Don Quixote – a possible parent body of a meteor shower

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Here we are interested in whether the meteoroid stream of (3552) Don Quixote can generate some observed meteor showers. We have showed that particles originating from Don Quixote particles produce two meteor showers at Earth: κ Lyrids and August μ Draconids.

1 (3552) Don Quixote

The (3552) Don Quixote asteroid was discovered in 1983 and categorized as Amor asteroid. The Tisserand parameter for the orbit has a value of 2,315 with respect to Jupiter, which indicates a comet-like orbit. The diameter of the object as calculated from the absolute magnitude is in the range of 12,3 – 24,5 km. This all makes Don Quixote a good candidate for a short-period comet among known NEOs, which has been confirmed by recent observations of some cometary activity (Momment et al., 2014).

2 Methodology

We have investigated the orbital evolution of the meteoroid stream originating from Don Quixote. For this purpose, we modelled the generation and evolution of the meteoroid stream in the Solar System. The ejections of meteoroids from the asteroid's surface took place when the asteroid was passing its perihelion between 5000 B.C. and 2013 A.D. Next, the orbits of the ejected meteoroids were integrated to the year 2050. The theoretical radiant of a meteoroid orbit that passed within 0.05 AU from Earth is calculated with the Q method (Hasegawa, 1990). The similarity between the orbits of those particles that reached the Earth and orbits of known meteoroid streams listed at the IAU MDC was established using the Southworth and Hawkins D_{SH} criterion (Southworth and Hawkins, 1963). Additionally, we used the D_V functions proposed by Jopek et al. (2008). The described method pointed to two meteor showers: κ Lyrids (#464, KLY), and August μ Draconids (#470, AMD).

3 Results

We achieved a good matching when comparing the orbits of the κ Lyrids and the August μ Draconids with orbits from our simulation. Calculated values of D_{SH} for KLY and AMD meteor showers (0.11 and 0.12, respectively) are below the conventional threshold value which assumed when establishing orbits similarity, i.e. 0.20 (Babadzhanov et al., 2013). Similarly, the values of D_V are below the usual threshold value of 0.08 (Jopek et al., 2008; Rudawska et al., 2012).

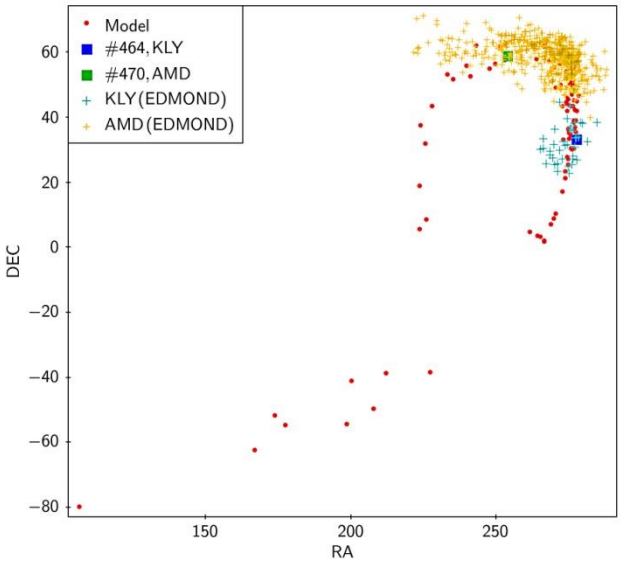

Figure 1 – Radiant positions for the simulated meteor showers, κ Lyrids and August μ Draconids taken from the IAU MDC, and κ Lyrids and August μ Draconids identified in the EDMOND database.

Figure 1 shows the distribution of the theoretical radiants of all the modelled meteors together with the radiant position of KLY and AMD taken from the IAU MDC, as well as KLY and AMD meteors identified by an independent identification method applied to the EDMOND database (Rudawska et al., 2014). The position of both showers taken from the IAU MDC fits nicely to the simulated meteor shower, occupying two parts of the simulated shower. Similarly, the dispersion of the radiants of both meteor showers extracted from the EDMOND database is in excellent agreement with the simulated distribution.

4 Conclusion

Our talk addresses the topic of the meteoroid stream of a parent body in relation to meteor showers observed on Earth. Particularly, we carried out a search to investigate the possibility of meteor shower observations caused by particles ejected from (3552) Don Quixote. With the methodology applied here and current observational data, we showed that a meteor shower can be created from Don Quixote. Moreover, we found that the particles originating from Don Quixote produce two meteor showers observed on Earth: the κ Lyrids and the August μ Draconids.

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