EPSC Abstracts
Vol. 7 EPSC2012-68-1 2012
European Planetary Science Congress 2012

Large meteoroids produced by comet 7P/Pons-Winnecke

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Abstract

By using high-sensitivity CCD video devices we have analyzed the activity of the June Bootid (JBO) meteor shower. This monitoring has provided an opportunity to analyze the physico-chemical properties of large meteoroids produced by comet 7P/Pons-Winnecke. The analysis of a fireball produced by a meteoroid with a mass of about 257 kg is presented here.

1. Introduction

Comet 7P/Pons-Winnecke is the parent body of the June Bootid meteoroid stream [1]. This gives rise to an annual display of meteors from about June 22 to July 2, with a maximum activity around June 28. By performing a continuous monitoring of meteor and fireball activity during this period we have previously identified large meteoroids produced by this comet [2]. Besides, a recent study reveals that it is possible that, under certain geometric favorable conditions, fragments from this comet could survive the atmospheric entry and reach the ground as meteorites [3]. So, the analysis of the debris produced by 7P/Pons-Winnecke can give valuable information about the physico-chemical properties of these particles and can also improve our understanding of the mechanisms that deliver these cometary materials to the Earth. In this context, two of the meteor observing stations operated by the SPanish Meteor Network (SPMN) simultaneously imaged in 2010 a June Bootid fireball with an absolute magnitude of about -14±1.

2. Instrumentation

Both stations involved in the detection of the fireball considered here (Sevilla and El Arenosillo) employ high-sensitivity 1/2" monochrome CCD video cameras manufactured by Watec Co. (Japan). These stations work in an autonomous way by means of proper software [4]. A more detailed description of our systems, which can record meteor trails as faint as mag. +3/+4, has been done elsewhere [5, 6].

2. Observations and results

Our meteor observing stations operating from Sevilla and El Arenosillo simultaneously imaged a JBO fireball (SPMN code 040710) with an absolute magnitude of mag. -14±1 on July 4, 2010, at 23h16m01.9±0.1s UT. The atmospheric trajectory and radiant were obtained by using the planes intersection method [7].

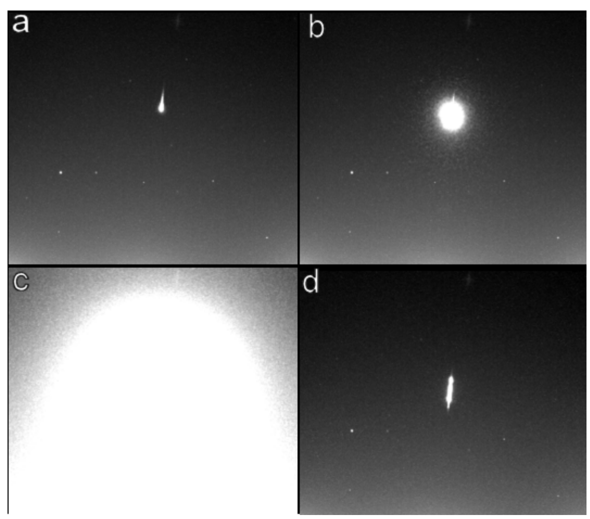

Figure 1: The SPMN040710 JBO fireball imaged from Sevilla: a) and b) initial instants of the luminous phase; c) main fulguration; d) persistent train.

The fireball, which exhibited a very bright fulguration (Fig. 1), started its luminous path at a height of about 85.1±0.5 km and the terminal point of the trajectory was reached at a height of 44.7±0.5 km. The preatmospheric velocity, obtained by extrapolating the velocities measured at the beginning of the meteor trail was V_∞=18.5.±0.5 km/s. The trajectory was located over the Atlantic Ocean (Fig. 2). Radiant and orbital data are shown on table 1. Although the bolide was imaged a few days after the usual activity period of the June Bootids, these data clearly confirm that the event belongs to this shower. We found a similar situation for a mag. -9 JBO fireball (SPMN code 050709) recorded on 2009 [2].

Table 1: Radiant and orbital data (J2000) for the SPMN040710 JBO fireball.

Radiant data			
	Observed	**Geocentric**	**Heliocentric**
R.A. (º)	256.4±0.3	252.6±0.4	-
Dec. (º)	30.9±0.2	29.7±0.3	-
Ecliptical lon.(º)	-	-	204.6±0.3
Ecliptical lat.(º)	-	-	18.2±0.5
V_∞ (km/s)	18.5±0.5	14.9±0.5	37.5±0.5
Orbital data			
a(AU)	2.6±0.3	**ω (º)**	209.2±0.2
e	0.63±0.03	**Ω (º)**	102.7158±10^{-4}
q(AU)	0.966±0.001	**i (º)**	18.5±0.6

Figure 2: Projection on the ground of the SPMN040710 JBO fireball.

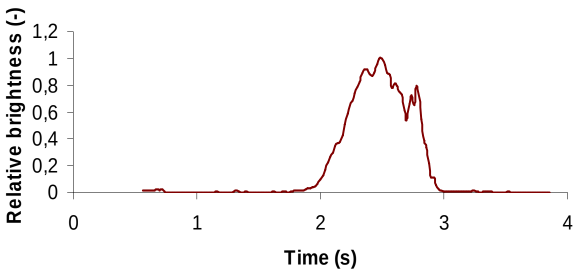

Figure 3: Light curve of the SPMN040710 bolide.

The light curve (Fig. 3) shows that brightness increased dramatically at ~63 km above the ground level, under an aerodynamic pressure, calculated in the usual way [8], of 4.5±0.6×10^4dyn/cm^2. This curve has been used to infer the initial mass of the meteoroid [9]. A value of about 257.0 kg was obtained, that considering a spherical particle and carbonaceous chondrite bulk density gives a pre-atmospheric meteoroid diameter of ~ 0.6 m.

6. Summary and Conclusions

The June Bootids activity period needs to be seriously considered as source of significant satellite impact hazard due to the presence of a population of large meteoroids produced in the disruption of comet 7P/Pons-Winnecke. We exemplify some of the brightest members recorded by the SPMN network by presenting the analysis of a mag. -14±1 JBO fireball. This has allowed us to obtain its atmospheric trajectory and has provided information about the orbit and mass of the corresponding meteoroid.

7. Acknowledgements

We acknowledge support from the Spanish Ministry of Science and Innovation (projects AYA2009-13227 and AYA2011-26522) and CSIC (grant #201050I043).

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