MAARSY meteor head echo observations of the Geminids

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**Motivation**

- continuous stream of meteoroids into the mesosphere/lower thermosphere (MLT)
- meteoric mass input into the MLT shows huge uncertainty: 10-270 t/d
- ablated meteoric material re-condensate and forms meteoric smoke particles

![Image](image1.png)

**MAARSY - Middle Atmosphere Alomar Radar System**

- geographic location (69°17'N, 16°18' E)
- frequency 55.5 MHz
- active phased array with 433 antennas
- 18-channel receiver system
- interferometric capabilities

![Image](image2.png)

**Meteor head echo interferometric analysis**

- Range-time-intensity (RTI) plot of a recorded meteor head echo using the full array for reception. Meteor head echoes are detected by an automated software routine.

- Determined trajectory with color coded altitude for same meteor. The green lines highlight the ambiguity due to the baseline length. The circles indicate minima in the radiation pattern.

- The accuracy of trajectory for the meteoroid is sufficient to compute a reliable radar cross-section (RCS). The receivers channels are phase calibrated to ensure this high accuracy.

- The pulse-to-pulse interferometry permits to measure the deceleration of the meteoroid. The meteor indicates different decelerations maybe due to fragmentation.

- The velocity-altitude plot reveals the vertical structure of the Geminid meteor shower, which shows a deceleration of the meteoroids in dependence of their penetration depth.

- Here we compare the motion of the Geminid source radiant in dependence of the solar longitude. The source radiant positions are given as apparent radiant and not corrected for zenith attraction to ensure comparability to the specular observations. The IMO reference data is corrected for zenith attraction.

**Summary**

- relative contribution of Geminids decreases with decreasing particle sizes
- observation of diurnal meteor head echo count rates at polar latitudes
- determination of meteoroid velocities, deceleration and trajectories with MAARSY
- velocity measurements indicate deceleration with altitude
- good agreement of the vertical structure of the Geminid meteor shower comparing head echo and specular meteor observations

**References**