ATMOSPHERIC TRAJECTORY AND ORBIT OF THE OSCEOLA METEORITE (JANUARY 24, 2016)

M. Gritsevich[1,2,3,4], E. Lyytinen[2], M. Hankey[5], M.M.M. Meier[6], R. Matson[7], and M. Fries[8], [1]Department of Physics, University of Helsinki, Finland (Gustaf Hällströmin katu 2a, P.O. Box 64, FI-00014 Helsinki, Finland, email: maria.gritsevich@helsinki.fi), [2]Finnish Fireball Network (Helsinki, Finland, email: esko.lyytinen@jippii.fi), [3]Institute of Physics and Technology, Ural Federal University (Mira St. 19, 620002 Ekaterinburg, Russia), [4]Department of Computational Physics, Dorodnicyn Computing Centre, Russian Academy of Sciences (Vavilova St. 40, 119333 Moscow, Russia), [5]American Meteor Society, [6]ETH Zurich, Institute of Geochemistry and Petrology, Zurich, Switzerland, [7]Leidos, 11955 Freedom Drive Reston, VA 20190, USA, [8]NASA Johnson Space Center, 1601 NASA Pkwy, Houston, Texas 77058, USA.

Introduction: Out of a total around 50,000 meteorites currently known to science, the atmospheric passage was recorded instrumentally in less than 0,1 % cases with the potential to derive their atmospheric trajectories and pre-impact heliocentric orbits. Similarly, while observations of meteors generate thousands of new entries per month to existing databases, it is extremely rare they lead to meteorite recovery [1].

The aim of this study is to present a summary on the trajectory reconstruction, dark flight simulations and the pre-impact orbit estimate for the day-light fireball widely observed over northern Florida (USA), on January 24, 2016 at 10:27 EST (15:27 UTC). The lower part of the atmospheric trajectory was retrieved from the weather radar indicating meteorite signatures shortly after the fall. The radar returns were strong, found at multiple altitudes and located on multiple stations: KJAX, KVAX and KTHL. There were also seismic recordings of the fireball which helped to specify, in particular, timing of the fireball.

The analysis of the luminous flight: A publicly available dash-cam video with the day-light fireball recording made by Erick Williams, was carefully calibrated [2] and taken into account in the reconstruction of the luminous part of the trajectory. The original dash-cam was kindly provided to us by the owner, so as to enable derivation of the exact camera properties, and for star calibration. This facilitated the robust extraction of key characteristics of the meteoroid based on the available data.

We have estimated the dynamic meteoroid mass (and also the way it changes along the trajectory) based on an analysis of drag and mass-loss rate [3] derived from the observations. The data were treated thoroughly with the actual weather conditions at the time and location of the fireball taken into account [4]. The heliocentric orbit was derived using numerical integration of the equations of motion implemented in a software "Meteor Toolkit" [5]. The Osceola has the most evolved orbit of all known L chondrites with orbits [6], with an aphelion sunward of the inner rim of the asteroid belt. It must therefore have experienced a close encounter with Earth or Mars in the past.

The derived ballistic coefficient and mass loss parameter indicate [7] that a significant part of the meteoroid's mass survived atmospheric entry and reached the ground.

Details on the recovered meteorite fragments: Based on the weather radar data analysis, Mike Hankey found the first meteorite fragment weighting 8.5 g on the eastern edge of the primary radar return on January 31, 2016. Within 2 hours, Larry Atkins found the second 18.5 g fragment directly under the radar signature. In the following searches, 6 more fragments of the meteorite were recovered with masses of 5.5 g, 48.5 g, 839 g, 75.5 g, 90.5 g and 18.6 g. The meteorite was classified as an L6 ordinary chondrite.

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