Slovak Academy of Sciences Programme | SASPRO

SASPRO

Interim report

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Project acronym: Ivanova1978

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A) PROJECT INTERIM REPORT

A1) Publishable project summary - English version

The main goals of the present project are to study physical properties of atmospheres and tails in dynamically new comets and to compare them with those of comets from other dynamical groups. Currently, attempts are underway to establish taxonomy of comets on the basis of their composition and to link it to the place of their origin. A comparison of physical characteristics of short-period comets with those of long-period and new comets may elucidate which properties of comets are primordial and which are a product of subsequent evolution. Physical properties of the body mainly depend on genetic factors such as stratification of temperature with distance from the Sun, structure and density on the surfaces of bodies, the ratio of volatile and refractory materials, and so on. However, the role of evolutionary processes that have determined the dynamics of small bodies, sources of internal energy, etc., can also be significant. It is recognized that the temperature gradient in the initial dust cloud and the presence of massive proto-planets influenced the processes of accumulation, formation and evolution of small bodies in the Solar System. This process results in different properties of bodies in the main asteroid belt (the difference between the properties of main types of asteroids S, C, E, etc.), objects of the Kuiper Belt, and the Oort cloud. Collisions, dynamic, and evolutionary processes have generated in the Solar System objects with transient properties - meteoroid streams, objects such as Centaurs, comets with dynamic characteristics of the main asteroid belt, comets of different classes regarding polarization, thermal properties, and dormant cometary nuclei.

The main goal of the first year of work is a comprehensive study of the observed characteristics of the radiation scattered by dust particles and gas properties of comets of different dynamical groups in the Solar System. Dust and gas are parts of atmospheres of comets, active centaurs, and also a new class of objects - comets of the main asteroid belt. Dust and gas play an important role in the process of forming different bodies and in their evolution. The main observable characteristics of scattered radiation, such as intensity, color, polarization, their spatial and spectral characteristics depend on a mechanism of scattering of light on the dust particles and physical properties of dust which are size, composition, structure, and form. So, a study of properties of radiation scattered by dust particles of different objects is the basis for the development of theoretical ideas about the interaction of radiation with matter, building physical and cosmological models of celestial bodies.

During reported period, complex observations and data analysis of dust properties for 16 new objects (10 distant comets with perihelion more than 4 au, 6 dynamically new comets, 1 active centaur, 1 “active” asteroid and 3 short-period comets) were made. We obtained data using different telescopes: big-sized - the 6-m SAO RAS telescope (Russia), the 4.1-m SOAR telescope (Chili), the medium-sized 2-m telescope p. Terskol (Russia), and small-sized - the 0.80-cm (Ukraine), 0.61-m Skalnate Pleso (AI of SAS), 0.60-m p. Terskol (Russia), 0.40-m Kourovka AO (Russia), 0.20-m telescopes (Belgium). We used different observational methods: photometric (using BVRI broadband filters, cometary filters), spectral (long-slit spectroscopy), and polarimetric observations of the selected objects. The data obtained in the previous observation period were processed and analyzed. The software for data processing and model analysis of the data was upgraded. We used the original methods and mathematical modeling of physical processes for interpretation of results. Based on data analysis, we estimated the optical properties of the selected comets, “active” asteroids and centaurs. We also tried to find a connection between their physical and dynamic characteristics to identify features associated with different areas of their formation in the Solar System or a different kind of evolution.

Observations and analysis of data for comet 67P / Churyumov-Gerasimenko within the program of the ground-based support of the ROSETTA cosmic mission were the most important results obtained during reported period. We obtained many physical characteristics of the comet, including an estimation of gas and dust productions, which confirmed that the comet 67P / Churyumov-Gerasimenko corresponds a class of “depleted” in carbon. We were found that cometary dust production rate is decreased in 4 times during observation period. Identified radial changes of polarization and color of cometary coma correspond the evolution properties of dust particles. Model interpretations of obtained data showed a decline in sizes of average particles with increasing of distance from the cometary nucleus. This may be caused by the disintegration of particles due to fragmentation and sublimation.

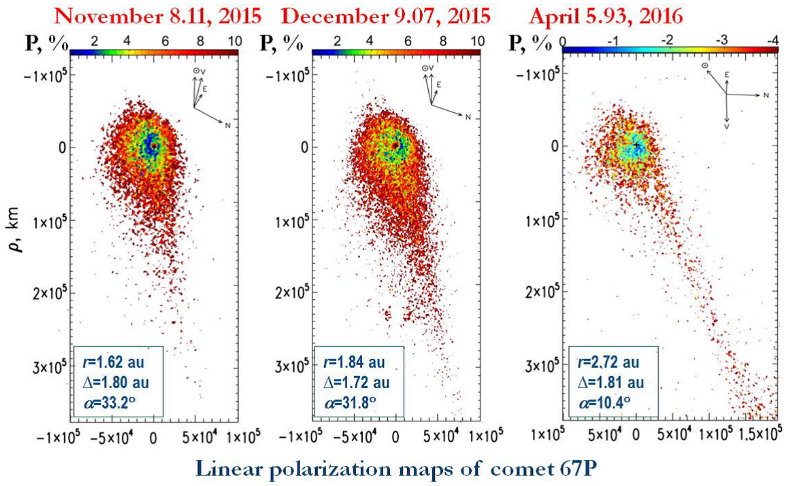


Fig.1 Linear polarization maps of comet 67P/Churyumov-Gerasimenko: there is a complex structure of the coma in polarized light with areas of high and low polarization.

Hence, determination of physical characteristics and optical properties of particles of various populations of small bodies in the Solar System allows one to identify similarities and differences in these characteristics depending on location and their relationship with the dynamic characteristics. The results will be used to build physical and cosmological models of the objects and will allow the fundamental problems of origin and evolution of the Solar System to be solved.

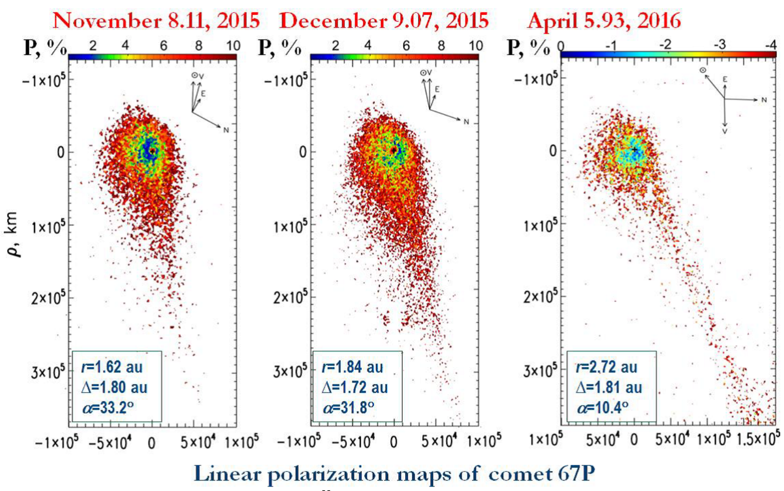
Publikovateľné zhrhnutie projektu – slovenská verzia

Hlavným cieľom predkladaného projektu je štúdium fyzikálnych vlastností atmosféry a chvostov dynamicky nových komét a porovnanie s kométami ostatných dynamických skupín. V súčasnej dobe prebiehajú pokusy zaviesť taxonómiu komét na základe ich zloženia a prepojiť to s miestami ich vzniku. Porovnanie fyzikálnych vlastností krátkoperiodických komét s dlhoperiodickými a novými môže objasniť, aké vlastnosti komét sú prvotné a ktoré sú produktom následnej evolúcie. Fyzikálne vlastnosti telesa závisia predovšetkým na genetických faktoroch, ako napríklad rozvrstvenie teploty so vzdialenosťou od Slnka, štruktúra a hustota látky na povrchu telies, pomer prchavých a pevných materiálov, a pod. Avšak úloha evolučných procesov, ktoré určujú dynamiku malých telies, vnútorných zdrojov energie, a pod., môže tiež byť významná. Je známe, že teplotný gradient v zárodočnom oblaku prachu a prítomnosť masívnych proto-planét ovplyvnili proces akumulácie, formovania a evolúcie malých telies v Slnečnej sústave. Výsledkom tohto procesu sú rozličné vlastnosti telies v hlavnom páse asteroidov (rozdiel medzi vlastnosťami hlavných typov asteroidov S, C, E, atď.), objektov v Kuiperovom páse a Oortovom oblaku. Kolíziami a dynamickými a evolučnými procesmi vznikli v Slnečnej sústave objekty s prechodnými vlastnosťami – prúdy meteoroidov, objekty ako kentaury, kométy s dráhovými vlastnosťami hlavného pásu asteroidov, kométy rôznych skupín líšiace sa polarizáciou a tepelnými vlastnosťami a spiace kometárne jadrá.

Hlavným cieľom prvého roku činnosti je komplexné štúdium pozorovaných charakteristík žiarenia rozptýleného prachu a vlastností plynov u komét z rôznych dynamických skupín v Slnečnej sústave. Prach a plyn sú súčasťou atmosfér komét, aktívnych kentaurov, aj novej triedy objektov - komét hlavného pásu asteroidov. Prach a plyn hrá dôležitú úlohu v procese formovania rôznych telies a v ich vývoji. Hlavné pozorovateľné charakteristiky rozptýleného žiarenia, ako je intenzita, farba, polarizácia, ich priestorové a spektrálne charakteristiky závisia na mechanizme rozptylu svetla na prachových častíciach a fyzikálnych vlastnostiach prachu, ktorými sú veľkosť, zloženie, štruktúra a forma.Takže štúdium vlastností žiarenia rozptýleného prachovými časticami pre rôzne objekty, je základom pre vytvorenie teoretickej predstavy o interakcii žiarenia s látkou a budovanie fyzikálnych a kozmologických modelov nebeských telies.

Počas sledovaného obdobia boli vykonané komplexné pozorovania a analýza charakteristík prachu pre 16 nových objektov (10 vzdialených komét s perihéliom väčším ako 4 AU, 6 dynamicky nových komét, 1 aktívneho kentaura, jedného "aktívneho" asteroidu a 3 krátkoperiodických komét). Údaje sme získali

pomocou rôznych tried ďalekohľadov: veľkých - 6-m ďalekohľadu SAO RAS (Rusko), 4,1-m SOAR ďalekohľadu (Chile), stredných - 2-m ďalekohľadu Pik Terskol (Rusko), a malých - 0,80 m (Ukrajina), 0,61-m Skalnaté pleso (AsÚ SAV), 0,60-m Pik Terskol (Rusko), 0,40-m Kourovka AO (Rusko), 0,20-m ďalekohľady (Belgicko). Použili sme rôzne pozorovacie metódy: fotometrické (pomocou BVRI širokopásmových filtrov a kometárnych filtrov), spektrálne (štrbinová spektroskopia), a polarimetrické pozorovania vybraných objektov. Spracovali a analyzovali sme aj pozorovacie údaje získané v predchádzajúcom období. Aktualizovali sme softvér na spracovanie dát a modelové analýzy. Na interpretáciu výsledkov sme použili originálne metódy a matematické modelovanie fyzikálnych procesov. Na základe analýzy dát sme odhadli optické vlastnosti vybraných komét, "aktívnych" asteroidov a kentaurov. Tiež sme sa snažili nájsť súvislosť medzi ich fyzikálnymi a dynamickými vlastnosťami, čo by umožnilo nájsť spojitosť s rôznymi oblasťami ich vzniku v Slnečnej sústave alebo rôznymi scenármi vývoja.
Pozorovanie a analýza dát kométy 67P/Čurjumov-Gerasimenko v rámci pozemnej podpory kozmickej misie Rosetta boli najdôležitejšími výsledkami získanými počas sledovaného obdobia. Získali sme mnoho fyzikálnych charakteristík kométy, vrátane odhadu produkcie plynu a prachu, ktorá potvrdila, že kométa 67P/Čurjumov-Gerasimenko zodpovedá triede komét "chudobných" na uhlík. Zistili sme, že produkcia kometárneho prachu klesla v priebehu sledovaného obdobia 4 násobne. Identifikované radiálne zmeny polarizácie a farba kometárnej kómy zodpovedajú vlastnostiam počas evolúcie prachových častíc. Modelové interpretácie získaných dát ukázali pokles veľkosti priemeru častíc s rastúcou vzdialenosťou od kometárneho jadra. To môže byť spôsobené rozpadom častíc vďaka fragmentácii a sublimácii.



Obr.1 Mapy lineárnej polarizácie kométy 67P/Čurjumov-Gerasimenko: Zaznamenali sme zložitú štruktúru kómy v polarizovanom svetle s oblasťami vysokej a nízkej polarizácie.

Teda, stanovenie fyzikálnych a optických vlastností častíc rôznych populácií malých telies v Slnečnej sústave nám umožní identifikovať podobnosti a rozdiely v týchto charakteristikách v závislosti na mieste výskytu telies a tiež určiť ich vzťah k dynamickým charakteristikám. Výsledky budú použité na vytvorenie fyzikálnych a kozmologických modelov objektov a umožnia riešenie základných problémov pôvodu a vývoja Slnečnej sústavy.

A2) Work progress and achievements during the reporting period

Work progress

All tasks planned for 2016 have been fully performed. We made complex observations and data analysis of dust properties for 16 new comets using different modes of observation and telescopes. The data obtained in the previous observation period were processed and analyzed. The software for data processing and model analysis of the data was upgraded.
Objects: dynamically new comets, short-periodic comets, “active” asteroids, centaurs.
Goal: To study optical properties of the selected comets, “active” asteroids, centaurs, Trans-Neptunian Objects and to search for connection between their physical and dynamic characteristics to identify features associated with different areas of their formation in the Solar System or a different kind of evolution. The observed data obtained by the principal investigator (PI) of the presented project in the

past were also included.

Methods: photometric (using BVRI broadband filters, cometary filters), spectral (long-slit spectroscopy), and polarimetric observations of the selected objects and interpretation of results using the original methods and mathematical modeling of physical processes. We obtained photometric observations, long-slit spectroscopy, and image polarimetry of the selected comets with a higher level of activity at large heliocentric distances (r>4 au).

Telescopes: We obtained data using different telescopes: big-sized - the 6-m SAO RAS telescope (Russia), the 4.1-m SOAR telescope (Chili), the medium-sized 2-m telescope p. Terskol (Russia), and small-sized - the 0.80-cm (Ukraine), 0.61-m Skalnato Pleso (AI of SAS), 0.60-m p. Terskol (Russia), 0.40-m Kourovka AO (Russia), 0.20-m telescopes (Belgium).

During the reporting period, we obtained: polarimetric, photometric, and spectral observations of comets, "active" asteroids, centaurs. During this period, we observed 10 distant comets with perihelion more than 4 au, 6 dynamically new comets, 1 active centaurs, 1 "active" asteroids and 3 short-period comets.

New results of numerous observational programs are as follows:

- The linear polarization of five distant comets: C/2014 A4 (SONEAR), C/2013 V4 (Catalina), C/2014 N3 (NEOWISE), C/2011 KP36 (Spacewatch),and C/2015 VL62 (Lommon-Yeung-PanSTARRS) was measured for the first time ever at such large heliocentric distances. Polarization maps of the comets showed spatial variations of the polarization over the coma from about –2% up to –4% that may be related to changes in the physical properties of dust particles (Fig.1). Average values of polarization are significantly higher (in absolute values) than the typical value of polarization (~1.5%) observed for the whole coma of most comets close to the Sun.

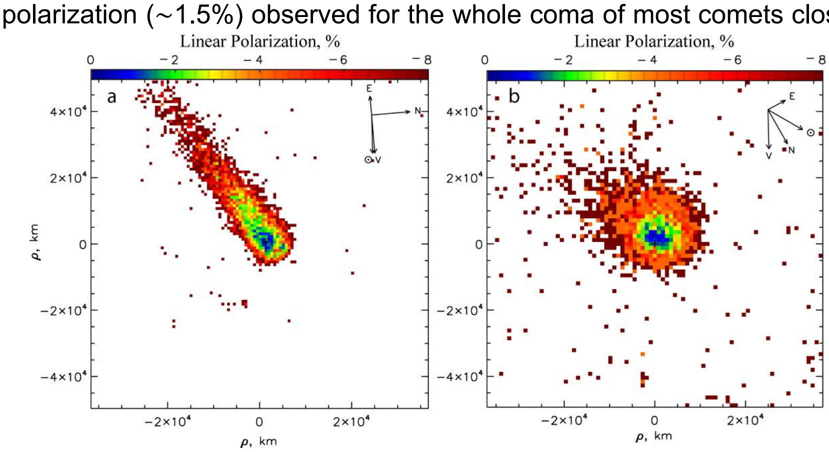


Fig.2. Polarization map of distant comets C/2014 A4 (SONEAR) (a) and C/2013 V4 (Catalina) (b). The arrows show the directions to the Sun, North, East, and motion of the comet.

- We analyzed the obtained spectra for comets belonging to different dynamical groups including distant comets. We analyzed the spectra of distant comets C/2014 A4 (SONEAR), C/2013 V4 (Catalina), and C/2014 N3 (NEOWISE) to search for gas emission. No emission lines could be detected with our spectroscopic observations of these comets.
- We obtained new observations of an outburst of Centaur 174P/Echeclus at a heliocentric distance of 6.2 au and determined dust production rates and dust colors. We found changes in the dust productivity and morphology of the coma compared to the last outburst.

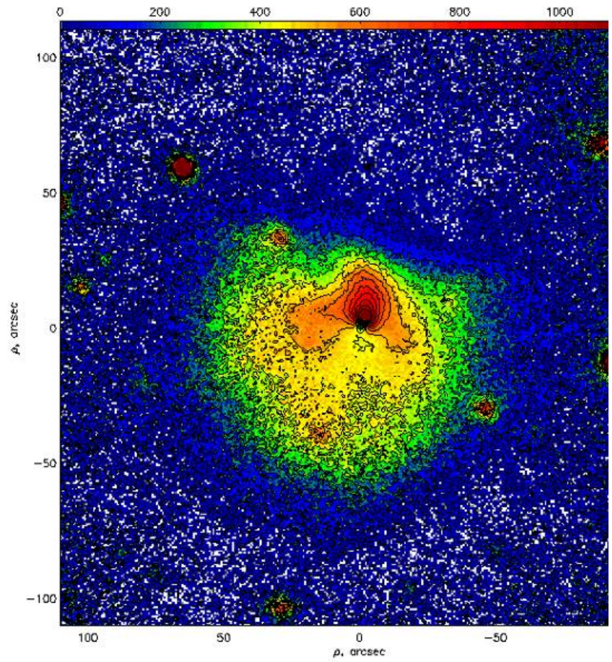


Fig.3. Morphology of the dust coma of the active Centaur 174P/ Echeclus during a new outburst on September, 2016.

- Investigation of a new class of objects – “active” asteroid (596) Scheila during and after completion of its activity. According to our information, the radius of this object is 55.3 ± 4.0 km and during the active period it released (1.3 ÷ 2.9) x 10^7 kg of the substance. The changes of the brightness of Scheila: the maximum amplitude is 0.20 ± 0.02^m in the B and V bands. The color indice, not previously known, were measured: B-V = 0.665 ± 0.016 ^{m}; V-R = 0.232 ± 0.035 ^{m}; R-I = 0.640 ± 0.048 ^{m}.

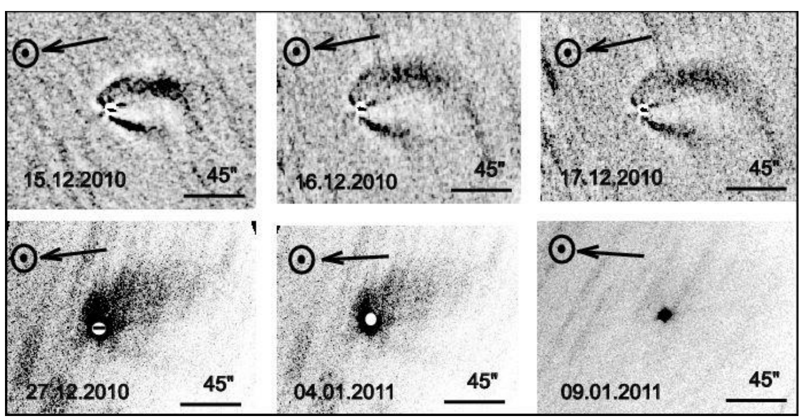


Fig.4. The R band images of (596) Scheila taken in six nights and processed with digital filters. The structure of the outburst has changed during the time of observation. After January 9, 2011, we could not detect the dust environment. We observed Scheila as a stellar object.

- The polarimetric, photometric, and spectral observations of the comet from the Oort cloud C/2009 P1 (Garradd) were obtained. The post-perihelion observations of the comet were performed at the 6-m BTA telescope of the Special Astrophysical Observatory (Russia) equipped with the SCORPIO-2 multi-mode focal reducer. Heliocentric distance changed between 1.64 and 2.23 au, geocentric distance between 1.39 and 1.97 au, and phase angle - between 36° and 27°. Spatial maps of relative intensity and circular polarization as well as spectral distribution of linear polarization are presented. Two features (dust and gas tails) oriented in the solar and antisolar directions were detected in the treated images of the comet that allowed us to determine the period of rotation of the nucleus as 11.1±0.8 hours. Emission features produced by the C_2, C_3, CN, CH, and NH_2 molecules as well as CO^+ and H_2O^+ ions were identified in the spectra of Comet Garradd. The C_2 Swan bands (Δv=-1, Δv=0, and Δv=+1 sequences) were the strongest, although the NH_2 emissions were also quite strong in the coma. The degree of linear polarization in the continuum, within the wavelength range of 0.67–0.68 μm, was about 5±0.2% in the near nucleus region up to ~6000 km and decreased to about 3±0.2% at ~40 000 km. After correction for the continuum contamination, the inherent degree of polarization in the C_2 emission band (Δv=0) was about 3.3%. We detected a small increase of polarization with wavelength with the spectral gradient $\Delta P/\Delta\lambda$=+4±0.8 %/mm and $\Delta P/\Delta\lambda$=+6.2±1.3 %/mm. Linear polarization of Comet Garradd is consistent with that for so-called dust-rich or high-P_{max} class of comets. The left-hand (negative) circular polarization at the level of approximately from -0.06±0.02% to -0.4±0.02% was observed at distances up to 3×10^4 km from the nucleus.

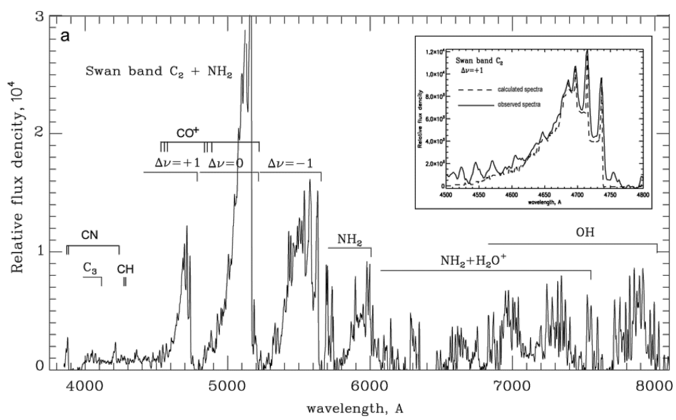


Fig.5. The spectra of Comet Garradd obtained in 2012. The sky background and sunlight reflected by cometary dust particles in the coma have been subtracted. The inset shows the observed spectrum (solid line) and the modeled spectrum (dashed line) of the Swan bands C_2 (Δv=+1) (top panel) and C_2 (Δv=0) (bottom panel) for comparison.

- We also observed the short-period comet 67P/Churyumov-Gerasimenko at the 6-m SAO RAS telescope within the program of the ground-based support of the ROSETTA cosmic mission. The analysis of the long-slit spectra of Comet 67P/Churyumov-Gersimenko on November 8 and December 9, 2015 at r=1.61÷1.84 au showed emissions CN, C_2, C_3, and NH_2. The CN emission only was detected in the spectrum of the comet on April 4, 2016 at r=2.72 au. Production rates for the gaseous molecules CN, C_2, C_3, and NH_2 were obtained. The value log[C_2/CN]= – 0.43 corresponds to a class of "depleted" comets. The cometary activity level, measured by the Afr parameter, varied from 148 to 172 cm at r=1.61÷1.84 au, while at r=2.72 au the Afr values were about 50 cm. The normalized reflectivity gradient for Comet 67P decreased with a heliocentric distance from 12.5%/1000 Å to 11.3%/1000 Å.

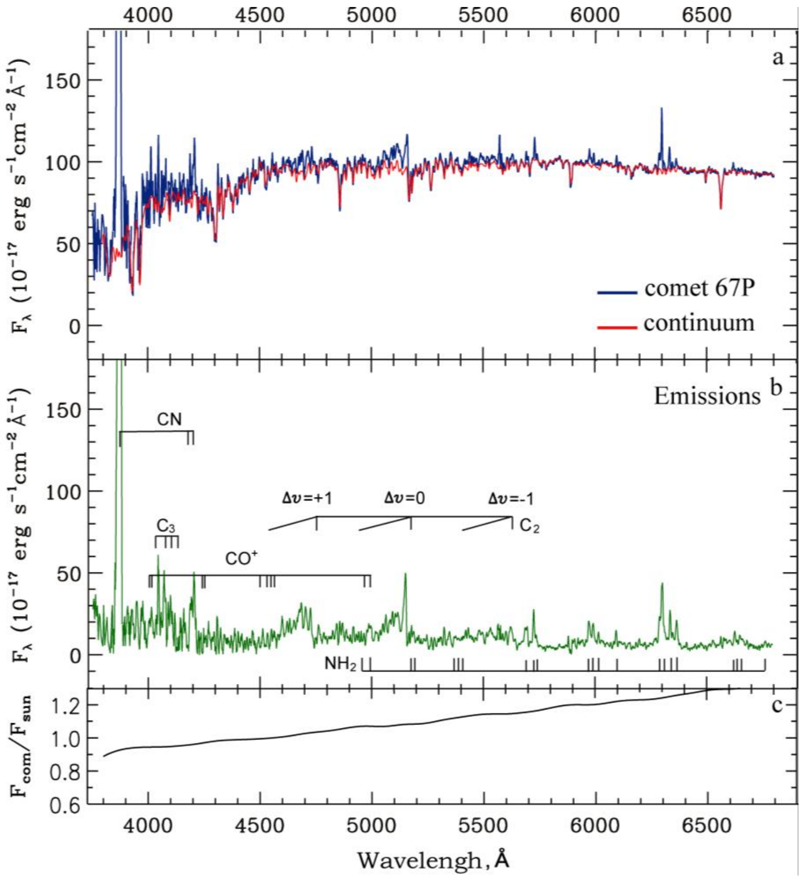


Fig.6. The spectrum of 67P obtained on November, 8, 2015: a) the observed spectrum with the superimposed continuum; b) the "observed spectrum − fitted continuum"; c) the polynomial correction of the solar spectrum.

- The analysis of polarization and color maps of the comet showed that near-nucleus area is redder and more polarized than the adjacent coma; the coma becomes more blue with increasing distance from the nucleus; near-nucleus polarization drops sharply from ~8% to ~2% at 5000 km; polarization of the coma increases with distance from the nucleus, reaching ~8% at 40000 km; the radial variations of polarization and color suggest evolution of the particle properties. Higher polarization and bluer color measured at larger projected radii are consistent with the decrease in the mean grain size with increasing distance from the nucleus which can be caused by disintegration of porous aggregates.

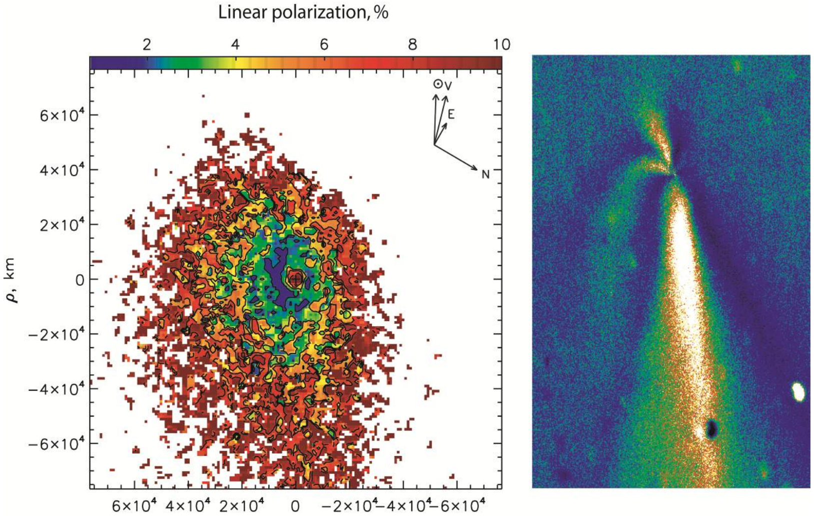


Fig.7. A complex structure of the coma in polarized light (left-hand image), two long-live jets and a tail (middle image) were seen in Comet 67P/Churyumov-Gerasimenko on November 2015.

- We investigated the relevant dynamical evolution of the short-period comet 29P/ Schwasmann-Wachmann 1 to point out its most probable site of origin and range of its migration in the inner Solar System. We numerically integrated the nominal orbit of the comet as well as the orbits of 100 clones mapping the phase space, in which the actual orbit of the comet could be situated in respect to the orbit-determination uncertainty. Non-gravitational effects which are stochastic and can thus be hardly traced are not considered. We confirm that 29P came, most probably, from the Oort cloud. And it will be ejected into the interstellar space. The cometary orbit has largely changed during its residing in the inner Solar System.
- Spectral observations of the short-period comet 29P/Schwasmann-Wachmann 1 confirmed our early observations of the objects about identification of N_2^+, and suggesting that the comet was formed in a low-temperature (about 25 K) environment.

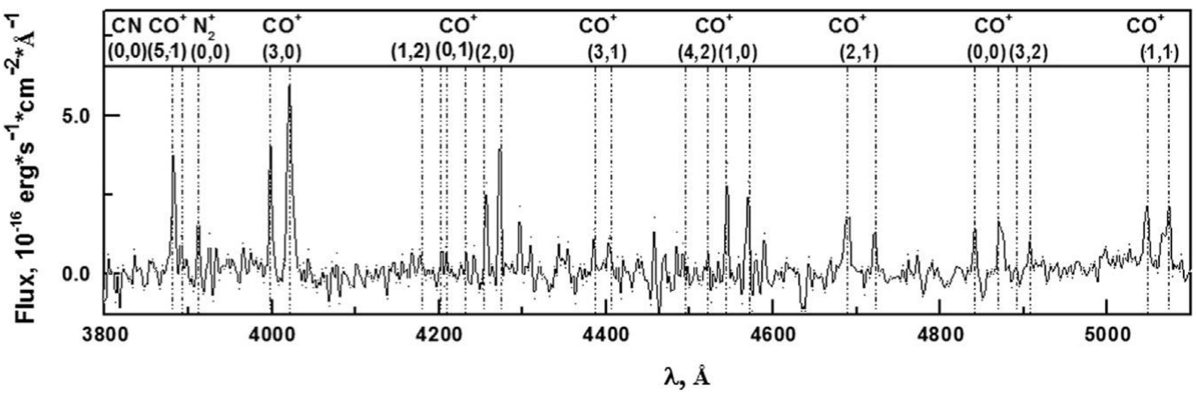


Fig.8. Molecular emissions identified in the observed spectrum of the comet 29P/Schwasmann-Wachmann 1.

- We have measured the color slope in the inner coma (< 4000 km) of Comet C/2013 UQ4 (Catalina) and found rapid variations on a scale of one-two days (Fig.9).

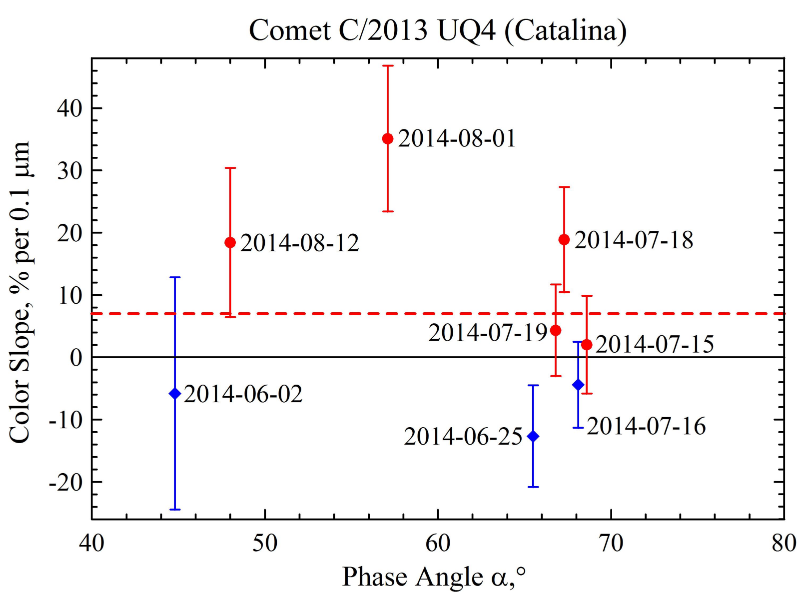


Fig. 9. The color slope as a function of phase angle in Comet C/2013 UQ4 (Catalina). Red dots and blue diamonds show positive and negative values of the color slope respectively. Every data point is labeled with the corresponding date of observation. The red dashed line shows the average color slope for eight available observations.

- We noticed that Comet Catalina is not a unique case in this sense. We computed the average color slope in Comet Catalina over eight available observations. We found, however, that it cannot adequately characterize the color of Comet Catalina due to the large dispersion of the results obtained on different epochs. Therefore, we analyzed the whole range of values of the color slope in Comet Catalina. Using the model of irregularly shaped agglomerated debris particles (Fig.9.) we retrieved physical and chemical properties of the dust in Comet Catalina on the epochs, when it revealed its reddest and bluest colors. All the intermediate values of the color slope in Comet Catalina can be explained in terms of different volume ratios of the two principle components. Our modeling also suggests that the dust particles in both components obey a power-law size distribution r^{-n} with the index n being consistent with in situ findings in comets.

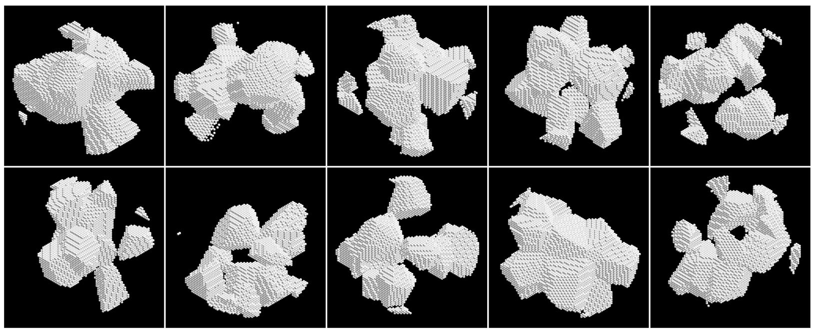


Fig.10. Ten examples of the agglomerated debris particles.

- The resulting polarization phase depending on the selected position in the Solar System, confirmed an earlier suggestion that polarization objects located in the outer part of the Solar System are far different from the polarization of the objects inside. Identified differences in polarization characteristics of these objects are likely determined by a chemical composition, i.e., places of origin in the Solar System. On the other hand, insolation varies depending on the distance from the Sun, leading to varying degrees of processing of celestial body surfaces and cometary nuclei.

The results were presented in **6** manuscripts, **11** oral and poster presentations on **6** international conferences.

Impact of the SASPRO project

This year (working with the SASPRO project) allowed me to participate in different conferences and workshops. Conferences were very important for creation new collaborations with scientists from different countries and institutes. During the reporting period, I was invited to hold 3 seminars in Germany and Brazil. I was included in the international program “Morphology of 4*P comets”. My investigation of Comet 67P/Churyumov-Gerasimenko was included in a big international article about ground-based observations of Comet 67P as a part of the ROSETTA program. The collaboration work with colleagues from the Host organization allowed me to include in my work a new topic about modeling of migration of comets in the Solar System during formation and evolution. Together with Dr. Svoreň, we also began to prepare the course of lectures on “Physics and chemistry of comets” for Slovak students. I also began new investigations as a part of the project together with my colleagues from SAO RAS about observations of bright comets at the 6-m telescope with Fabry-Perot etalon. We made scans to search for the [0I]λ6300 emission line in order to estimate oxygen production of comets.

Deliverables / Activities

During the report period the results were published in 7 manuscripts, presented in 11 oral and poster presentations on 6 international conferences. The results obtained during the report period are presented in 1 accepted article and 2 submitted ones. All research results were presented on 6 international conferences and workshops. First results about gas and dust properties in comets from different dynamical groups were presented on seminar in Astronomical Institute of SAS. We wrote 3 international agreements between AS of SAS and Research Institutions in Russia. Our group was included in the international program "Morphology of 4*P comets". Our results of investigation of Comet 67P/Churyumov-Gerasimenko were included in a big international article about ground-based observations of Comet 67P as a part of the ROSETTA programme. We wrote 4 proposals at different international telescopes. During the report period I am active working with my PhD student - Olena Shubina and we finished upgrading a new version of the database of comet polarimetry (DBCP V2.0). We wrote 3 proposals for international grants and one was supported.

Title: Observation of dynamically new comets at different heliocentric distances

Deliverable Type: Proposal to telescope time

Accepted:

1. 6-m SAO RAS (observation time, January 18 to February 4, 2017)
2. 2-m telescope p. Terskol (Russia/Ukraine)

Submitted:

1. 6-m SAO RAS (Russia)
2. 4.1-m SOAR (Chili/Brazil)

Title: 4*P Coma Morphology Campaign

Deliverable Type: International science program

Our group including in international observation program "4*P Coma Morphology Campaign". This campaign is nearly identical to what we carried out for Comet ISON (C/2012 S1) and is aimed at achieving science objectives facilitated by multi-longitudinal observations during the upcoming close approaches of comets 41P/Tuttle-Giacobini-Kresak (hereafter 41P/TGK) and 45P/Honda-Mrkos-Pajdusakova (hereafter 45P/HMP) in 2017 and comet 46P/Wirtanen in 2018.

Title: International Agreements

Deliverable Type: International collaborations

1. On the cooperation between the Special Astrophysical Observatory of the Russian Academy of Sciences and the Astronomical Institute of the Slovak Academy of Sciences, Slovak Republic for the period of 2017-2018.
2. On the cooperation between the Federal State Autonomous Educational Institution of Higher Professional Education "Ural Federal University" (Ural, Russia) and the Astronomical Institute of the Slovak Academy of Sciences, Slovak Republic for the period of 2017-2018.
3. Memorandum of understanding between Federal State Autonomous Educational Institution of Higher Education "Far Eastern Federal University" (Vladivostok, Russian Federation) and Astronomical Institute of the Slovak Academy of Sciences (Tatranská Lomnica, Slovak Republic).

Title: Special interview for Ukrainian journal WOMO about Astronomy and Women in Science

Deliverable Type: Popularisation activity

http://womo.ua/aleksandra-ivanova-o-professii-astronoma/

Title: submitted during the report period

Deliverable Type: Publishing activity (according to the Directive)

1. Ivanova O. V., Rosenbush V. K., Afanasiev V. L.б Kiselev N. N., Korsun P.P. 2016. Post-perihelion spectral observations of comet 67P/Churyumov-Gerasimenko. Monthly Not. Roy. Astron. Soc.
2. Ivanova O., E. Zubko, G. Videen, Z. Seman Krišandová, Ján Svoreň, S. Borysenko, A. Novichonok Color variations of Comet C/2013 UQ4 (Catalina). Monthly Not. Roy. Astron. Soc.
3. V. Rosenbush, O. Ivanova, L. Kolokolova, N. Kiselev, V. Afanasiev. Spatial variations of brightness, color, and polarization of dust in comet 67P/Churyumov–Gerasimenko. Monthly Not. Roy. Astron. Soc.

Title: accepted during the report period

Deliverable Type: Publishing activity (according to the Directive)

1. Snodgrass C., A'Hearn M. F., Aceituno F., Afanasiev V., …, Ivanova O., …, Kiselev N., …, Rosenbush V. et al. 2016. The 67P/Churyumov-Gerasimenko observation campaign in support of the Rosetta mission. 2016. Philosophical Transactions A, 1-21.

Title: published during the reporting period

Deliverable Type: Publishing activity (according to the Directive)

1. Ivanova A.V., Lukyanyk I.V., Kiselev N.N., Afanasiev V.L., Picazzio E., de Moraes O. C., de Almeida A.A., da Costa R.D.D., Andrievsky S.M. 2016. Photometric and spectroscopic analysis of the comet 29P/Schwassmann–Wachmann 1 activity. Planet. Space Sci. 121, 10–17.
2. P. Korsun, I. Kulyk, O. Ivanova, O. Zakhozhay, V. Afanasiev, A. Sergeev, and S. Velichko. Optical spectrophotometric monitoring of comet C/2006 W3 (Christensen) before perihelion. 2016. Astron. Astrophys.596, A48.
3. Kulyk I., Korsun P., Rousselot P., Afanasiev V., Ivanova O. 2016. P/2008 CL94 (Lemmon) and P/2011 S1 (Gibbs): comet-like activity at large heliocentric distances. Icarus 271, 314–325.
4. Neslusan L., Ivanova O., Husarik M., Svoren J., Krisandova Z.S. 2016. Dustproductivity and impact collision of the asteroid (596) Scheila. Planet. Space Sci. 125, 37–42.
5. Andrienko Yu. S., Golovin A.V., Ivanova A.V., Reshetnik V.N., Kolesnik S.N., Borisenko S.A. 2016. A photometric and dynamic study of comet C/2013 A1 (Siding Spring) from observations at a heliocentric distance of ~4.1 AU. Solar System Res. 50, Issue 2, 102–112.
6. Ivanova O., Rosenbush V., Afanasiev V., Kiselev N. 2017. Polarimetry, photometry, and spectroscopy of comet C/2009 P1 (Garradd). Icarus. 284, 167–182.
7. Ivanova, O., Borysenko, S., Zubko, E., Krišandová, Z. S., Svoreň, J., Baransky, A., & Gabdeev, M. (2016). Comet C/2011 J2 (LINEAR): Photometry and stellar transit. Planetary and Space Science, 122, 26-37.

Title: Comparative analysis of gas and dust properties in comets of different dynamical groups

Deliverable Type: Seminar

Currently, attempts are underway to establish a taxonomy of comets on the basis of their composition and to link them to the place of their origin. A comparison of physical characteristics of short-period comets with those for long-period and new comets (in the Oort sense) may elucidate which properties of comets are primordial and which are a product of subsequent evolution. Study of spectrophotometric and polarization properties of different comets may also provide classification of comets and understanding the main processes of dust and gas formation in the protosolar nebula. In addition, spectrophotometric and polarimetric characteristics of comets may indicate differences in the properties of dust and gas on the surface and inside of nuclei through observations of jets and different fragments of comets. For these purposes, we perform systematic photometric, spectral and polarimetric observations of comets (from different dynamical groups) that are available for our instruments. Here we present the comparison of results for selected comets from different dynamical group.

Title: Working with PhD students

Deliverable Type: Supervising of PhD students

I am supervisor of PhD student (1-st year of PhD) - Olena Shubina (MAO NASU).

The topic of PhD AS thesis is "Features of short- and long-period comets based polarimetric and spectral observations".

Title: Conferences and workshops

Deliverable Type: Workshop

1. Shubina O., Kiselev N., Rosenbush V., Ivanova O. Upgrading the Database of Comet Polarimetry. “The 23rd Young Scientists' Conference on Astronomy and Space Physics”, 25–27 April 2016, Kyiv, Ukraine.
2. Rosenbush V., Ivanova O., Kiselev N., Afanasiev V. Linear and circular polarimetry of comet 67P/Churyumov–Gerasimenko. “Europlanet NA1 Workshop on ground-based observationsof 67P/Churyumov-Gerasimenko”. 20–23 June 2016, Graz, Austria.
3. Kiselev N., Ivanova O., Rosenbush V., Afanasiev V. Imaging photometry of 67P/Churyumov–Gerasimenko at the 6-m telescope of the SAO RAS. “Europlanet NA1 Workshop on ground-based observationsof 67P/Churyumov-Gerasimenko”. 20–23 June 2016, Graz, Austria.
4. Ivanova O., Rosenbush V., Kiselev N., Afanasiev V., Korsun P. Spectroscopy of comet 67P/Churyumov-Gerasimenko at the 6-m telescope of the SAO RAS. “Europlanet NA1 Workshop on ground-based observationsof 67P/Churyumov-Gerasimenko”. 20–23 June 2016, Graz, Austria.
5. Ivanova O., Afanasiev V., Rosenbush V., Kiselev N. 2016. Imaging polarimetry of distant comets at the 6-m BTA telescope. COSPAR Scientific Assembly, 30 July – 7 August 2016, Istambul, Turkey.
6. Ivanova O., Borysenko S., Zubko E., Krišandova Z.S., Svoreň, J., Baransky A., Gabdeev M. 2016. Comet C/2011 J2 (LINEAR): photometry and stellar transit. COSPAR Scientific Assembly, 30 July – 7 August 2016, Istambul, Turkey.
7. Shubina O., Kiselev N., Rosenbush V., Ivanova O. Database of comet polarimetry V2.0: phase-angle dependence of linear polarization for short and long period comets. COSPAR Scientific Assembly, 30 July – 7 August 2016, Istambul, Turkey.
8. Shubina O., Kiselev N., Rosenbush V., Ivanova O. A new version of the Database of Comet Polarimetry (DBCP V2.0). The Eighth Scientific Conference in Honor of Bohdan Babiy Selected Issues of Astronomy and Astrophysics, 18–20 October 2016, Lviv, Ukraine.
9. Rosenbush V., Ivanova O., Kolokolova L., Kiselev N., Afanasiev V. 2016. Photometry and polarimetry of comet 67P/Churyumov-Gerasimenko at the 6-m telescope of the SAO RAS. “Comets: A new vision after Rosetta/Philae”, 14-18 November 2016, Toulouse, France.
10. Ivanova O., Rosenbush V., Kiselev N., Afanasiev V., Korsun P. Spectroscopy of comet 67P/Churyumov-Gerasimenko at the 6-m telescope of the SAO RAS. “Comets: A new vision after Rosetta/Philae”, 14-18 November 2016, Toulouse, France.
11. Rosenbush V., Ivanova O., Kolokolova L., Kiselev N., Afanasiev V. 2016. Photometry and polarimetry of comet 67P/Churyumov-Gerasimenko at the 6-m telescope of the SAO RAS. AGU’s Fall Meeting, 12-16 December 2016, San Francisco, USA.

Grants / Projects

Written 3 proposals:

1. Ukrainian - Slovak joint research project “The physical properties of dust particles of comet based on photometric and polarimetric observations”, 2017, for 3 years.
2. Russian Science Foundation grant "The relationship between the polarization and color of comets in the visible range and the heat emission in the mid-IR range"
3. SAIA Grant "Estimation of the gas contamination in the study of the dust environment of bright comets with broadband filters" for 3 month

Title: The physical properties of dust particles of comet based on photometric and polarimetric observation

Type: International

Project Scheme: Study of optical properties of the cometary dust based on photometric, polarimetric and spectral observations of selected comets and search connection between the physical and dynamic characteristics of comets, which belong to different dynamic groups to identify characteristics associated with different places of their formation in the Solar System or a different evolution.

Visiting Researcher Position: Project leader from AI of SAS

Status: SubmittedWithoutEvaluationResults

Relation to the SASPRO project:

This grant complements a grant SASPRO. The grant will be solved minor problems which were not included in the basic grant SASPRO

Title: The relationship between the polarization and color of comets in the visible and IR ranges

Type: International

Project Scheme: The obtained observational and experimental data will make it possible to develop an integrated model of cometary dust for visible and mid-IR and, thus, for the first time fit the whole set of observational data within a united paradigm. This will dramatically enhance quality of analysis and reliability of the chemicaland physical properties of cometary dust inferred from observations. It is important to stress that PI of this proposal has significant practical experience in modeling light scattering by comets, that is reflected in his list of publications. Such experience makes quite realistic the achievement of the goals of this project in time.

Visiting Researcher Position: Executor

Status: SubmittedWithoutEvaluationResults

Relation to the SASPRO project:

The objectives of this project are not included in SASPRO project. However, the model developed in this project will be used for data interpretation could that will be obtained in the implementation of the project SASPRO.

Title: Estimation of gas contamination in study of dust environment of bright comets with broad filters

Type: National

Project Scheme: The project is focused on study of the development of physical properties of bright comets. We plan to analyze gas and dust properties selected comets from different dynamical group. Will be estimate the gas contamination in the study of the dust environment of bright comets with broadband filters.

Visiting Researcher Position: Executor

Status: ApprovedAndFunded

Relation to the SASPRO project:

This grant complements a grant SASPRO. The grant will be solved minor problems which were not included in the basic grant SASPRO. This grant will be realized with collaboration with Slovak colleagues from AI of SAS and my PhD students from MAO NASU.