coooperating research institute (milions of EUR)	0,317	0,029	0,213	0,000	**0,559**	**0,140**

- **Supplementary information and/or comments on research projects and funding sources**

The assessment period covers a main phase of remarkable improvement of institutional infrastructure of AISAS. Thanks to the three EU Structural Funds the AISAS gained modern infrastructure which cost more than ***100 years "standard" funding*** from Slovak Academy of Sciences. This infrastructure brought AISAS to be fully competitive concerning the infrastructure on astrophysics in Europe. More, some instruments belong to unique technique worldwide.

2.5. PhD studies and educational activities

2.5.1. List of accredited programmes of doctoral studies, period of validity

Title of study programme	Title of study field (SF)	Number (SF)	University	Duration
Astronomy and astrophysics	astronomy	4.1.7	Comenius University, Bratislava	Unlimited
	astrophysics	4.1.8		

2.5.2. Summary table on doctoral studies (number of internal/external PhD students; number of foreign PhD students, number of students who successfully completed their theses, number of PhD students who quit the programme*)*

PhD study	31.12.2012			31.12.2013			31.12.2014			31.12.2015		
Number of potential PhD supervisors	17			16			17			17		
PhD students	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted
Internal	6,0	1,0	0,0	4,0	2,0	0,0	5,0	0,0	0,0	4,0	1,0	0,0
External	1,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0
Other supervised by the research employees of the institute	2,0	0,0	0,0	2,0	1,0	0,0	2,0	0,0	0,0	1,0	1,0	0,0

Additional information on activities of PhD students:

a) Visits of PhD students at institutions abroad:

2015: J. Kavka, Czech Republic, 3 days
J. Kavka, Spain, 11days
R. Vašková, Spain, 16 days
Z. Garai, Italy 6 days

2014:	Z. Garai, Hungary	20 days
	Z. Garai, Germany	5 days
	J. Nedoroščík, Germany	5 days
	J. Nedoroščík, Spain	14 days
	J. Kavka, Austria,	3 days
2013:	Z. Garai, Germany	5 days
	J. Nedoroščík, Germany	5 days
	J. Nedoroščík, Spain	14 days

b) Attendance of PhD students at international conferences and schools:

2015: Z. Garai, Hungary, *14-th International conference on application of natural-, technological-and economics sciences*

N. Shagatova, France, *The physics of evolved stars: a conference dedicated to the memory of Olivier Chesneau*

R. Vašková, Spain, 1st CASSDA School: A week above the clouds

R. Vašková, Slovakia, *2nd SOLARNET School: "Ground- and space- based solar instruments", 2nd SOLARNET Workshop: "Methods in high resolution and synoptic solar physics" and 2nd SPRING (Solar Physics Research Integrated Network Group) meeting*

2014 R. Vašková, Poland, *1-st SOLARNET Spring School: "Introduction to Solar Physics" and 1st SOLARNET Workshop: "Radiative Processes in the Sun and Stars",*

Z. Garai, Czech Republic, *Planets, Stars, Binaries - Living Together: Planets, Host Stars and Binaries*

Z. Kreibikova, Czech Republic, *Planets, Stars, Binaries - Living Together: Planets, Host Stars and Binaries*

N, Shagatova, Czech Republic, *Planets, Stars, Binaries - Living Together: Planets, Host Stars and Binaries*

Z. Garai, Hungary*, 3-rd Scientific Writing for Young Astronomers*

2013: Z. Garai, Poland, *Scientific applications of Small Telescopes 2013*

J. Nedoroščík, Poland, *Scientific applications of Small Telescopes 2013*

2.5.3. Summary table on educational activities

Teaching	2012	2013	2014	2015
Lectures (hours/year)[2]	129	106	83	317
Practicum courses (hours/year)[2]	82	30	103	75
Supervised bachelor theses (in total)	1	1	1	0
Supervised diploma theses (in total)	2	2	2	2
Supervised PhD theses (in total)	7	5	5	6
Members in PhD committees (in total)	10	10	10	10
Members in DrSc. committees (in total)	3	3	3	3
Members in university/faculty councils (in total)	0	0	0	0
Members in habilitation/inauguration committees (in total)	0	1	1	0

2.5.4. List of published university textbooks

2.5.5. Number of published academic course books

2.5.6. List of joint research laboratories/facilities with universities

- **Supplementary information and/or comments on doctoral studies and educational activities**

The number of PhD. students of astronomy and astrophysics at AISAS and number of lectures given by scientists of AISAS correspond and fully cover needs of Institute and Slovakia concerning new generation of astronomers and astrophysicists in praxis.

Scientists of AISAS act as a members of boards of State exams at UPJŠ university Košice and at Comenius University Bratislava (A. Kučera, J. Svoreň, V. Porubčan, A. Skopal)

Scientists of AISAS act as a members of Committee for defending of DrSc degree in astronomy and astrophysics (Chairman - J. Svoreň, members - D. Chochol and A. Skopal).

Scientists of AISAS act as a members of Committee for defending of PhD in astronomy and astrophysics (members - D. Chochol, A. Kučera, L. Neslušan, V. Porubčan, T. Pribulla, V. Rušin, J. Rybák, A. Skopa, J. Svoreň, M. Vaňko and J. Žižňovský).

L. Hric refereed University text book "Základy astronómie a astrofyziky", Author: RNDr. Rudolf Gális, PhD. Issued. University P. J. Šafárika, Košice, 2014, ISBN 978-80-8152-089-1

AISAS cooperate with the following universities:

[1] Faculty of mathematics, physics and informatics, Comenius University, Bratislava

Cooperation established:1955

Goal: astronomy - teaching, membership in committees

[2] Faculty of natural sciences, UPJŠ, Košice

Cooperation established:1997

Goal: astronomy, astrophysics - teaching, membership in committees

[3] Charles University, Faculty of mathematics and physics, Prague,

Cooperation established:2001

Goal: astronomy, astrophysics - vacation praxis of students, evaluation of inner projects, membership in committees

[4] Université de Franche-Comté, Besançon, France

Cooperation established:2004

Goal: Theoretical physics, quantum theory of informatics, finite geomeries, co-supervising of PhD studies common projects, common papers

[5] Technische Universität Wien, Wien, Austria

Cooperation established:2007

Goal: Theoretical physics, quantum theory - teaching, common projects, common papers

[6] Budapest University of Technology and Economics, Budapešť, Hungary

Cooperation established:2008

Goal: Theoretical physics, finite geomeries, consultations of PhD studies, common projects, common papers

[7] Uniwersytet Marii Curie-Sklodowskiej, Lublin, Poland

Cooperation established:2010

Goal: Astronomy - teaching

2.6. Social impact

Even the AISAS is the organisation exclusively aimed at a basic research it gives, as listed below, also expertise and studies for Society authorities and for civil sphere, has membership in the Advisory Forums of public institutions, gives consultation and advisory. AISAS is active in enlightenment, edification and in popularization of science in the media (this part is more detailed in section *2.7. Popularisation of Science (outreach activities)*

2.6.1. List of the most important results of applied research projects. Max. 10 items

AISAS is the organisation exclusively aimed at a basic research and it, therefore, does not have applied research projects.

2.6.2. List of the most important studies commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes

Expertise for Court hearing on "Okresný súd Trenčín" on the "The term and the time difference between the perception of the sunset and civil twilight (M. Jakubík)

Expertise on paper Mr. Štefkovič for decisions at Ministry of Culture and Slovak Academy of sciences. (L. Neslušan)

Expertise: Definition of term *"Night"* (Nautical, astronomical and civil) for Council of "Mestský úrad Poprad" for use in Court legal issues (M. Jakubík)

J. Ambróz acts as a expert member of *"The national team of technical experts to assess the goods and dual-use technologies and military equipment"* to the Ministry of Economy"

R. Komžík is a representative of a full member of AISAS in the "*SANET – Slovak Academy Data Network",* the strategic State consortium for development of Internet and network activities in Slovakia

R. Komžík is an expert member of *The Steering Committee of the national project "Slovak grid infrastructure SlovakGrid"*

V. Rušin acts as vice-chairman of board of councils of *"State program for science and research - Complex solution of support and the efficient use of infrastructure, research and development"*

D. Chochol, act as member of *"APVV - Council for Natural Science, Working Group 1 science - mathematics, physics, astronomy and informatics".*

V. Porubčan and J. Svoreň serve as an experts for "Assessment of findings "meteorites" and records of special flying bodies in the atmosphere" (overal 124 events in the assessment period) They provided also enlightenment and clarifying to the public the extraordinary events, e.g. the Chelyabinsk meteor which was a superbolide caused by a near-Earth asteroid.

2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues

AISAS is the organisation exclusively aimed at a basic research and it, therefore, does not have any contracts and research projects with industrial partners.

2.6.4. List of licences sold abroad and in Slovakia, incl. revenues

AISAS is the organisation exclusively aimed at a basic research and it, therefore, does not have any licences.

2.6.5. List of most important social discourses under the leadership or with significant participation of the institute (max. 10 items)

One of the most important social discourses led by AISAS was in 2012 the enlightenment concerning the "prediction" of "End of world" which caused panic in society. We prepared expertise for media and for Slovak Academy of Sciences see www:

http://www.sav.sk/index.php?doc=services-news&source_no=20&news_no=4760

which enormously helped for people as documented by hundred of emails thank us for explanation of the situation. Enormous interest on the expertise documents also number of hits at the above given www page at Slovak Academy of Sciences (**25 359 times!)**

2.6.6. Summary of relevant activities, max. 300 words

Social impact of AISAS is essential in enlightenment, edification and in popularization of achievements of science and technology, in education and motivation of young generation for science and in transmitting knowledge to society.

2.7. Popularisation of Science (outreach activities)

2.7.1. List of the most important popularisation activities, max. 20 items

AISAS done in the assessment period overall **1158 activities** in popularization in Slovakia and abroad, including 5 documentary films, 8 big exhibitions, 136 presenting in TVs and 147 excursions at our observatories. The selected events only roughly document an important impact to public made by popularization by AISAS.

[1] Transit of Venus across the Sun 2012. Event on June 5, 2012 connected with wide cooperation with media, schools and public in popularization of the extraordinary event - last for the next 120 years. There were observations and excursions of schools at AISAS and given lectures (J. Koza) on the nature of the event and its importance in the past concerning the estimation of the distance of Earth from the Sun (more than 200 visitors)

[2] Project APVV on popularization of astronomy "Discover Universe your Home".

Funding: 89 659 EUR, People: Coordinator V. Rušin, others 14 members of AISAS Events: Slovak workshop for teachers with proceedings, four times open doors at Lomnicky Peak Observatory, 46 lectures, numerous excursions,, two night observations, issued 45 000 postcards with astronomical themes, building of educational trail with 13 panels in surrounding of AISAS, preparation of presentations and posters and 30 large format photographs. Impact on thousands of students and public.

[3] Visit of United Nations Secretary-General Ban Ki-moon at Lomnicky Peak Observatory. On October 18,2015 visited United Nations Secretary-General Mr. Ban Ki-moon with Slovak Minister of Foreign Affairs Mr. Miroslav Lajčák Lomnicky Peak Observatory, where the director of the AISAS provide them with excursion and short lecture on the research made with the instrumentation at the Observatory.

[4] The 70-th anniversary of the founding of the Institute. Issued Special supplement of the popularization journal Kozmos consisting of 16 pages of articles written by members of AISAS on history, people, scientific achievements and instrumentation of AISAS in the 70-years history. Press conference in Bratislava, presentations press-conference and interviews in media.

[5] Visit of three presidents (Czech Republic, Poland and Slovakia at Lomnicky Peak Observatory. Within the V4 summit invited his excellence Slovak president Ivan Gašparovič his colleagues, presidents of the Czech Republic - Vaclav Klaus and Poland - Bronislaw Komorowski with wifes at the highest situated workplace of Slovak Academy of Sciences - Lomnicky Peak. Director of the AISAS provide them with excursion and short lecture on the new infrastructure from Structural Funds.

[6] Series of exhibitions on theme "art and science". Glass art and its similarity with Universe.Three exhibitions "Poetry of Universe" 2012 in Pporad, Slovakia, "Mysteries of Life" 2013 in Riihimäki, Finland and "Big Bang Paradis retrouvé" 2013 in Paris, France combined images of astronomical objects (containing full scientific information on nature, distance, diameters ages and other parameters of the astronomical objects, given by A. Kučera from AISAS) with glass art made by maestro Zoritchak especially to these events. In Finland the exhibition was made with help of Slovak Embassy in Helsinki. The exhibition in Paris was opened by Mayor of Paris. The exhibitions visited several thousand of visitors.

[7] Two exhibitions "Colourful Universe" and "Universe around us" were presented in the frame of events "Researchers night" in the ZOC MAX shopping centre in Poprad in 2014 and 2015. "Colourful universe" prepared by V. Rušin, M. Husárik M. Bodnárová and D. Tomko, consisted of 30 big format astronomical pictures. It was made in cooperation with VÚCHV Svit and SHMÚ Gánovce. The exhibition visited 5 000 visitors including his excellence President of Slovakia Andrej Kiska. The exhibition "Universe around us" prepared by V. Rušin consisted of 17 big format panels and introduced also a new 1.3 m mirror telescope of AISAS. Exhibition visited 6000 visitors

.

[8] Partial eclipse of the Sun on March 20, 2015. Big event organised at territory of AISAS in Stara Lesna connected with full eclipse of the Sun in Norway - the place of AISAS expedition. Hundreds of visitors including media, and pupils, seen directly the partial eclipse using telescopes of AISAS, learned on lectures, and followed total eclipse on-line via transfer from Norway. Many responses in TVs and newspapers appeared

[9] Series of articles in popularization journal Kozmos on research on bodies in the Solar System (Comet Čurjumov-Gerasimenko + spacecraft Rosetta, Pluto + spacecraft New Horizons, Ceres + spacecraft Dawn). (J. Svoreň)

[10] TV programme "Euroskop" in channel Ta3. Discussion with AISAS director A. Kučera on a new infrastructure from Structural funds and research at AISAS.

[11] Open doors at Lomnicky Peak Observatory (each year organised four times) with lectures and excursions to the dome with solar coronagraphs and instrumentation. (J. Rybák, P. Habaj, P. Gömöry, A. Kučera, J. Koza, M. Bodnárová, P. Schwartz, J. Kavka, R. Mačura, P. Bendík, M. Kozák…) More than 1200 visitors in whole assessment period

[12] Open doors in Stará Lesná - AISAS headquarters, (each year organised four times during the "Week of science and technology" and in the frame of events "Researchers night") with lectures and night observations (L. Hambálek, D. Chochol, Z. Kreibiková, J. Nedoroščík, M. Sekeráš, E. Kundra, M. Husárik, V. Rušin, J. Žižňovský, L. Hric, M. Bodnárová, Z. Krišandová). More than 800 visitors in whole assessment period

[13] Regular presentation of Astro-News and actual information on astronomical events at internet web page of AISAS http://www.ta3.sk/news/ (M. Husárik, J. Koza)

[14] Realization of educational trail "Klátovské meteority" with information panels in the vilage Klátov, the location, where the parts of Košice meteorite were found. (J. Svoreň)

[15] Night observations for public at Kežmarok Castle with education on planets, asteroids and constellations. (L. Hambálek, M. Husárik, Z. Krišandová, M. Vaňko)

[16] Issue of set of nine postcards with astronomical images (36 000 in total) for event "European Researchers' Night 2014, science is adventure" - (Rušin, Krišandová, Tomko, Husárik)

[17] Popularization discission in "Vedecká cukráreň" in the Slovak Centre of Scientific and Technical Information in Bratislava on theme "Comets in light of the newest discoveries" (J. Svoreň)

[18] TV main news headline in channel Markíza on exoplanet of Earth type - Kepler 452b, circulating Sun-like star (T. Pribulla)

[19] TV main news headline in channel STV1 "Voyager is already beyond our world". The headline on spacecraft Voyager passing though the boundary of Heliosphere entering an interstellar space.(D. Chochol)

2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2012	2013	2014	2015	total
Articles in press media/internet popularising results of science, in particular those achieved by the Institute	72	95	43	128	338
Appearances in telecommunication media popularising results of science, in particular those achieved by the Institute	60	55	43	70	228
Public popularisation lectures	92	107	104	88	391

- **Supplementary information and/or comments on popularisation activities, max. 300 words**

AISAS has good established cooperation with media based on professional contacts with journalists, enough scientists (also in young generation) who are willing to popularize the science, work and achievements of AISAS. Systematic work in this field has led to high professionalism and effectiveness in popularization.

2.8. Background and management. Human resources and implementation of recommendations from previous assessment

2.8.1. Summary table of personnel

Personnel	2012	2013	2014	2015
All personnel	60,0	60,0	55,0	58,0
Research employees from Tab. Research staff	37,0	39,0	36,0	38,0
FTE from Tab. Research staff	33,610	33,800	31,150	32,180
Average age of research employees with university degree	46,9	45,6	46,6	47,9

2.8.1.1. Professional qualification structure (as of 31.12. 2015) FEMALE

FEMALE	AGE								
Number of	**< 30**	**31 - 34**	**35 - 39**	**40 - 44**	**45 - 49**	**50 - 54**	**55 - 59**	**60 - 64**	**> 65**
DrSc. / prof.									
II.a / Assoc. prof.			**1**		**1**				
Other researchers PhD./CSc.	**1**	**3**			**1**				
doc. / Assoc. prof.									

2.8.1.2. Professional qualification structure (as of 31.12. 2015) MALE

MALE	AGE								
Number of	< 30	31 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	> 65
DrSc. / prof.							2		4
II.a / Assoc. prof.			2	1	1	2	2	3	
Other researchers PhD./CSc.		4	2		1		1		
doc. / Assoc. prof.									1

2.8.2. Postdoctoral and mobility scheme

2.8.2.1. Postdoctoral positions supported by national and international resources

Support from SAIA (Slovak Academic Information Agency)

(2015)
Kravtsova Alexandra 90 days
Ivanova Oleksandra 184 days
Krushevska Viktoria 90 days

(2014)
Ivanova Oleksandra 92 days
Kravtsova Alexandra 92 days
Zemko Polina 79 days

(2013)
Breus Vitalii 157 days

(2012)
Katysheva Natalia 210 days
Volkov Igor 244 days
Pavlenko Olena 91 days

2.8.2.2. Postdoctoral positions supported by external funding

(2012)
Pracna Petr 62 days
Krejčová Tereza 90 days

2.8.2.3. SAS stipends and SASPRO stipends

2.8.2.4. Internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz

AISAS obtained in the assessment period two Supporting Funds of Stefan Schwarz for scientists L. Hambálek and Z. Cariková.

2.8.3. Important research infrastructure *(max. 2 pages)*

There were unprecedented improvements of research infrastructure of AISAS in the assessed period. The most significant investments to the infrastructure came from Structural funds of EU. They were roughly equal to 100 regular annual investments of AISAS. Thus AISAS is now, equipped with modern observational, computational and technical infrastructure including fiber optics and radio networking. We will list here only important infrastructure and there are pointed out by **bold** the most important improvements which were added to the older infrastructure of AISAS in the assessment period

a) Solar department:

Infrastructure is used for investigation of the solar atmosphere, eruptive solar events, solar cycle and Sun Earth connections.

Lomnicky Peak Observatory

[1] Two 20/300 ZEISS coronagraphs with a diffraction grating spectrograph and CoMP – Coronal multi-channel polarimeter, one of two worldwide instruments for spectro-polarimetry of solar corona

Post-focus equipments to coronagraphs:

[2] Near Infrared Detectors for Solar Spectrograph (Coronagraph) – equipped with super sensitive infrared cameras for registration of IR radiation from solar corona

[3] New postfocus detector for corona and prominences observations with four cameras (two high new cameras sensitive in visible range and two in near infrared)

[4] Solar Chromospheric Detector for observations of magnetic fields in solar chromosphere, equipped with Tunable birefringent filter and polarimeter

[5] Robotization of the coronagraphs and the dome at Lomnicky Peak Observatory

Stará Lesná Observatory

[1] Horizontal solar telescope with spectrograph (d = 50 cm) for teaching purposes

b) Department of interplanetary matter and Stellar department (night observations)

Infrastructure is used for investigations of minor planers, comets and meteorites, stellar astronomy, exoplanets, binary stars, novae and othe variable stars.

Skalnaté Pleso Observatory

[1] 61 cm photometric and astrometric reflector with CCD camera
[2] 1.3 meter class telescope equipped with large CCD camera
[3] Two video-cameras - system for observing of faint meteors
[4] CCD camera for observing of asteroids,
[5] two spectrographs to 60-cm telescopes,
[6] CCD camera 4K x 4K to 1.3-m telescope,
[7] robotization of the 0,61-m telescope at the Skalnaté Pleso Observatory,
[8] robotization of the 8-m dome at the Skalnaté Pleso Observatory,
[9] device for vacuum metal coating of astronomical mirrors,
[10] CCD camera for cometary observations,
[11] an echelle spectrograph to 1.3-m telescope,
[12] CCD camera 10K x 10K to 1.3-m telescope,
[13] Near Infrared camera to 1.3-m telescope.

Stará Lesná Observatory

[1] two 60 cm photometric reflectors.
[2] two digital bolide cameras,
[3] all sky automatic bolide camera.

AISAS as a whole

[1] the optical fiber link between Stara Lesná and Tatranská Lomnica for connecting Skalnaté Pleso Observatory to academic net SANET,
[2] Computational Cluster for parallel computations
[3] Intel Server Systems
[4] Intel Storage Server System
[5] Radio communications devices for data transfer between Stará Lesná and observatories at Lomnicky Peak and Skalnaté pleso.
[6] Videoconference system

Facilities abroad which AISAS has possibility to use regularly in the frame of international cooperation:

[1] GRID computing with collaboration with the Institute of Informatics of the Slovak Academy of Sciences within the project Enabling Grids for E-science II.
[2] Large worldwide solar telescopes (VTT, SST, DOT, THEMIS) at Canary Islands and "Solar" satellites, Hinode, SoHO, Goes, SDO for topl level observations of the Sun
[3] Sharing in the designing of satellite programmes for stellar astrophysics - the HIPPARCOS and TYCHO databases are frequently used.

2.8.4. Description of how the results and suggestions of the previous assessment were taken into account

The suggestion of the previous assessment was: ***"To continue in outlined strategy of a development of the Institute".*** This recommendation is fulfilled.

- **Supplementary information and/or comments on management, research infrastructure, and trends in personnel development**

There are at AISAS several instruments introduced to focus scientists to do quality and high level science with quality outputs. Internal Regulation prescribes to each scientist minimum output (one article in high ranked journal per year) required for right to get additional part of salary. For PhD. students and young scientists (35 years) are given financial bonuses for publications in journals with high impact factor (higher than 2) in case that the scientist is leading person of the paper.
Every five years all scientists attend an overall evaluation to get extension of working contract or prove the existing one.

AISAS has very good infrastructure, comparable to European level and good contacts and international cooperation to get access to the top infrastructure worldwide.

AISAS have had very good personnel development in the assessment period. There was big change of generations at AISAS (as can be seen in the subsequent Figure) which led to radical rejuvenation, but not affected the quality of science at the Institute.

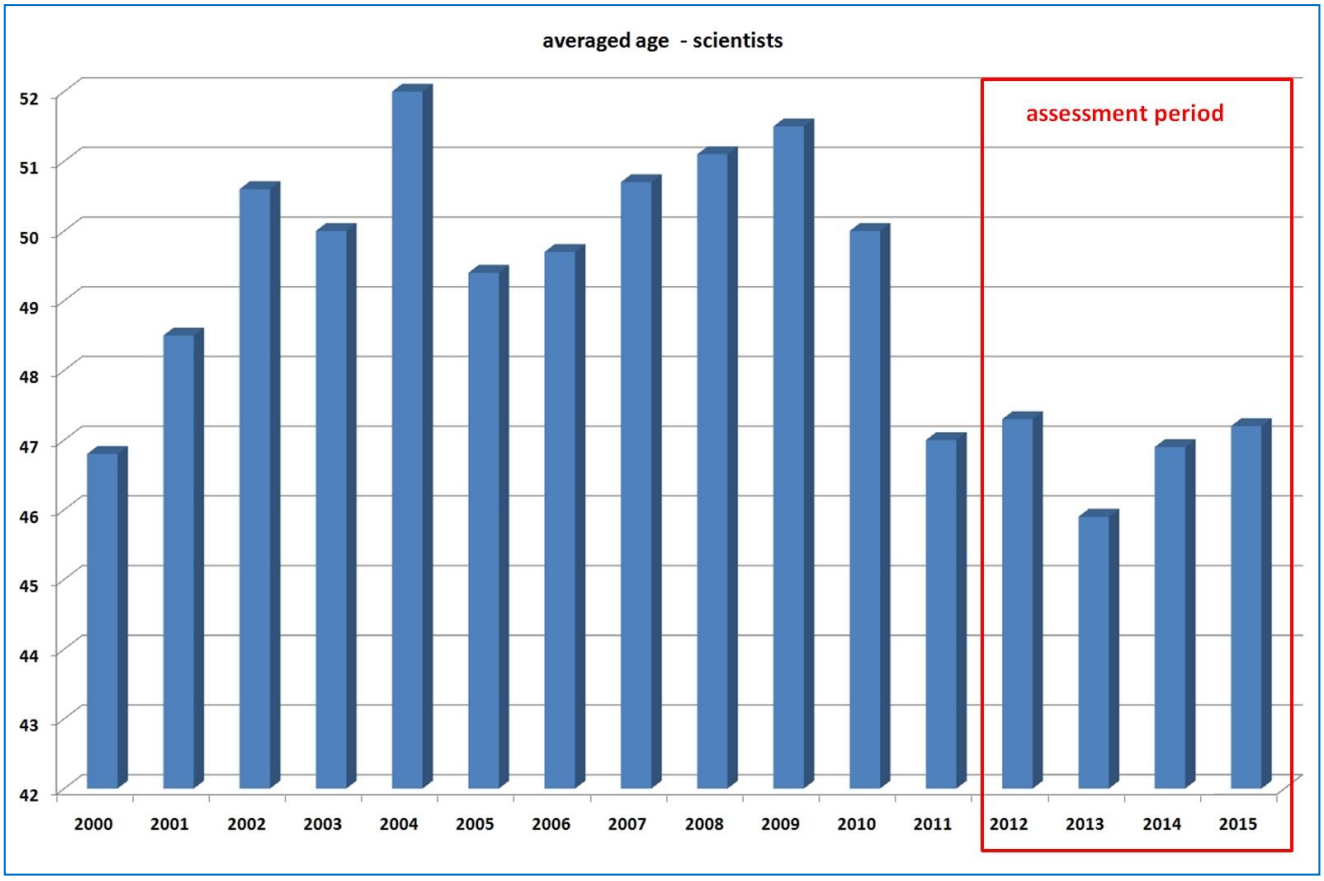

Figure 4: Development of the averaged age of scientists at AISAS.

AISAS has also good distribution of age of scientists (see next Figure) with relative high number of "middle-age" scientists between 40-59 years (36 %) and very promising "tail" of young scientists in the distribution between 30-39 years (39%).

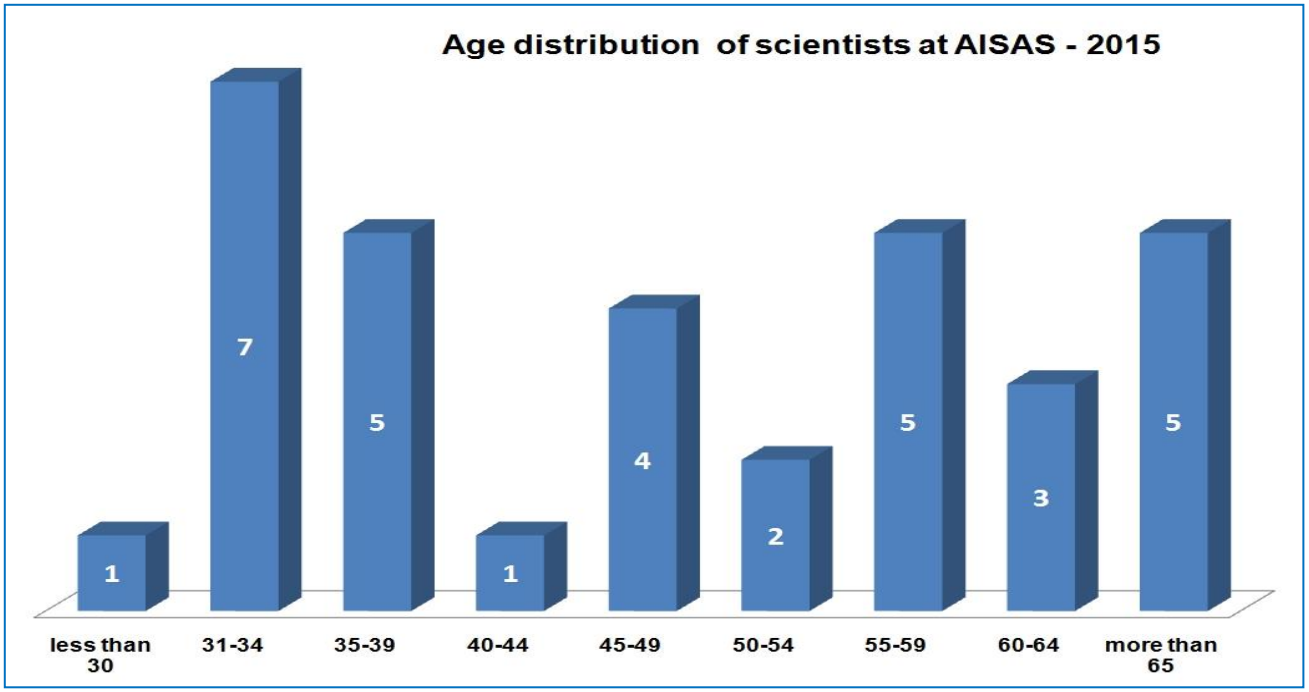

Figure 5: Distribution of an age of scientists at AISAS.

3. Research strategy and future development of the institute for the next five years (2016-2020) (Recommended 3 pages, max. 5 pages)

3.1. Present state of the art in both the national and the international contexts

AISAS has regular system of planning and managing scientific vision of the Institute. There are supported at AISAS (by Scientific board) **only high ranked** research visions **proved periodically** (every 5 years). The most recent evaluation was done in 2011, just before present accreditation. There must be given clearly in each vision: *"present state of knowledge", "significance of the vision within the field of research", "objectives of the concept" and "proposed strategies and methods to be applied".* Only the following visions which fulfilled criteria of high ranked level of research from both, international and national perspectives and personal guarantee were selected for period 2012-2016:

a) *Physics of the solar photosphere and chromosphere*
b) *Physics of an active solar corona and Sun-Earth connections*
c) *Structure of meteoroid streams and complexes of small bodies of the Solar System, evolution and physical characteristics of the meteoroids parent bodies*
d) *Dynamical evolution of small bodies of the Solar System*
e) *Characterization of dust particles by electromagnetic radiation*
f) *Exoplanets, brown dwarfs and low-mass stars*
g) *Study of activities of selected interacting binaries*
h) *Classical binaries and multiple star systems*
i) *Symbiotic stars and novae*

These perspective research areas guarantee that AISAS will continue its cutting edge research in the next five years

Detailed description of the *Present state of knowledge* for each particular vision, can be found at: http://www.astro.sk/general/scientific_council/devel_studies/ (in Slovak)

3.2. Research strategy of the institute in the national and the international contexts, objectives and methods

Generally, the research strategy in AISAS is focussed to use high quality experimental data and modern interpretational tools in astronomy and astrophysics.
Data are gained from our own modern infrastructure, as well as from high quality instruments worldwide and also from "virtual observatories" - open data archives. There is, in astrophysics, policy to open freely data archives to scientific community. Interpretation is focused on sophisticated methods, modelling and simulations which can bring realistic picture on nature of the investigated phenomena.

Concerning the international cooperation and integation, AISAS has good established contacts and acceptance to be reliable partner in European strategic consortia and centres

Research activities will be done mainly the fields of Solar physics , Stellar astronomy and inretplanetary matter, but in terms of right of freedom in scientific research also interdisciplinary research and fundamental astrophysics will be supported.

*Research activities in the **Solar physics department** will be focused on:*

a) Spectropolarimetric investigation of physical properties of the solar corona, especially magnetic and velocity field in prominences and coronal structures and their temporal evolution with consequences to the near Earth environment – Space Weather

b) investigation of physical conditions and fast dynamics of small the structures of the solar photosphere and chromosphere at distances less than 100 km (a high spatial resolution). Investigation will be focused on temporal evolutions measured with a high temporal resolution. For this the large solar facilities at Canary Islands (GREGOR, VTT, THEMIS and SST telescopes) will be used

c) continuation in the patrol measurements of the solar coronal emission lines and H alpha prominences using them for study of the solar activity cycle and solar-terrestrial relations

d) study of fundamental open problems in the solar physics, i.e. dynamics and mechanisms of the energy production, modification and transfer to upper layers of the solar atmosphere (chromosphere and corona). Wave and nanoflare heating mechanisms are planned to be observationally addressed.

*Research activities in the **Department of interplanetary matter** will be focused on**:***

a) continuation in attempt to fulfil a giant challenge to create a unified theory of the origin of major parts of the Solar System (giant planets, the Kuiper belt and Oort cloud)

b) estimation of dynamical properties of the interplanetary hazardous bodies which come to the vicinity of the Earth and Sun, their space migration and transitional phases among individual populations. Particular attention will be paid to determination of the physical properties of the medium-size main-belt asteroids and sufficiently bright Near-Earth asteroids and comets. Based on observational material obtained by the 1.3-m telescope equipped with top level postfocus devices, we will study an evolution of cometary nuclei at large heliocentric distances in time when coma is absent and we can analyze a naked cometary nucleus

c) using the database of the precise photographic meteor orbits search for minor shower and further to study of mechanisms of generation of the complexes of meteoroids, asteroids and comets, dynamical evolution of the individual members of the complexes, mechanisms of generation of the meteoroid streams up to their contribution to stability of the zodiacal cloud.

d) development of complex theories, of the dynamical behaviour of dust populations consisting of arbitrarily shaped grains and analyze possible erosions processes of the grains. Further an interaction of the irregular particles with an incident electromagnetic radiation will be investigated. An attention will be paid to optical effects by fluffy particles, which typically occur in the space.

*Research activities in the **Stellar department** will be focused on:*

a) study of exoplanets, discovery of new exoplanets, study of their physical parameters, development of the top level theoretical tools for interpretation of observables, search for exoplanets in young open clusters (project YETI), search for circumbinary exoplanets (project Dwarf)

b) determination of the absolute parameters of the components of interacting binaries, to study interactions in binaries with emphasis to systems with eccentric orbits, to study evolution and origin of binaries, to detect binaries in stellar clusters, to detect and study gravitational interaction in multiple systems

c) study of classical novae, cataclysmic variable stars and close binaries to achieve a better understanding of the nature and processes in these objects, namely the outburst stages, mass transfer processes, wind outflow, the nature of the accreting stars and physical reasons of the outbursts

d) study of pre-main sequence stars and young objects, determination of absolute parameters of their components aimed at the calibration of evolutionary models.

Proposed strategies and methods to be applied, and time schedule

*Strategies in the **Solar physics department** in objectives for the next four years*

a) there will be used modern tools – high resolution spectro-polarimetry of the solar corona performed with the state of art instrument *Coronal multi channel polarimeter (CoMP-S)* installed at the Lomnicky Peak Observatory in 2011 and with a new Solar Chromospheric Detector. Close collaboration with colleagues from HAO, Boulder and Univ. of Hawaii (USA) is running in this field

b) inversion of the high spatial and temporal resolution spectral and spectro-plarimetric data taken at top level ground based telescopes (GREGOR, SST, DOT, THEMIS) at Canary Islands will be used together with predictions of the advanced numerical simulations of the convection in the solar atmosphere. Close collaboration with colleagues from Germany, Spain, Sweden and France is planned in this field. The above mentioned FP7 project guarantees for four years an observational time at those facilities

c) important data for investigation of a solar cycle will be acquired regularly at the Lomnicky Peak Observatory with the classical coronagraph and with the attached new instruments. Additional data from the Kanzelhöhe Observatory (Austria) will be used in close collaboration with colleagues from the University Graz

d) problem of the energy production, modification and transfer to upper layers of the solar atmosphere will be addressed using data of observing campaigns performed at ground-based telescopes together with space-borne satellites (SOHO, RHESSI, HINODE, SDO). Close international cooperation is planned for an interpretation of the acquired data – monochromatic images, spectra, spectro-polarimeric data and UV and X-ray data.

*Strategies in the **Department of interplanetary matter** in objectives for the next four years*

a) there will be used state of art tools: massive parallel computing numerical simulations including the most modern codes available. The new own facility – computational cluster bought form Structural funds of EU will be used. This will be done in close, well-developed, cooperation with the leading group in this field at L'Observatoire de la Côte d'Azur (Observatory of Nice). Two computing clusters were obtained from the Structural funds of EU in 2011

b) the best quality and long-term data series will be used to create 3-D models of asteroids. Using the new AISAS facility 1.3 m telescope constructed in the frame of Structural funds of EU (installation in 2013 at the Skalnaté Pleso Observatory) and equipped with high-tech post-focus technology will be used for acquiring data for this purpose

c) within the foreign partnership, we have an intention to model initial conditions of the particle release (ejection velocity distribution and spatial angle) from the parent comets. We will continue in separation the main meteoroid showers from the updated database of the precise photographic meteor orbits and search for minor showers and associations. In cooperation with Astronomical Institute, Ondřejov, Czech Republic we will obtain atmospheric orbits of bolides in the frame of European Bolide Network.

d) modern computational methods will be used, namely light scattering tools (DDA and T-matrix) that represent extensions of the conventional Mie theory. Thanks to close cooperation with German colleagues (Universität Duisburg-Essen, Universität Münster) we have possibilities to proof theoretical results with real “in laboratory radiation influenced“ dust grains.

*Strategies in the **Stellar department** in objectives for the next four years*

a) CCD photometry of exoplanet transits will be obtained with older 60cm telescopes but also with a new 1.3m telescope funded by the Structural funds of EU (installation in 2013 at Skalnaté Pleso Observatory). The new echelle spectrographs will provide medium and high-dispersion spectroscopy to detect and study exoplanets. For theoretical interpretation and modeling of physical picture of exoplanets there will be used state of art codes for advanced simulations.

b) we will continue in CCD photometry to obtain multi-colour light curves and medium-dispersion spectroscopy of close binaries with our facilities. The high-dispersion spectroscopy, and long-baseline interferometry will be obtained in international collaboration. We will model the observations using our own codes ROCHE and SHELLSPEC to determine the basic parameters of the components, and to determine distances to the objects.

c) we will use long-term photometry as well as high-resolution spectroscopy for studying details in the electromagnetic spectrum of active stars. We plan to develop more sophisticated model of the energy distribution in the composite spectra of symbiotic and cataclysmic binaries to build better picture of fundamental parameters and photometric behaviour of them multi-frequency observational approach (X-ray, UV, visible and IR) will be used to gain the data and modelling processes of ionization, Raman and Rayleigh scattering, acting in these binaries, will be applied to understand the structure of active objects during outbursts and mass-outflows. Our own software will be applied. Satellite observation will be used outside the visual domain.

d) Photometric and spectroscopic observations of pre-main-sequence objects (focusing on binaries) will be performed with our own facilities but also within international collaboration. Infrared photometry will be used to better characterize the cold components.

Project proposals submited to 7RP or H2020	**2012**	**2013**	**2014**	**2015**
Institute as coordinator				
Institute as participant	2	0	1	1

4. Other information relevant for the assessment

Tatranská Lomnica, July 30, 2016

RNDr. Aleš Kučera, CSc.
Director of the Institute

Annex 1: EST ESFRI Sheet:

An advanced telescope for observing the Sun and its magnetic activity

EST
European Solar Telescope

TYPE: single-sited
COORDINATING COUNTRY: ES
PROSPECTIVE MEMBER COUNTRIES: ES, SE, UK

PARTICIPANTS: AT, CH, CZ, DE, FR, HR, HU, IT, NL, NO, PL, SK

TIMELINE
- ESFRI Roadmap entry: 2016
- Preparation phase: 2011-2019
- Construction phase: 2019-2025
- Operation start: 2026

ESTIMATED COSTS
- Capital value: Not Available
- Preparation: 10 M€
- Construction: 200 M€
- Operation: 9 M€/year

HEADQUARTERS
Instituto de Astrofísica de Canarias
Canary Islands
Spain

WEBSITE
http://www.est-east.eu/

SPAIN

Description
The European Solar Telescope (EST) is a 4-metre class telescope dedicated to study the fundamental processes in the Sun that control the solar atmosphere and its activity and the physical conditions in the heliosphere. EST will be optimized for high-resolution multi-wavelength simultaneous multi-instrument observations of the photosphere and chromosphere, as well as magnetic structures therein. One aim is to address the still unresolved and difficult question concerning the emergence of magnetic fields at the solar surface and transfer of magnetic and kinetic energy from subsurface layers to the solar atmosphere. This is the key question for understanding how the magnetic field is controlling the solar atmosphere and its activity. As the Sun is the only star at which photospheric and chromospheric features can be resolved, these observations will be of astrophysical wide relevance. Understanding the interaction of plasmas with magnetic fields has many technological application, e.g. in fusion nuclear reactors. Space missions are also tributary of data from ground solar telescopes.

Background
The solar physics community was involved in the development of the project from the beginning: i) creation of the EAST consortium, ii) elaboration of the conceptual design study, iii) I3 Trans-National Access network SOLARNET and iv) GREST project. The solar astronomy community is organized through SOLARNET and ASTRONET and operates with success, since the last decades, a set of national observing facilities and infrastructures on the Canary Islands including the Swedish Solar Telescope, the DOT, the VTT, GREGOR and THEMIS, most of which are approaching the end-of life stage. These national observatories shall be decommissioned or reoriented to become test facilities for detector development or to educational programmes, and the research programme shall concentrate to the EST. Key elements of the landscape are the space missions, in particular the ESA Solar Orbiter programme to be launched in 2018, and the US Daniel K. Inouye Solar Telescope (DKIST, formally the Advanced Technology Solar Telescope ATST), currently being built in Hawaii. DKIST is an asymmetric telescope with an observation programme concentrated on the Sun's corona and linked with space missions. EST has the same diameter (4m) but it is symmetric and optimized to detect light polarization as it is mandatory for the study of the emergence of magnetic fields at the solar surface and transfer of magnetic and kinetic energy from subsurface layers to the solar atmosphere. A significant advance can be achieved by obtaining observations, of the lower/cooler part of the solar atmosphere, with greatly improved spatial and temporal resolutions. The behaviour of the solar atmosphere in response to the input of magnetic energy is then observable with space instrumentation. The combination of space and ground-based instrumentation will allow a throughout comprehension of the solar magnetic dynamics.

Steps for implementation
EST will be built in the Canary Islands, where the current aging telescopes are already situated. This will give continuity and increase the importance of the scientific parks existing at present in the islands. Operation of the telescope will progressively implement "queue-mode" observing, which is standard for night-time telescopes, allows optimisation of the observations, and does not require on-site presence of the beneficiary. 30% of the observing time will be through open calls for proposals, and the open access data policy (after a one year proprietary period) allows access to the whole interested scientific community. Siting will be decided between the Tenerife or Roque de los Muchachos both at 2.400 m of altitude in the Canary Islands along with sea-level and mainland facilities including the TOSC (Telescope Operation and Science Center) to steer the operation of the EST and the Science Data Center in Germany, to provide data storage and access to the solar physics community.