Planetary and Space Science 118 (2015) 120–126

Contents lists available at ScienceDirect

Planetary and Space Science

journal homepage: www.elsevier.com/locate/pss

TV observations of the Perseid meteor shower in 2012–2013

Anna P. Kartashova *, Galina T. Bolgova

Institute of Astronomy of the Russian Academy of Sciences, Moscow, Russia

ARTICLE INFO

Article history:
Received 21 January 2015
Received in revised form
12 August 2015
Accepted 18 August 2015
Available online 3 September 2015

Keywords:
Meteor
Perseid meteor shower
Meteor observations

ABSTRACT

The results of television meteor observations during the Perseid meteor shower activity in 2012–2013 are presented. The observations were carried out in the Moscow region using the television system PatrolCa – the patrol camera with the field of view of 56° × 44° and limiting magnitude (for meteors) of $+4^m$. The distribution of the Index of Meteors Activity of the Perseid meteor shower in 2012–2013 was estimated. The maximum activity occurs on August 12 with the Index of Meteors Activity (IMA) ($\lambda = 140.4°$) 192 (± 0.03)*10^3 particles to the Earth per 1 h in 2012 and 122 (± 0.06)*10^3 particles to the Earth per 1 h in 2013 ($\lambda = 140.2°$). In total for 91 meteoroids radiants, geocentric velocities and orbit parameters were calculated. The daily drift of Perseid radiant was determined. The dependence of the beginning and ending heights by absolute magnitude is presented.

1. Introduction

The Perseid is one of the most active and the most interesting meteor showers. It is active between July 17 and August 24 with the maximum of activity on August 12–13. The radiant at the activity moment is $\alpha = 48°$, $\delta = +58°$ (IMO). The geocentric velocity is 59 km/s (IMO). An interesting feature of the Perseid shower is its presumed association with the comet 109P/Swift–Tuttle. The comet has an orbital period about 130 year and last visited the inner Solar System in 1992.

Usually the Perseid meteor shower is rather stable with the maximum activity on August 12 ($\lambda = 140.1°$). However, the additional peak of activity of this meteor shower was observed in some years.

The "new" peak of the Perseids activity was first detected in 1988 ($\lambda = 139.78°$) (Roggemans, 1989). It was evident again in 1989 ($\lambda = 139.56°$) (Koschack and Roggemans, 1991). The additional peak of the Perseid activity was also observed in other years at the solar longitude from 139.48° to 139.86° (Brown and Rendtel, 1996; Koschack and Roggemans, 1991; Rendtel and Arlt, 1996; Arlt, 1998; Rendtel and Arlt, 1999; Arlt and Buchman, 2002; Rendtel, 2008; Koschack et al., 1993).

According to the Wu and Williams (1993) model meteoroids ejected from comet 109P/Swift–Tuttle at apparition in 1862 should be seen on the Earth as an additional peak. Its position in 1992 was predicted at a solar longitude of about 139.5°.

The Perseid meteor shower is observed by many amateur and professional observes each year (International Meteor Organization (IMO); Central European Meteor Network (CEMeNt) and etc.). Here we present the data and analysis of double-station observations carried out in Institute of Astronomy of the Russian Academy of Sciences (INASAN).

2. Perseids observations and results

The TV observations of meteors were carried out at Zvenigorod observatory of the Institute of Astronomy of the Russian Academy of Sciences (ZO INASAN) and "Istra" station (Kartashova, 2013). The observations were performed during the activity of the Perseids (from July 18 to August 18) in 2012–2013. The cameras "PatrolCa" (the camera Watec LCL-902H Ultimate with the lens Computar 6/0.8) were used for observations. These cameras have the field of view (FOV) 56° × 44°and the limiting magnitude above $+4.0^m$ for meteors. The first camera is oriented to the zenith area (the center FOV: Azimuth = 178.9°, Elevation = 87.1°); the second camera is supported by first camera (the center FOV: Azimuth = 150.7°, Elevation = 80.2°) at the altitude 100 km. The distance between stations is about 20 km.

The UFOCapture (SonotaCo, 2005a) software was used for detection of the video signal. The UFOAnalyzer (SonotaCo, 2005b) and UFOOrbit (SonotaCo, 2005c) were used for data analysis and calculation of orbit parameters.

695 and 743 meteors were detected from both cameras in 2012 and 2013 respectively (Table 1).

* Corresponding author.
E-mail address: akartashova@inasan.ru (A.P. Kartashova).

http://dx.doi.org/10.1016/j.pss.2015.08.014
0032-0633/

Table1
Results of the television meteor observations 2012–2013.

18 July–19 August	ZO INASAN		«ISTRA»	
	2012	2013	2012	2013
Total time of observations (h)	119.3	131.3	42	54.75
Number of meteors	495	396	200	347
Number of the Perseids	233	195	93	166
Number of the Perseids (%)	47	49	46.5	47.8

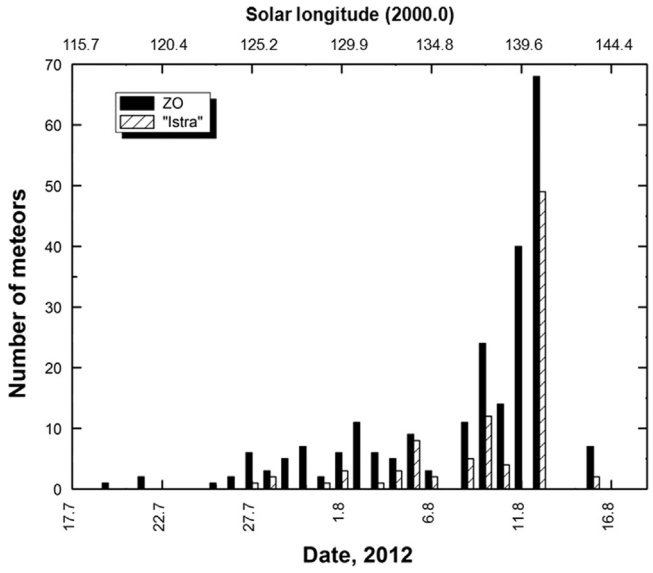

Fig. 1. The distribution of the number of the Perseids is detected at ZO INASAN and "Istra" station in 2012.

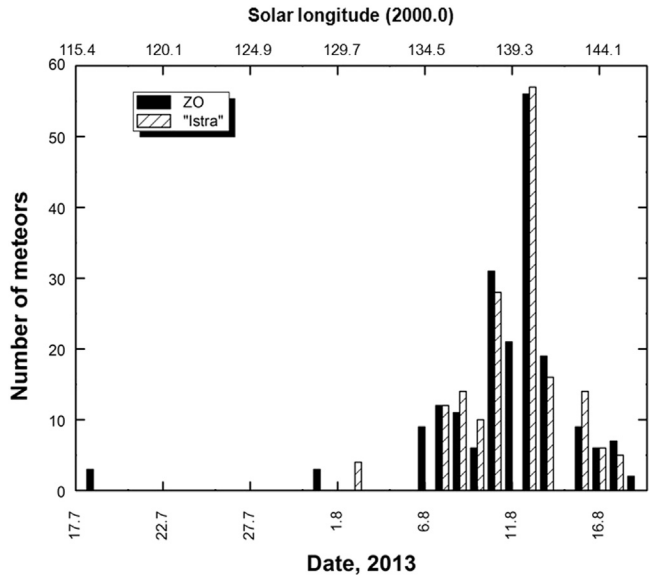

Fig. 2. The distribution of the number of the Perseids is detected at ZO INASAN and "Istra" station in 2013.

The 120 double station meteors (43 of them are Perseids) were detected during the observations in 2012 and 129 double station meteors (48-Perseids) in 2013.

The distributions of the number of the Perseids in 2012 and 2013 (from ZO INASAN – black columns and "Istra" station – the shaded columns) are presented in Figs. 1 and 2.

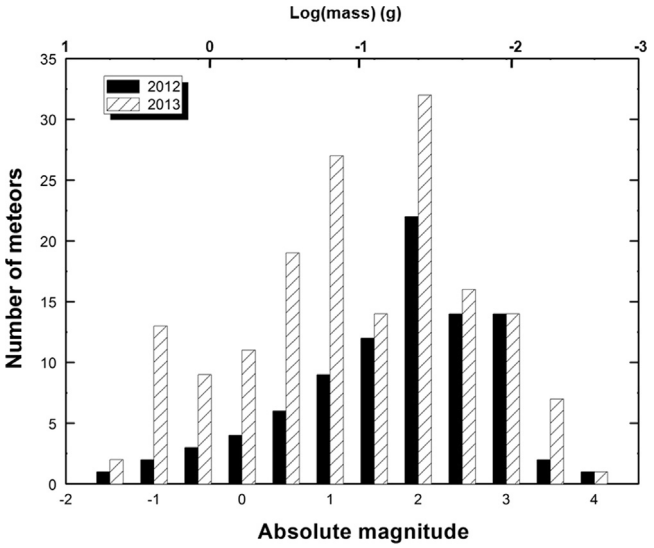

Fig. 3. The absolute magnitude distribution of the double-station observations Perseid meteors in 2012–2013.

The maximum number of meteors occurs at August 12 ($\lambda = 140.4^\circ$ in 2012 and $\lambda = 140.2^\circ$ in 2013).

2.1. Magnitude distribution of the Perseids

The cameras "PatrolCa" detected meteors brighter than $+4.0^m$. The absolute magnitude distribution of double-stations observations meteors from the Perseid meteor shower in 2012–2013 is presented in Fig. 3.

According to our observations (Fig. 3) the distribution of absolute magnitudes of the Perseids has the maximum at $+2^m$. The absolute magnitude distribution (Hughes, 1995) has the maximum at $+3^m$. This distribution presented by NEMETODE TV observations (Stewart et al., 2013) is in agreement with our data and also shows maximum at $+2^m$ Using the formula Verniani (1973) (Eq. (1)) the mass of meteors can be estimated (Fig. 3, upper scale):

$$m = 63.71 - 10\log(V) - 2.5\log(M) - 2.5\log(\cos Z_R), \quad (1)$$

where m – the absolute magnitude of the meteor, V – the Perseid velocity (59^*10^5 cm/s), M – the meteoroid mass outside the Earth's atmosphere, and Z_R – the zenith angle of the meteoroid (we took the mean value 45°).

According to our data (Fig. 3, upper scale) the most of Perseids have mass from 0.01 to 0.02 g.

2.2. Perseid radiants

The UFOOrbit software was used to calculate the radiant position of individual Perseid meteors from double-station observations. The distribution of geocentric radiant positions in 2012–2013 is shown at the Fig. 4.

The positions of the radiants for 43 double-station Perseids in 2012 and 48 in 2013 were used to obtain the drift of the radiant Perseid meteor shower. The drift of the radiant in right ascension and declination in 2012 and 2013 is plotted in Figs. 5–8.

The method of least squares gives following linear fit for 2012:

$$\alpha = 1.01\lambda_0 - 94.7^\circ \ (r = 0.633)$$
$$\delta = 0.20\lambda_0 + 29.9^\circ (r = 0.383), \quad (2)$$

and for 2013: