

The Toroidal Sporadic Source: Understanding Temporal Variations

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The origin and characteristics of the North toroidal (NT) sporadic meteoroid source remains poorly known. Though the NT was first noted in radar measurements in the late 1950s, its origin has puzzled astronomers for more than 50 years. The NT meteoroid population shows orbital elements dominated by particles with very high inclinations, modest semi-major axis values and low eccentricities unlike any known contemporary parent population in the Solar System. Recently, several dynamical models have suggested that the parent bodies of the NT source may be linked to the population of Halley-type comets. However, no model to date has been able to reproduce in detail the significant temporal variations in activity seen throughout the year. In this work we will present NT data measured by the Canadian Meteor Orbit Radar (CMOR) between 2011–2014, which we use to define in detail the temporal and orbital element variations in NT activity which a model must reproduce. In this first model, we have identified over 150 near-Earth ob-

jects which might contribute to the NT meteoroid population at the current time and integrated their orbits backward in time 25,000 years. For each potential parent body, we simulate ~ 10 clones to span the range of possible parent body orbits as a function of time. From our initial epoch 25 ka, we eject 2000 test meteoroids per 100 years of sizes $30 \mu\text{m}$ to 1 mm per potential parent clone and examine the resulting dust trail intersecting the Earth in an attempt to match the various temporally distinct portions of the NT meteoroid complex. We find that while some of the observed features of the NT can be modeled as distinct past contributions from individual parent bodies (notably 2008 KP, 1973 NA, 2009 WN25, 96P/Machholz, and P/2008 Y12), but many major features in the NT source shown no correspondence with known parent bodies or their potential clones. We will discuss a best estimate for the age of observed NT features and discuss several candidate parent bodies that are able to reproduce some sub-structure in the NT source.

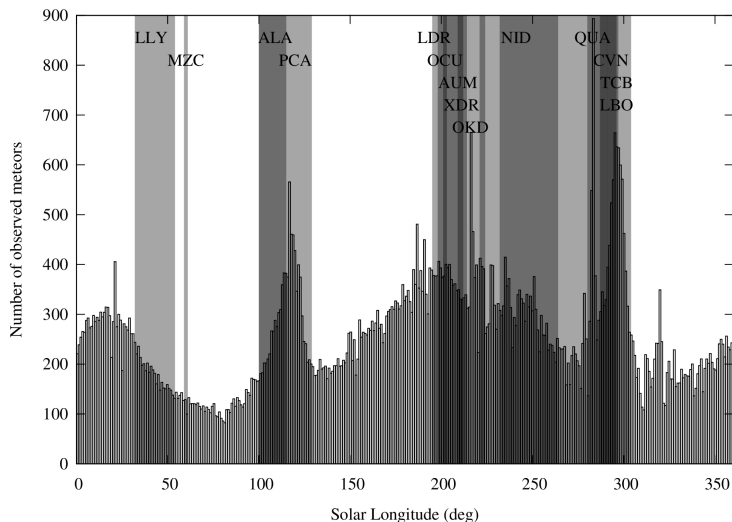


Figure 1: Average flux of the north toroidal source measured by CMOR during 2011–2014. Gray boxes represent the duration of known NT showers where their three letter IAU designations are positioned at the peak of their flux.