September ε Perseids observed by the Czech Fireball Network in 2013 and 2015

L. Shrbený, P. Spurný
Astronomical Institute of the Czech Academy of Sciences (shrbeny@asu.cas.cz)

Introduction

During first two hours of observations in the night of 9 September 2013 we recorded a total of 19 bright September epsilon Perseids (SPE). Only a part of them were multi-station fireballs. One SPE fireball was also observed on 6 September 2013 and two bright SPE fireballs were observed on 14 and 18 September 2015 (Fig 1). Autonomous Fireball Observatory (AFO) cameras with large-format sheet film as a detector and one new generation digital autonomous fireball observatory (DAFO) tested at Ondřejov observatory were instruments used in 2013. DAFO cameras were gradually installed on all Czech stations during 2014 and provided multi-station data on SPE fireballs in 2015.

Fig 1 Very bright SPE Fireball recorded by DAFO at Czech station Svratouch on 18 September 2015

The 2013 SPE outburst and 2015 SPE fireballs provided us with 15 atmospheric trajectories and heliocentric orbits, evolution of two long-lasting persistent trains (one more than half an hour, second about 15 min), and one video spectrum. These data enabled us to study in much detail physical properties and orbital characteristics of the shower.

Atmospheric trajectories

The beginning heights range from 100 to 120 km (up to 140 km for more sensitive DAFO) and approximately increase with initial mass of the meteoroid. The terminal heights range from 75 to 90 km (down to 65 km for DAFO) and approximately decrease with initial mass.

Physical properties and persistent train

We compared empirical end-height criterion PE coefficients [1], dynamic pressures at the point of the meteoroids fragmentation, light curves, and spectra of SPE fireballs and other meteor shower fireballs. The material of SPE meteoroids is a bit harder than that of Orionids and statistically the same as that of Perseids.

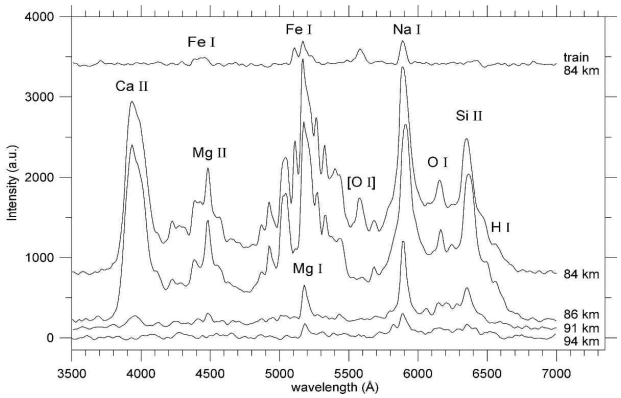

Fig 2 Spectrum of SPE fireball recorded on 14 Sep 2015

The spectrum of the SPE fireball (Fig 2) was recorded by digital video camera with diffraction grating with 600 grooves per mm. The video was in progressive scan format with 7.5 frames per second. From the temporal evolution of the spectrum and identification of emission lines of the second (high-temperature) spectrum [2], which is connected with a meteor shock wave (created at the time when the continuous flow regime forms around the meteoroid [3]), we concluded that the beginning of the continuous flow regime occured at the height between 90 and 93 km. We also determined the height of the beginning of the continuous flow regime according to [4] and we come to the same height range between 90 and 97 km (the height depends on the method of determination of the mean free path). The spectrum is similar to spectra of other shower meteors with similar velocity and brightness and does not show any exceptional or rare features.
From the evolution of both persistent trains we found that both trains remained observable for the longest time at the height around 90 km and that the maximum horizontal shift due to the high-altitude wind was 70 m/s.

Radiant and orbit

The mean geocentric radiant of the SPE 2013 outburst meteors for solar longitude 167.21° is 47.67 ± 0.10°, 39.54 ± 0.10°. The mean heliocentric orbit of the SPE 2013 outburst meteoroids has perihelion distance of 0.727 AU, eccentricity of 0.992, and inclination of 139°.

References

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[4] Bronshten V. A., D. Reidel Publ. Co., 1983.