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On the activity of the γ-Ursae Minorids meteoroid stream on 2010 and 2011

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Abstract

Here are presented the preliminary orbital results obtained on the recently discovered γ-Ursae Minorids meteoroid stream during the 2010 and 2011 SPanish Meteor Network (SPMN) and Finish Fireball Network observing campaigns. We have used an array of high-sensitivity CCD video devices operating from different locations in Spain and Finland. Despite unfavorable weather conditions, we have obtained precise radiant and orbital information for 7 meteors associated with this new meteor shower.

1. Introduction

The newly identified γ-Ursae Minorids (GUM) meteor stream was first detected by means of radar observations [1]. It was introduced in the IAU working list of meteor showers with the code 404 GUM. This stream exhibited an outburst of relatively bright meteors (average absolute mag.=+0.55) on Jan. 2010, and several single and multiple stations trails were imaged by Finish observers by means of wide-angle CCD video cameras [2].

Additional observations of this stream can provide helpful information in order to improve our knowledge about its origin, evolution and activity period. Of particular interest is the determination of high-precision orbits, as these can provide important clues to establish, for instance, which is the likely parent body of the γ-Ursae Minorids. With this aim, we have monitored this stream on Jan. 2010 and 2011. Radiant and orbital information was derived from multiple station meteors.

2. Instrumentation

The observation of the γ-Ursae Minorids was made on 2010 and 2011 from several video stations operated by Finish observers and by the SPanish Meteor Network (SPMN). These employ high-sensitivity 1/2" black and white CCD video cameras (Watec Co., Japan) endowed with fast aspherical optics. A detailed description of these systems has been given elsewhere [3, 4]. Besides, some of our observing stations work in an autonomous way by means of proper software [4] and have attached holographic diffraction gratings to record the emission spectra resulting from the ablation of meteoroids in the atmosphere. However, none of the imaged GUM meteors was bright enough to produce any spectrum that could be recorded by these video cameras.

3. Observations and data reduction

Bad weather over Finland and Spain did not allow for a continuous observing during the activity period of the γ-Ursae Minorids meteor shower. However, single and multi-station meteor trails could be recorded from Jan. 11 to Jan. 21 in 2010 and 2011. The brightest event recorded from our cameras was a mag. -5 fireball imaged on Jan. 20, 2011 at 20h40m03.2±0.1s UT from our automated video observing station in La Hita (Fig. 1).

For data reduction we employ our Amalthea software [5]. This package employs the method of the intersection of planes to reconstruct the trajectory of the meteors in the atmosphere. It also provides radiant and orbital parameters for meteor trails that are simultaneously recorded from at least two different observing stations. From the sequential measurements of the video frames and the trajectory length, the velocity of the bolide along the path was obtained. The preatmospheric velocity V_∞ is found by extrapolating the velocities measured at the earliest part of the fireball trajectory by means of a suitable fitting model.

4. Preliminary results

The average observed preatmospheric velocity calculated from the velocities measured at the beginning of the meteor trail was V_∞=32.0±0.5 km/s. The mean orbital and radiant data (N=7 orbits) can be found on table 1. These data obtained with the Amalthea software have been compared to the orbital parameters calculated with the Dutch Meteor Society (DMS) orbit calculation software [6] and both results coincided.

The inclination of the orbit (about 48º) indicates a cometary origin for this shower. Besides, measurements indicate that these meteors could be trapped in a 5/2 resonance with Jupiter.

In order to find a likely parent body for the γ-Ursae Minorids we used our ORAS software (ORbital Association Software) with the information contained in the NeoDys database. By using several dissimilarity criteria, the best match is obtained with the near-Earth object 2007 BJ. Thus, for instance, by using the Southworth and Hawkings dissimilarity criterion [7], we obtain a value of Dsh of about 0.144. The Jopek dissimilarity criterion described in [8] gives Dh:0.08.

Table 1: Average radiant and orbital data (J2000) for 7 γ-Ursae Minorid meteors.

Radiant data (observed)			
R.A. (º)	223.6±0.3		
Dec. (º)	69.9±0.1		
V_∞ (km/s)	32.0±0.5		
Orbital parameters			
a (AU)	3.03±0.29	**ω (º)**	156.02±0.71
e	0.686±0.030	**Ω (º)**	300.2902±0.0001
q (AU)	0.949±0.001	**i (º)**	48.69±0.60

5. Summary and Conclusions

High-sensitivity CCD video cameras operating from Spain and Finland have provided orbital information with unprecedented accuracy about the recently discovered γ-Ursae Minorids stream. This is included in the IAU working list of meteor showers and, so, these observations can be very useful to improve our knowledge of this meteoroid stream. Thus, for instance, our orbital data suggest that the near-Earth object 2007 BJ could be its parent body.

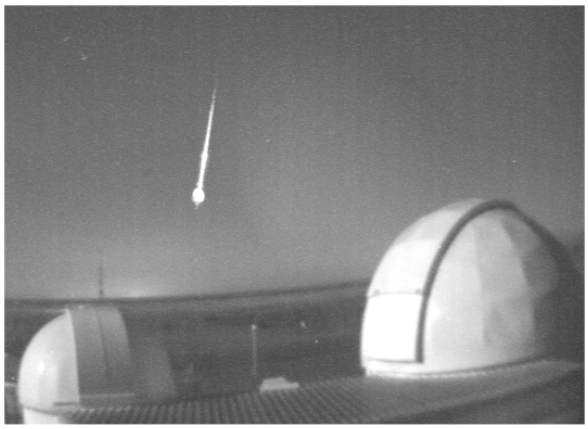

Figure 1: mag. -5 γ-Ursae Minorid fireball imaged on Jan. 20, 2011 at 20h40m03.2±0.1s UT over the domes of La Hita Astronomical Observatory.

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