Meteoroid Orbits from Video Meteors
The Case of the Geminid Stream

M. Hajdukova (1), P. Koten (2), and L. Kornos (3)
(1) Astronomical Institute of the Slovak Academy of Sciences, Slovakia, (2) Astronomical Institute, Ondrejov Observatory, Czech Republic, (3) Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia; (astromia@savba.sk)

1. Introduction

The recent rapid development of video techniques is reflected in the massive increase in detected meteors. This is of high significance for minor meteor shower radiant determinations, derivations of meteor flux densities, and other purposes. However, the production of a large number of meteor orbits often comes at the expense of their quality. This is then reflected in the meteor's characteristics and influences further analyses.

The fact that the original orbital dispersion can be smeared by larger observational and measurement errors has to be considered when studying the structure of meteoroid streams through the shower meteors. The initial dispersion of meteoroids in a stream is influenced by a number of processes, which appear during different stages of the stream evolution. However, Kresak [1] showed that, for the widely dispersed annual meteor showers, the measurement errors can be two or three orders of magnitude larger than the dispersion produced by planetary perturbations integrated over several revolutions. For the short-period meteor showers, the differences in the velocities are less representative, and the dispersion in the semi-major axes smaller. Discovering errors is more difficult because they do not produce, as clear evidence of their presence, a spurious hyperbolicity, as is the case with long-period showers [2].

In this study, we concentrate on the influences of the varying accuracy of measurements and the varying precision of the orbit determination on the distribution of meteor orbits within the stream of Geminids. The dispersion of the orbital elements is studied, comparing several catalogues, which enables the specific features of the Geminids, as well as the diversities of the catalogues, to be shown.

2. Video orbits and their precision

We analyzed the orbits of the Geminids selected from video catalogues that are based on various meteor detection software packages and various meteor orbital element softwares: the Slovak Video Meteor Network's database [3], the Czech Catalogue of Video Meteor Orbits [4], the CAMS (Cameras for Allsky Meteor Surveillance) Meteoroid Orbit Database [5], Duch Meteor Society Video Database [6], the SonotaCo Shower Catalogue [7], and the European Video Meteor Network Database (EDMOND) [8]. The observed orbital dispersions of video Geminids, including the measurement errors, were compared with those obtained from the photographic and radar orbits of Geminids selected from the IAU Meteor Data Center [9, 10].

The semi-major axes of meteor orbits in almost all the video datasets seem to be systematically biased in comparison with the photographic and radar meteors. The observed distributions in $1/a$ are shifted towards higher values of $1/a$. The determined velocities seem to be underestimated, probably as a consequence of the methods used for the measurement of the meteor positions, and/or the orbit determinations.

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