

The Geminid Meteor Shower as observed by the CILBO Double Station Network

J. Zender (1), R. Rudawska (1) and D. Koschny (1,2)

(1) European Space Agency, ESTEC, Noordwijk, The Netherlands (2) Chair of astronautics, TU Munich, Germany

Abstract

We report on the current status of the processing, calibration, and analysis of spectral video data obtained from the Geminid meteor showers from 2011 until 2016. The spectral video data were acquired by the Canary Island Long-Baseline Observatory (CILBO), that also provides double station videos, allowing to compute the orbit for individual meteors.

1. Introduction

The Meteor Research Group (MRG) of the European Space Agency operates double station, called CILBO (Canary Island Long-Baseline Observatory). Currently, five image-intensified video cameras observe the night sky every clear night. The system is sensitive to sporadics and shower activity. Since full operations in 2012, about 70000 meteors have been observed. With two of the cameras (ICC7 and ICC9), we have recorded almost 20000 double-station meteors, while recently installed large field-of-view cameras (LIC1 and LIC2) typically record between 1300 and 1700 meteors per month. For detailed information about CILBO and its setup, please see [2]. The 3D trajectory and heliocentric orbits of these meteoroids were computed, and stored in the Virtual Meteor Observatory (VMO), which is the long-term archive of the International Meteor Organisation's video meteor camera network. In particular, it contains a record of precise measurements of Geminid meteors. The Geminids meteor shower, thought to originate from dust emitted by 3200 Phaethon, show a complicated structure, including a double-peaked activity profile [1]. In 2009, weak activity of asteroid Phaethon itself was reported, [1] and [3]. The most plausible reason behind the observed brightening is the dust production by thermal fracture and decomposition [4]. The abundance of sodium in Geminid shower dust particles vary strongly and in most spectra, Sodium is abundant [7].

2. Data Analysis

For the period from 2010 onwards, the cameras have recorded 20 events in all three cameras: ICC7, ICC9, and the spectral camera ICC8. We recalculated the orbital elements from the double station observation information and confirm the known Phaeton (2013) orbital elements.

The 3D plot, shown for the Geminids observed in 2011 in Figure 1, shows several substructures within the stream, filaments, that could indicate different ejection times of the dust particles.

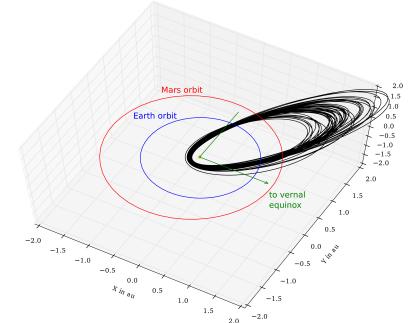


Figure 1: Computed orbits for Geminid meteors in 2011.

Figure 2 plots the semimajor axis (a) against eccentricity (e) of individual meteor events. It thus shows the evolution of the orbital elements against. Larger meteoroid masses are indicated by larger point areas in the plot. The orbital propagation was computed using the RADAU integrator in the MERCURY software and is solely based on gravitational effects.

Figures 3 and 4 show the spectral response of two Geminid events of 2013. Figure 3 is showing a high sodium content in the meteor, that is rarely observed in Geminid meteor spectra, see [5], [6] and [7].

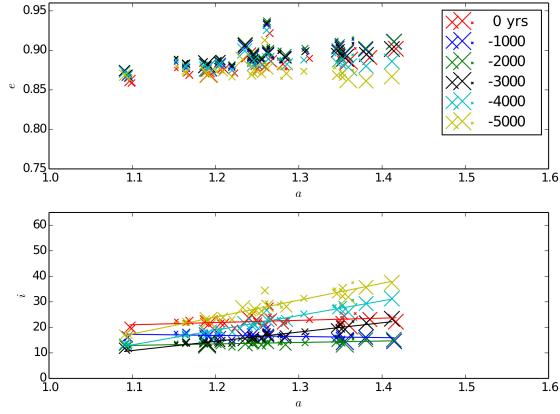


Figure 2: Orbital elements of individual Geminid meteor shower events.

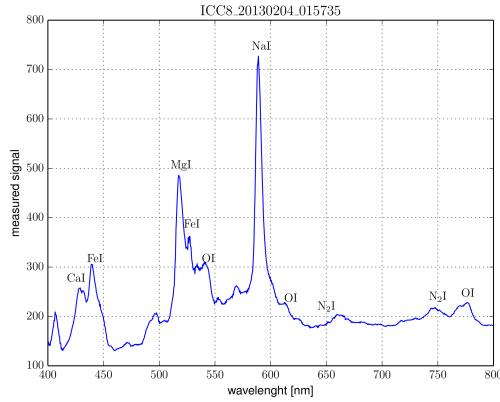


Figure 3: Calibrated spectrum of Geminid spectra 20130204T015735.

3. Summary

We present a snapshot of the ongoing analysis of the Geminid meteor shower data obtained by the Canary Island Long-Baseline Observatory (CILBO) of the ESA's Meteor Research Group (MRG). The analysis includes the determination of individual orbital elements and the propagation of these. Spectral data are calibrated and analyzed in view of abundances of the main chemical elements of meteoritic spectra.

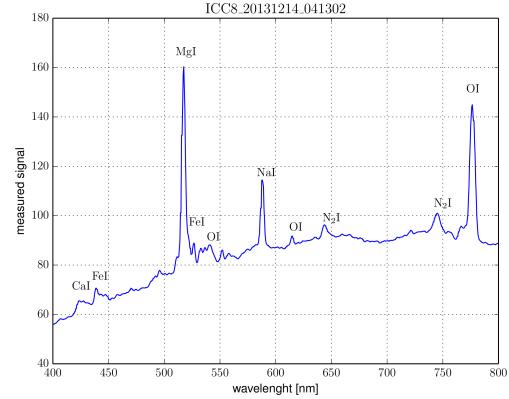


Figure 4: Calibrated spectrum of Geminid spectra 20131214T041302.

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