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Double-station video observations of the Quadrantids meteoroid stream from 2008 to 2011

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Abstract

The activity of the Quadrantid meteor stream during January 2008, 2009, 2010 and 2011 has been investigated by the SPanish Meteor Network (SPMN). For this purpose, an array of high-sensitivity CCD video devices operating from different locations in Spain has been used. Despite unfavorable weather conditions, we could obtain precise radiant and orbital information for this stream. Some preliminary results are presented here.

1. Introduction

The Quadrantid meteor stream takes its name from the ancient constellation Quadrans Muralis (the Mural Quadrant). Its alternative name, the Bootids, refers to the modern constellation of Bootes. Recently, the near-Earth object 2003 EH1 has been identified as its parent body [1]. Although it is has one of the highest ZHR of all annual showers (above. 100 meteors/hour), it is very difficult to observe because of frequent bad weather in early January in the northern hemisphere. This meteor shower is unusual for its strong but brief maximum. Thus, the main activity of the stream is confined to a 12 to 14 h window near maximum, although some extended activity is visible for approximately ±4 days centered around this date.

The dynamical evolution of the stream has been studied by several authors. Hamid & Youssef [2] found large changes in both eccentricity and inclination to the ecliptic with a period of about 4,000 years. More recent studies performed by Hughes et al. [3], Froeschlé and Scholl [4, 5], Babadzhanov and Obrubov [6], as well as Wu and Williams [7] revealed rapid and large changes in all orbital elements within the periods of a few thousand years. So, the determination of precise orbital and radiant information can be very useful to improve our knowledge about the Quadrantids. For this purpose, we have monitored the activity of this stream from 2008 to 2011 from several video meteor observing stations operating in Spain. Despite the typically unfavorable weather conditions during January, we successfully identified multiple-station meteors of this meteor shower during those years.

2. Instrumentation

The SPMN meteor observing stations involved in the imaging of the Quadrantids meteors employ high-sensitivity Watec CCD video cameras (models 902H and 902H Ultimate from Watec Corporation, Japan) to monitor the night sky. The cameras are arranged in such a way that the whole sky is monitored from every station and, so, this maximizes the common atmospheric volume recorded by the different systems. These devices are equipped with a 1/2" monochrome Sony interline transfer CCD image sensor with their minimum lux rating ranging from 0.01 to 0.0001 lux at f1.4. Aspherical fast lenses are used for the imaging objective lens. A detailed description about how these video stations are operated has been given elsewhere [8, 9, 10].

3. Data reduction and first results

For data reduction we use our Amalthea software [11]. This package employs the method of the intersection of planes to reconstruct the trajectory of the meteors in the Earth's atmosphere. It also provides radiant and orbital parameters for multi-station meteors. Velocity values along the meteor path are calculated from the video frames by obtaining the variation of the trajectory length as a function of time. Then, the preatmospheric velocity V_{∞} is found by extrapolating the velocities measured at the initial part of the trajectory by using a fitting model.

Bad weather conditions did not allow us to perform a continuous monitoring of the activity of the Quadrantids. Despite of this, over 100 meteor trails could be obtained from several SPMN meteor observing stations operating during the maximum activity period of this shower. For all the years analyzed, we could measure a similar value of the magnitude distribution index r=1.8±0.6, calculated from about 20 to 25 meteors brighter than mag. 4, depending on the year considered. A value of the ZHR of about 105±20 was obtained particularly for 2011. The averaged apparent radiant was located at R.A.: 230.4 ± 0.5 º, Dec: 47.3 ± 0.6º.

The averaged preatmospheric velocity calculated from the velocities measured at the beginning of the meteor trail was V_∞=43.0±0.4 km/s. The mean orbit of the Quadrantids derived from 10 double-station meteors can be found on Table 1. By using our ORAS software (ORbital Association Software), these data confirm that asteroid 2003 EH1 is the likely parent body of the Quadrantids. Thus, by using the Southworth and Hawkings dissimilarity criterion, we obtain a value of Dsh of about 0.2 [12].

Table 1: Averaged radiant and orbital data (J2000) for 10 Quadrantids meteors.

Radiant data			
	Observed	**Geocentric**	**Heliocentric**
R.A. (º)	231.1±0.5	232.8±0.5	-
Dec. (º)	48.2±0.6	47.9±0.6	-
V_∞ (km/s)	43.0±0.4	41.3±0.4	39.0±0.4
Orbital parameters			
a (AU)	3.1±0.5	**ω (º)**	194.6±0.7
e	0.69±0.06	**Ω (º)**	282.987±0.004
q (AU)	0.97±0.05	**i (º)**	71.7±1.3

6. Summary and Conclusions

We have studied the activity of the Quadrantids from 2008 till 2011 by means of high-sensitivity CCD video devices. Despite unfavorable weather conditions, we have identified so far 10 double-station events from several of our meteor observing stations operating in Spain. These have provided precise radiant and orbital information about this meteor stream. Our recently developed orbital association software (ORAS) provides a result compatible with the fact that asteroid 2003 EH1 could be the parent body of this stream.

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References

[1] Jenniskens P., AJ, Vol. 127, pp. 3018, 2004.

[2] Hamid S. E., Youssef M. N., Smith. Cont. Astrophs, Vol. 7, pp. 309, 1963.

[3] Hughes D. W., Williams I. P., Fox K., MNRAS, Vol.195, pp. 625, 1981.

[4] Froeschle Cl., Scholl H., A&A, Vol. 111, 346, 1982.

[5] Froeschle Cl., Scholl H., in Lagerkvist C.-I., Lindblad B. A., Lundstedt H., Rickman H., eds, Asteroids Comets Meteors II, Uppsala Universitet Reprocentralen, 1986.

[6] Babadzhanov P. B., Obrubov Yu. V., in Ceplecha, Pecina, eds, Interplanetary Matter. Czech. Acad. Sci., 1987.

[7] Wu Z., Williams I. P., MNRAS, Vol. 259, 617, 1992.

[8] Madiedo, J.M. and Trigo-Rodríguez, J.M. Earth, Moon, and Planets 102, pp. 133-139, 2007.

[9] Madiedo, J.L., Trigo-Rodriguez, J.M., Ortiz, J.L., Morales, N. Advances in Astronomy, Vol. 2010, 1-5, 2010.

[10] Madiedo, J.M. and Trigo-Rodriguez, J.M., abstract # 1504, 41st Lunar and Planetary Science Conference, 2010.

[11] Trigo-Rodriguez J.M. et al. MNRASVol. 394, pp. 569-576, 2009.

[12] Southworth, R.B., Hawkins, G. S. Smithson Contr. Astrophys. Vol. 7, pp. 261–285, 1963.