Video Orbits of the Geminids

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Geminid meteoroids, observed by the video technique, were analysed with the aim of determining the actual dispersion of their reciprocal semimajor axes 1/a within the stream. Orbits were selected from the European Video Meteor Network Database, EDMOND, (Kornos et al., 2013), from the SonotaCo Shower Catalogue (SonotaCo, 2009), and from the Czech Catalogue of Video Meteor Orbits (Koten et al., 2003). The observed orbital dispersion, including the measurement errors, was compared with that obtained from the precisely-reduced photographic orbits of Geminids from the IAU Meteor Data Center (Lindblad et al., 2003). In this paper, we concentrate on the influence of errors on the orbital dispersion. The size and distribution of observational errors determined from the long-period meteoroid streams (Hajdukova 2013), were applied to determine the real dispersion within this short-period meteoroid stream.

The observed dispersions, described by the median absolute deviation in terms of 1/a, range from 0.041 to 0.050 1/au. The deviation of the median reciprocal semimajor axis from the parent (3200) Phaethon, obtained from Japanese video orbits, is 0.009 1/au, and that from the EDMOND data 0.01 1/au. This deviation obtained from the photographic orbits of the IAU Meteor Data Center was significantly greater (Hajdukova 2009). Similar results were obtained from the Czech Video Orbits Catalogue, where the value is 0.05 1/au. The investigation showed that semimajor axes of meteor orbits in both the SonotaCo and EDMOND datasets are systematically biased as a consequence of the method used for the video orbit determination, probably because corrections for atmospheric deceleration were either incorrectly made or were not done at all. Thus, the determined heliocentric velocities are underestimated, and the semimajor axes medians shifted towards smaller values. The observed distributions in 1/a from these video data become biased towards higher values of 1/a.

The orbits of the Geminid meteoroids, with aphelia far inside the orbit of Jupiter, indicate that the gravitational effects of the other outer planets are negligible. Therefore, the structure of the Geminid meteoroid stream is dominated by the initial spread of meteoroid orbits. The deviations which may have accumulated since the formation of the stream can hardly exceed a few thousandths in 1/a (Kresakova, 1974). This study demonstrates that the original orbital dispersion can be smeared by larger observational and measurement errors. This fact has to be taken into consideration when studying the fine structure of the stream.

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