Atmospheric trajectory and heliocentric orbit of the bright bolide over Denmark terminated by a meteorite fall in Copenhagen suburbs on February 6, 2016

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Introduction

A very bright bolide illuminated the sky over Denmark and neighboring countries on February 6th, 2016 at 21:07:17-22UT. It terminated by a multiple meteorite fall in the heavily populated area of the western outskirts of Copenhagen and several meteorites have been found in districts Herlev, Ejby, Glostrup and Vanløse shortly after the fall [1]. Total recovered mass already exceeded 10 kg and the largest recovered piece found in Herlev weighed about 6.5 kg and it was found shattered on many pieces as it fell on the paved surface. Although conspicuous luminous and acoustic effects of this spectacular bolide have been observed and reported by hundreds of casual witnesses, the instrumental records, which could serve for complex description of this extraordinary event, are very scarce. In this study we present results of the analysis of the available instrumental records, which we were able to collect and which were useful for the analysis. It allowed us to determine at least basic parameters describing atmospheric trajectory and heliocentric orbit of the initial meteoroid causing this spectacular meteorite fall.

Instrumental observations

After quite extensive effort to find any useful instrumental records, we collected two suitable photographic images and one high resolution light curve which proved to be suitable for basic trajectory and orbital analysis. Both photographic records were taken by digital cameras from northern Germany. These images were taken from Kühlungsborn and a nearby town Bad Doberan, two places located only 10 km apart close to the shore of Baltic Sea. In spite of this relatively bad geometry, high quality of these images (Fig. 1) enabled us to determine the atmospheric trajectory of the bolide with a sufficient precision. Fortunately there is complete luminous part on both images (except the very beginning on the Kühlungsborn image), so the whole trajectory is covered by these two images.

Fig 1 Spectacular image of the February 6, 2016 bolide taken by the Kühlungsborn digital camera

Results

Using our standard procedures [2] we reduced both images and determined that the bolide started its light at a height of almost 85 km (SW of town Borup) and terminated at a height of 18 km (NE of town Taastrup). The luminous trajectory was relatively steep with a slope of about 62 degrees and it was about 75 km long (Fig 2).

Fig 2 Projection of the atmospheric trajectory of Feb 6, 2016 bolide over Denmark with position of both cameras.

This trajectory information in combination with the high resolution radiometric light curve taken by the digital autonomous fireball observatory at the northernmost Czech station Růžová was used for the independent determination of initial speed using the method described in [3]. The light curve of this bolide was favorable for this purpose because it contained several well defined distinct flares. Based on these data we determined orbital elements and we proved an asteroidal origin of the initial meteoroid. It orbited Sun on a very low inclined orbit with perihelion close inside the Earth orbit and aphelion in the outer part of the main belt of asteroids.

References

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