The mass index and total mass of the Geminid meteoroid stream as found with radar, optical, and lunar impact data

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The Geminid meteor shower was observed in 2015 using the Western Meteor Physics Group's Canadian Meteor Orbit Radar (CMOR), Marshall Space Flight Center's (MSFC) eight wide-field optical cameras, and MSFC's lunar impact monitoring. These observations allowed Geminid fluxes to be calculated in three unique mass-ranges, from 1.8e-4 grams to 30 grams. From these fluxes, a mass index of 1.68 +/- 0.04 is found, which is in excellent agreement with past Geminid mass indices such as 1.69 found by Blaauw et al [1] using only radar data and 1.7 found by Arlt & Rendtel [2] using visual data. This mass index, however, is found over five orders of magnitude of mass, which allows a higher level of confidence that this mass index holds over a large portion of the stream. Mass indices are an important quantity to be accurately measured for a shower, indicating the distribution of mass in a well-studied stream in which we know the parent body (3200 Phaethon), improving forecasts of the shower activity, and allow fluxes to be scaled to high and low masses.

The quantities derived here, along with a profile of the Geminid meteor shower activity in 2015 from CMOR, permit the total Geminid mass the Earth encountered in 2015 to be found, along with a minimum total mass of the Geminid meteoroid stream. Attempts have been made in the past to measure the mass of meteoroid streams using ZHR profiles, but here this new and improved treatment uses empirically derived fluxes and measured mass indices for the 2015 encounter with the meteoroid stream. This is to be compared with other meteoroid stream mass estimates including that of the Perseids, caused by comet Swift Tuttle.

References

[1] Blaauw, R., Campbell-Brown, M., Weryk, R., Monthly Notices of the Royal Astronomical Society, Vol 414 (4), pp 3322-3329. 2011

[2] Arlt, R., and Rendtel, J., Monthly Notices of the Royal Astronomical Society, Vol 367 (4), pp 1721-1726. 2006.