Television meteor observations in INASAN

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Abstract

The results of TV observations of meteors during the period 18 July - 19 August (activity period of Perseid meteor shower) in 2011 and 2012 are presented. The wide field of view cameras "PatrolCa" were used for observations. Observations were carried out by a single station method as well as double-station one. The double-stations observations have the aim of determination of individual orbits of observed meteors. The principle of Index Meteor Activity (IMA) calculations can be used for all meteor showers acted at the period of observations. The IMA for sporadic meteors can be only approximately estimated from single station observations. We can use IMA parameter to estimate influx of meteor particles to the Earth per 1^h, both for shower and sporadic meteors. The distribution of the influx rate (IMA) of Perseids to the Earth for the period from 2011 to 2012 is given. The distributions of Perseid meteors by stellar magnitude are presented.

1. Introduction

The Perseids are one of the most active and most interesting meteor showers. It is active in the period 17 July – 24 August. It normally reaches a broad maximum on 12-13 August. The Perseids radiant in the activity moment is $\alpha = 48°$, $\delta = +58°$.The velocity is 59 km/s. An interesting feature of the Perseid shower is its suggested association with comet P/Swift – Tuttle.

The TV observations of meteors were carried out at the INASAN station (Zvenigorod observatory) and "Istra" station from 18 July to 19 August (activity period of Perseid meteor shower) in 2011 and 2012. The cameras "PatrolCa" were used for observations. These cameras have field of view 50°x40°and the limiting magnitude above + 4.0^m for meteors.

2. Observations and Data

The main task of our meteor observations is to clarify picture of low-mass particles migration inside the Solar System. A number of individual meteor orbits seem to be representative data for this task, so we began double-station meteor monitoring.

The PatrolCa (the camera Watec LCL-902H Ultimate with the lens Canon 6/0.8) has the design similar to ones of cameras used by other meteor observers and adapted to the Russian climate (the camera has warming and the cover). The parameters of PatrolCa are presented in the table (Table1).

	Parameters of «PatrolCa»
Type of CCD	CCD 1/2" Watec LCL-902H Ultimate
Size of CCD (pixel)	720×576
The frequency (frames/sec)	25
The field of view	50°×40°
The limiting magnitude of stars*	$+5.5^m$
The limiting magnitude of meteors**	$+4^m$

* **The initial of estimate** ** **In the night without of moon**	

Table 1 - Parameters of the meteor camera - PatrolCa.

The double-station observations are provided from Zvenigorod observatory (ZO) (Fig. 1) of the INASAN and "Istra" place (Fig. 2).

Figure 1 -The PatrolCa at ZO

Figure 2- The PatrolCa at "Istra"

The first camera is permanently oriented to the zenith area; the second one observes above 90% of the first camera FOV at altitudes of meteor events. The distance between stations is 25 km. The example of frames with the meteor obtained by both cameras shown at pictures (Figures 3-4).

Figure 3 - The example of the frame from the PatrolCa at ZO

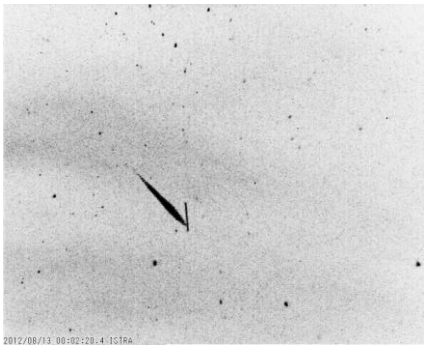

Figure 4- The example of the frame from the PatrolCa at "Istra"

The UFOCapture [1] software was used for detection of the video signal in 2012. The observations were performed during the activity of the Perseids (from 18 July to 19 August) in 2011-2012. 247 and 680 meteors were detected in 2011 and 2012. The 120 double-stations meteors (65 of them are Perseids) were detected observations in 2012 and 16 double-stations meteors (5 - Perseids) in 2011. The distributions of the number of meteors (the total number of meteors, the number of Perseids and the number of sporadic meteors) in 2011 and 2012 (from both stations) are presented in Figures 5-8.

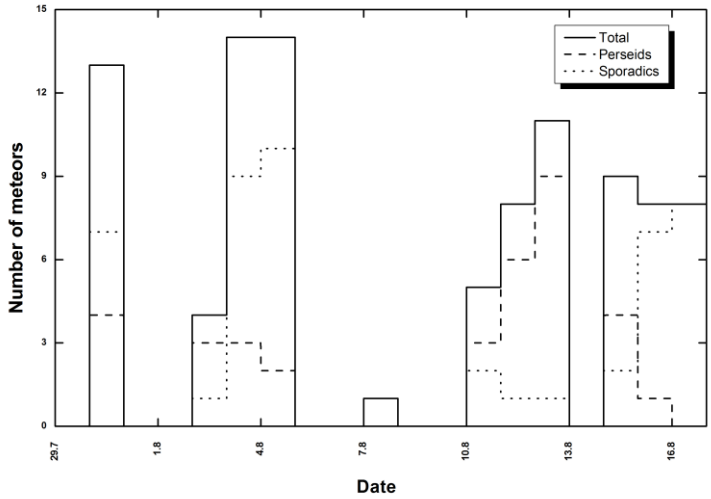

Figure 5 - The distribution of the number of meteors detected at the ZO in 2011.

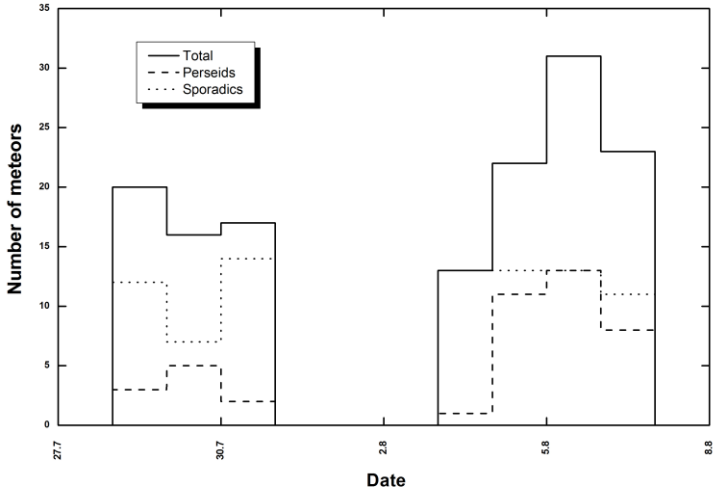

Figure 6 - The distribution of the number of meteors detected at the «Istra station» in 2011.

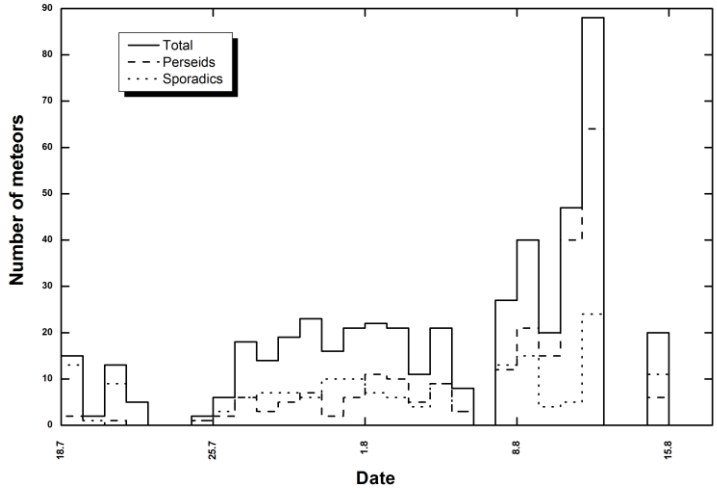

Figure 7 - The distribution of the number of meteors detected at the ZO in 2012.

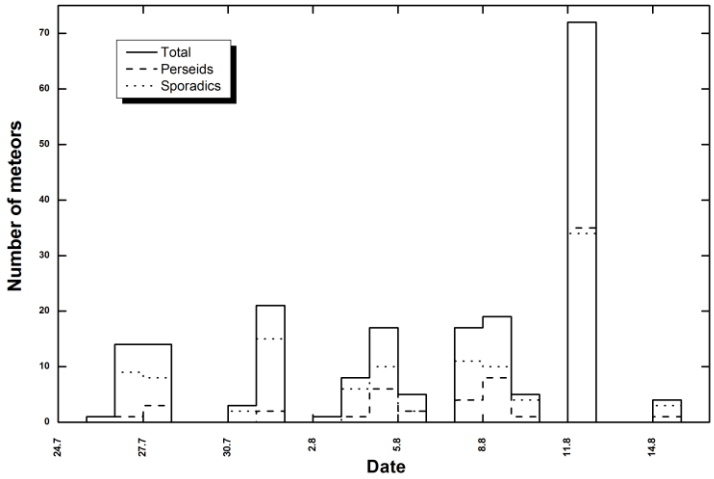

Figure 8 - The distribution of the number of meteors detected at the «Istra station» in 20120.

The ground projection of the individual meteor trails (Perseids) as seen by the double- station observation is shown in the Figure 9.

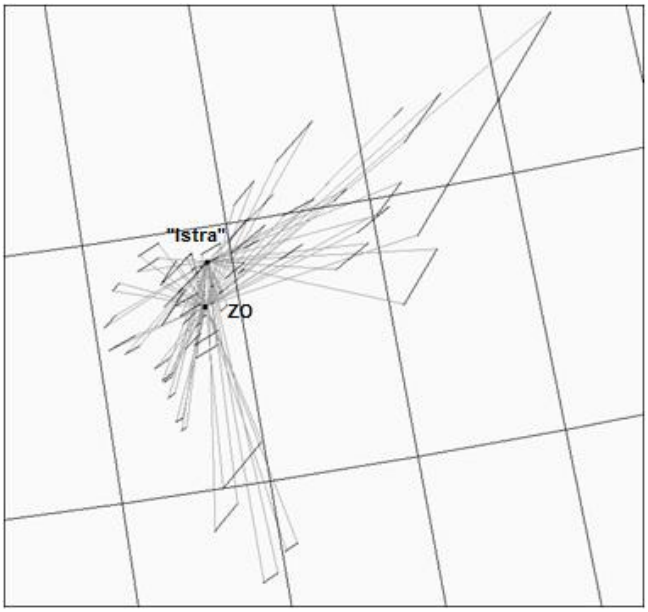

Figure 9 - The ground projection of the meteor trails detected by ZO and "Istra" station in 2012.

3. Results

3.1. Magnitude distribution of Perseids

Our cameras detected meteors brighter than $+4.0^{m}$. The brightness distribution of Perseids in 2011-2012 is presented in Figure 10. In 2011 our cameras worked in test mode, so there was a scanty the number of meteors. The data for 2012 show (Figure 10) that most Perseids in the interval considered are of magnitude $+0.0^{m}$ - $+2.0^{m}$.

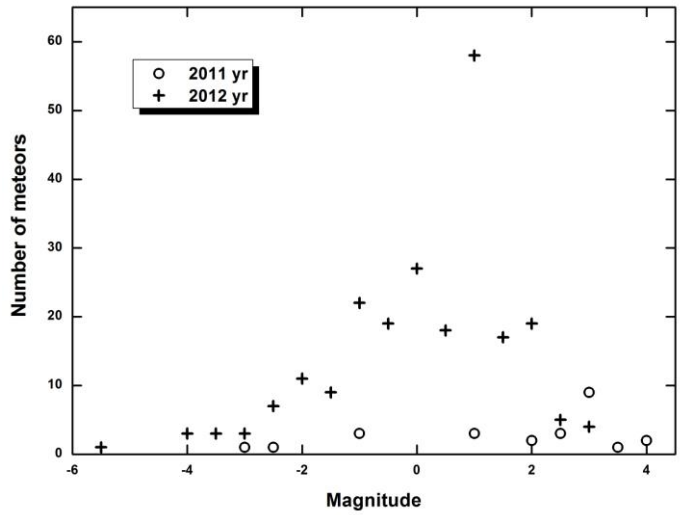

Figure 10 -The magnitude distribution of Perseids in 2011-2012 (18 July - 19 August).

3.2. The distribution of meteor radiants

120 double-station meteors were detected in 2012. The radiant was calculated for each meteor. The distribution of radiants is shown in the Figure 11.

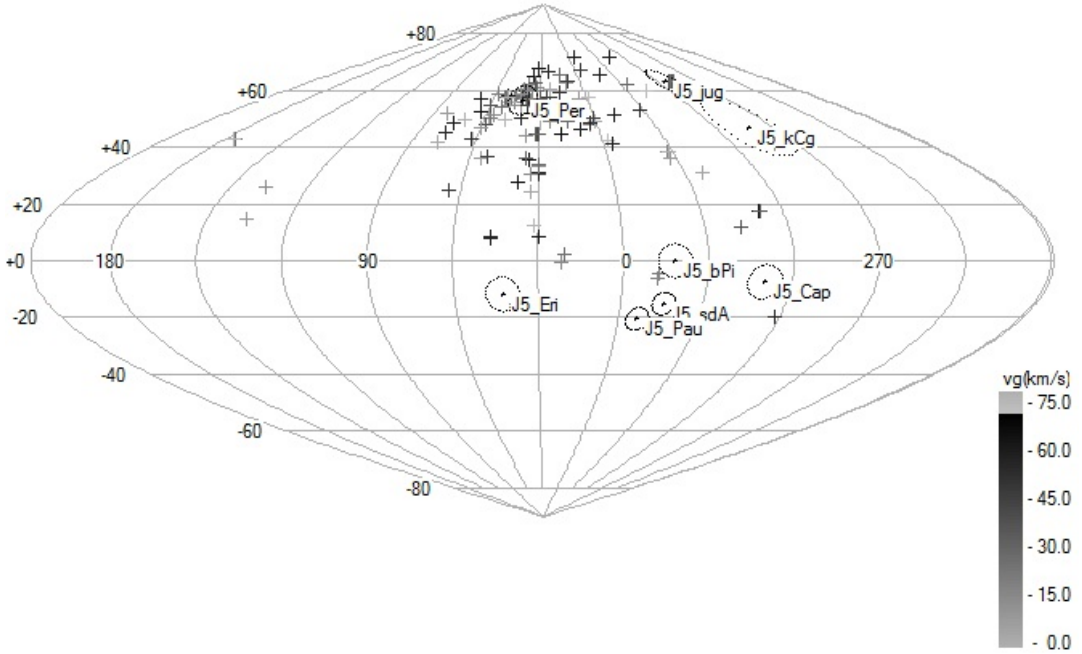

Figure 11- The radiants of double-station meteors.

The distribution of individual radiants of Perseid meteors (for 2012) is presented in the Figure 12 with color marking their geocentric velocity.

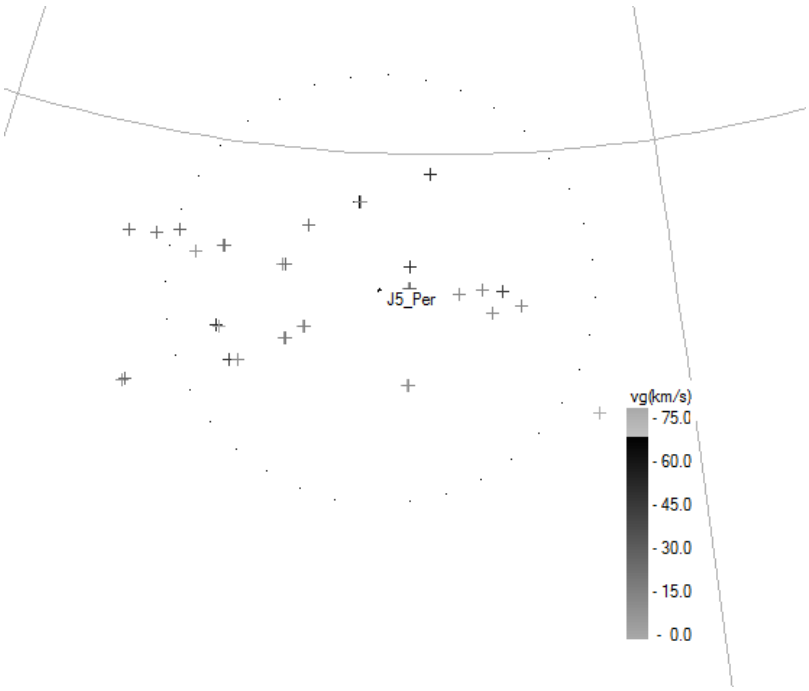

Figure 12- The individual radiats of Perseids (the radiation area showed at the 12-13 August)

It is clearly seen that both groups of points referred to high and low speeds are concentrated to the Perseids orbital plane. A possible explanation of this fact is that it is result of non-gravitation drift of lighter particles to orbits with decreased eccentricity. On the other hand both distributions are mixed, that points to multi-streams structure of the Perseids shower.

3.3. Index meteor activity (IMA)

IMA is used for determination of meteor influx [2, 3]. For meteors associated with Perseid meteor shower the IMA was calculated. This result is presented in the Figure 13.

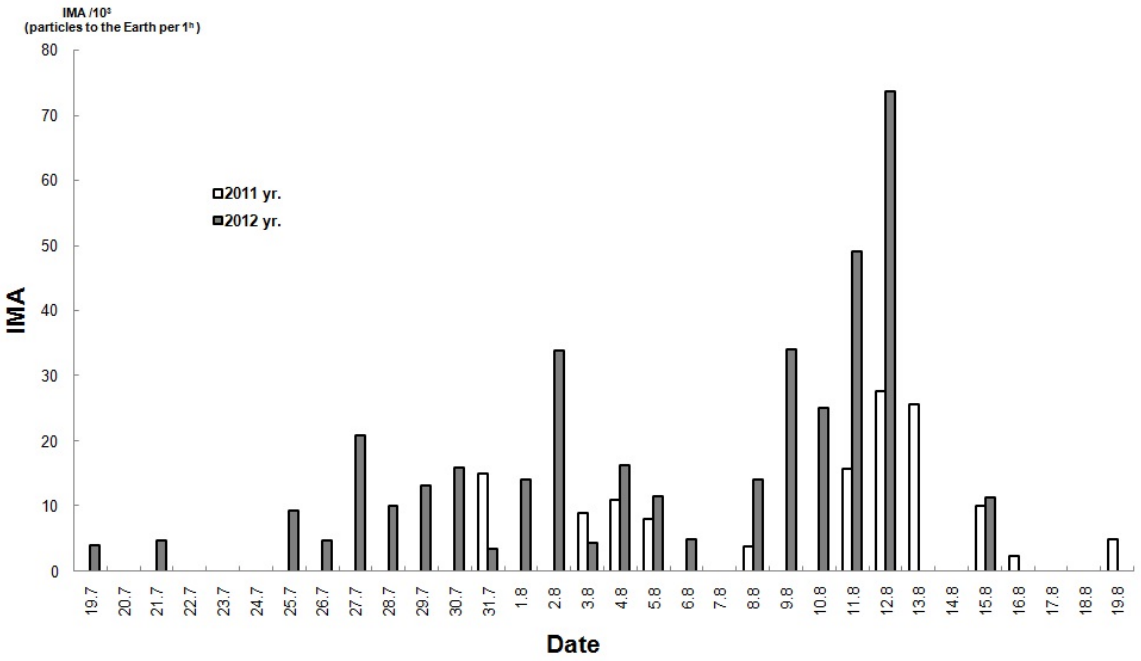

Figure 13 - Index meteor activity of Perseids 2012

IMA of Perseids in 2011 is shown by white bars, and the IMA of Perseids in 2012 is shown by grey bars. The maximum IMA was $28*10^3$ (particles to the Earth per hour) in 2011 and $74*10^3$ (particles to the Earth per hour) in 2012 during the maximum activity (August 12-13) of the Perseid meteor shower.

Conclusions

Simple design and cheapness of TV meteor systems allows us to perform the monitoring of meteors at almost all small observatories. Observations of meteors from many points in a single program will provide essential information for decision of various tasks.
Weather conditions did not allow us to conduct monitoring observations and we observed in conditions of partly cloudiness too. This makes it difficult to calculate the total IMA, but we can get the IMA for different solar longitudes step-by-step. In order to obtain the distribution of meteors in space the knowledge of their orbits is required. Our double-station observations are intended to get a view of this distribution. However, a small number of meteor stations in Russia cannot provide the necessary number of observational material and we need to use the help of International Meteor Organization. Investigation of the meteor matter influx to the Near-Earth space should be supported by the study of its physical properties –the mass and the density of properties. Double-station observations can provide the necessary basic information. The meteor group in INASAN plans to perform such observations in the nearest future. The Meteor Database of INASAN includes more than 1500 meteor registrations.
The observations are carried out according to the unified methodology under the INASAN supervision in Moscow and Irkutsk, which allow us to get objective information about meteoroid streams in the Solar System and the inflow of meteor matter to the Earth.

Acknowledgments

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References

[1] SonotaCo, “A meteor shower catalog based on video observations in 2007-2008”. WGN, Journal of the Meteor International Organization 37, 55-62.

[2] Bagrov A. V., Leonov V. A., Maslennikova E., Determining the influx rate of meteor matter to the Earth based on measurements with a patrol TV camera from a single station, Solar System Research, Volume 41, Issue 6, pp. 498-504, 2007.

[3] Kartashova A. Determination of meteor influx (Index of meteors activity) for August - December 2006// Proceedings of IMC-2010, Armagh, North Ireland, 2011, 32-36 pp.