Observing of Leonids, Draconids, α- Monocerotids, ε- Perseids meteor showers. Investigating of technical possibilities of All-Sky camera on the example of searching for meteors of C/2012 (ISON) comet.

[1]Alexander Golubaev, [2]Ivan Brukhanov, [2]Anastasia Tabolich, [2]Valentin *Tabolich, [2]Anastasia Kulakovskaya, [2]Dmitry Akulich and [3]Ivan Sergey*

[1]Astronomical Institute of Kharkiv V.N. Karazin National University, Ukraine
[2]Amateur astronomers, the Republican center of technical creativity, team "Astrobloknot", Belarus, Mins
[3]Amateur astronomers, team "Astrobloknot", Belarus, Molodechno

Our group presents the new results of "All-Sky Beobachter" astronomical project which is based on previous experience of working with different widescreen cameras (All-Sky). In accordance with this project a search for meteor phenomena is carried out in images got with All-Sky camera. As a result coordinates of radiants of active meteor showers are calculated.

In 2010 - 2013 it was conducted collecting of images which were taken from All-Sky camera and followed out a search of Leonids meteors on these images. Calculated coordinates of radiant of Leonids meteor shower for mentioned 4 years are presented in the figures (**Fig. 1 - 4**). When even the Moon was being in the Leo constellation in 2011 it turned out to detect demonstration of Leonids activity with only 2 stationary meteors well.

In 2012 it was also detected α-Monoceratides meteor shower which was demonstrating activity simultaneously with Leonids (during its maximum activity) (**Fig. 3**)

In 2011 conditions of observing of Draconids meteor shower were unfavorable due to strong Moon's illumination. Nonetheless meteors and their coordinates were detected in All-Sky images (**Fig. 5 - 6**).

In September 2013 many observers noticed unexpected increasing of activity of ε-Perseids, the small meteor shower. Using the images of All-Sky camera The Liverpool Telescope's we were able to calculate radiant coordinates of this meteor shower. (**Fig. 7**).

An analysis of results of conducted work of searching meteor activity in All-Sky images shows impossibility to detect meteor shower activity during one day if its activity is less than 20 meteors per hour, and meteors are faint than +2 - +3 magnitude (for the fast meteors). To detect activity of meteor shower with the faint meteors (less than +3 magnitude) of average and low angular velocity is impossible if the meteor activity is less than 15 meteors per hour. But if it combines all archives of observations from some days all accessible All-Sky cameras then it's possible to detect an activity of meteor shower with ZHR value more than 10 meteors per hour. We got the same results during working on observations data of Gemenids meteor shower in 2009-2010 (the results had been published in journal of IMC-2011 conference **[1]**).

Meteors of C/2012 S1 (ISON) comet.

We provide the final result of found meteors of C/2012 S1 (ISON) comet in period from 05/01/2014 to 27/01/2014 in this paper. And also here are three possible variants of radiants of meteors of C/2012 S1 (ISON) comet (**Fig. 8, 9** and **11**).
While analyzing All-Sky images it also were found fireballs which demonstrate very uncertain radiant being close to theoretical one. The photo of one of the most bright fireball is presented in (**Fig.10**)

Introduction

Special researches on detection of possible meteoric activity in January 2014, connected with remains of comet C/2012 S1 (ISON) are conducted. This work was based on the observation material received in various points of the Earth, by means of 10 CCD cameras, equipped with "Fish eye" lenses like ("All-sky" camera) and FM radio observations. Expositions vary from 60 to 180 seconds for different CCD cameras. The interval between received images varies from 10 to 120 seconds (in a full moon).

The special theoretical researches about possibility of manifestation of the meteoric activity connected with the close arrangement to Earth of the central point of the orbit of comet C/2012 S1 (ISON) were presented in work [**2**]. Authors drew a conclusion that such meteoric activity is improbable. But we decided to check existence or lack of the meteoric activity connected with the comet C/2012 S1 (ISON), using the observation which was at our disposal.

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The special technique and the computer program described in **[3]** was applied to calculation of the theoretical radiant of the meteor shower. Calculations are based on known elements of the heliocentric orbit of comet C/2012 S1 (ISON) published in the Minor Planet Electronic Circular (M.P.E.C. 2012-S63). We represent observation conditions of possible meteoric activity: αR=153°, δR=+16.8°. Maximum of activity was expected on January 16.2, 2014 ($\lambda_{\odot}$(2000.0)=295.7°). In date of the estimated maximum the Earth settled down at distance 0.02 a.u. to the closest point of an orbit of the comet when it was there in 74.7 days prior to perihelion passage. On January 16 the closest point of the comet orbit post-perihelion was located from Earth at 0.4 a.u.. Therefore the meteoric activity connected with the remains of the comet is improbable after perihelion passage.

Results of CCD and FM radio detection of meteors

43 meteor events were revealed during viewing of 54 000 images from 10 till January 17, 2014. The radiants of the meteors were located in constellations of the UMa, LMi, Leo and Lyn. As a result of position measurements of images and calculations by means of the "RADIANT-1.43" program (Rainer Arlt, *www.imo.net/software/radiant*) coordinates of a meteor radiant were (**Fig. 11**): αR=156°, δR=+38°.

The greatest number of meteors was observed during the period from 10 till 15 January 2014 as result of supervision of two cameras located in SAO of Russian Academy of Sciences (The North Caucasus). The maximum quantity of the meteors was registered on 12 January at observations by means of the camera located in La-Palme. As the sky was strongly lit by the Moon (a full Moon on 16 January 2014), unfortunately, it wasn't succeeded to get a full-fledged observation material in the dates close to the expected maximum of meteoric activity.

Patrol observations of a meteor background in FM radio frequency range (88.6 MHz, Ivan M. Sergey) were carried out in Belarus (**Fig. 12a**). Increase of the meteor activity concerning level of the sporadic meteoric background was recorded during the period from January 08 to January 24, 2014.
During this period increase of meteor activity relative to the level of a sporadic meteor background is confirmed by radio observations (143.05MHz, Lorenzo G. Morillas_Sanchez_EA7GA) (*http://www.rmob.org/index.php*) in Spain (**Fig. 12b**).

Conclusions

All photo supervision used in the research aren't basic. Therefore the elements of the orbits of the recorded meteoric bodies weren't calculated. The good coherence of the temporary period and the area of meteoric activity with the theoretical prediction gives the grounds to assume that the meteoric bodies which have been genetically tied with of a comet C/2012 S1 (ISON) were recorded. Meteor activity was the lowest and was shown in the form of lack of the pronounced active radiant of the meteoric shower. Thus, the meteoric shower was observed as surge in activity of the sporadic meteors concerning usual level of the sporadic background. The coordinates of the radiant were found only thanks to the big statistical material collected in various observation posts on the Earth. Possibly, weak meteor activity is explained by that Earth passed through the peripheral part of a swarm of the dust particles which have been thrown out by the comet C/2012 S1 (ISON). The results of the observations are carefully being checked now.

References

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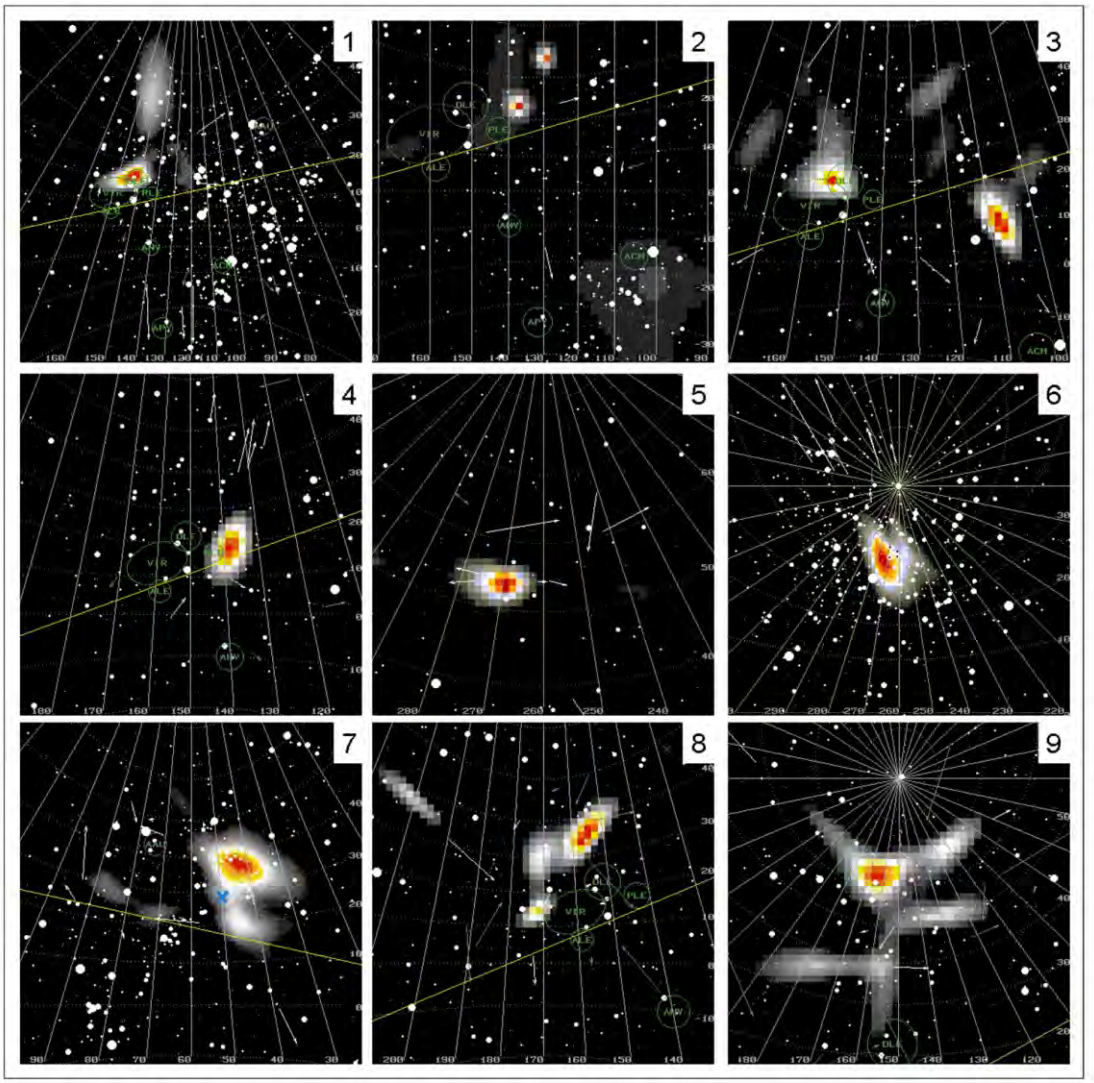

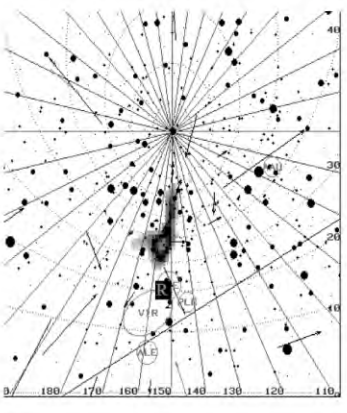

Fig. 11

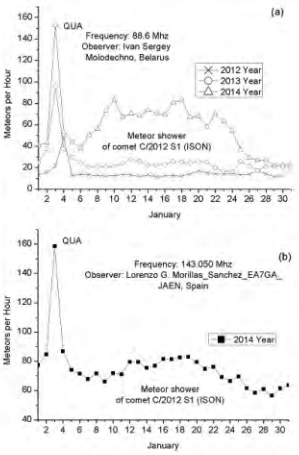

Fig. 12

Fig. 1. Radiant Leonids – 2010, RA=152°, Dec=+21°

Fig. 2. Radiant Leonids-2011, RA~135°, Dec~+25°

Fig. 3. Radiant Leonids-2012, RA=155°, Dec=+21° and meteor shower α-Monoceratides - 2012, RA=108° , Dec=+09°

Fig. 4. Radiant Leonids-2013, RA=138°, Dec=+19°

Fig. 5. Radiant Draconids-2011, RA=270°, Dec=+52°, all-sky camera IRF

Fig. 6. Radiant Draconids-2011, RA=274°, Dec=+45°, all-sky camera SAO.

Fig. 7. Radiant ε-Perseids - 2013, RA=43°, Dec=+38°

Fig. 8. Radiants of meteors of C/2012 S1 (ISON) comet RA~155°, Dec~+45°, All sky camera The Liverpool Telescope's 12/01/2014.

Fig. 9. Radiants of meteors of C/2012 S1 (ISON) comet RA~165°, Dec~+65°, All sky camera SAO 13-14/01/2014.

Fig. 10. Bolid -3 mag in theoretical meteor shower radiant of comet C/2012 S1(ISON): All sky camera in Australia, 13/01/2014 18:03 UT.

Fig. 11. Results of CCD observations in January, 2014 of a meteor shower of comet C/2012 S1 (ISON). R - theoretical meteor shower radiant.

Fig. 12. Observations of a meteor background in FM radio frequency range (a) - (January, 2012, 2013 and 2014, of 88.6 MHz) were carried out in Belarus; (b) - (January, 2014, of 143.05 MHz) were carried out in Spain; QUA - meteor shower Quadrantids.