ESA's NEO Coordination Centre

Earth and Mars Impactor

Every year, around 18 November, the Earth travels through a cloud of cometary dust and we can witness another display of the Leonid meteor shower. The meteors are created when the dust ejected many decades or centuries ago by the comet Tempel-Tuttle enters in the dense atmosphere of the Earth and disintegrates at altitudes around 80 to 100 km. Typically the sizes of the dust particles are just a few millimetres.

Comet Tempel-Tuttle is in a retrograde orbit with a period of 33 years. Its aphelion is close to the orbit of Uranus at around 20 au. And the dust particles are in very similar orbits. Therefore their velocity when they enter the Earth atmosphere is very high (72 km/s). "Average" meteors in prograde orbits have typical impact velocities around 20 km/s. And this brings us to the riddle of this month:

The Flyeye telescope has detected a 500 m big NEO. (This is fictitious!!) After 3 days the NEOCC publishes some more details. The inclination is almost 0 degrees, the impact probability on 22 November 2049 is 1:230 000 and the impact velocity on the Earth surface is 20 km/s (ignoring atmospheric effects). A day later Juan Luis Cano from NEOCC adds that an impact on Mars can also not be excluded. And by chance the impact velocity on Mars would also be 20 km/s.

What is the perihelion of this peculiar NEO?
N.B.: for simplification, assume circular orbits for Earth and Mars, with Mars orbiting in the ecliptic plane. Fig. 1 shows the orbit of an object that is crossing Earth and Mars orbit.
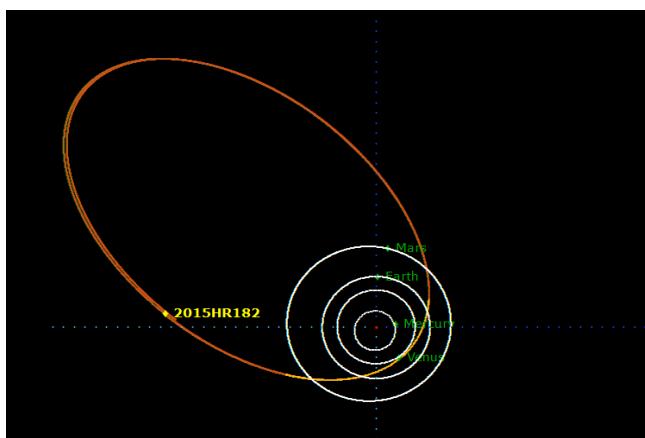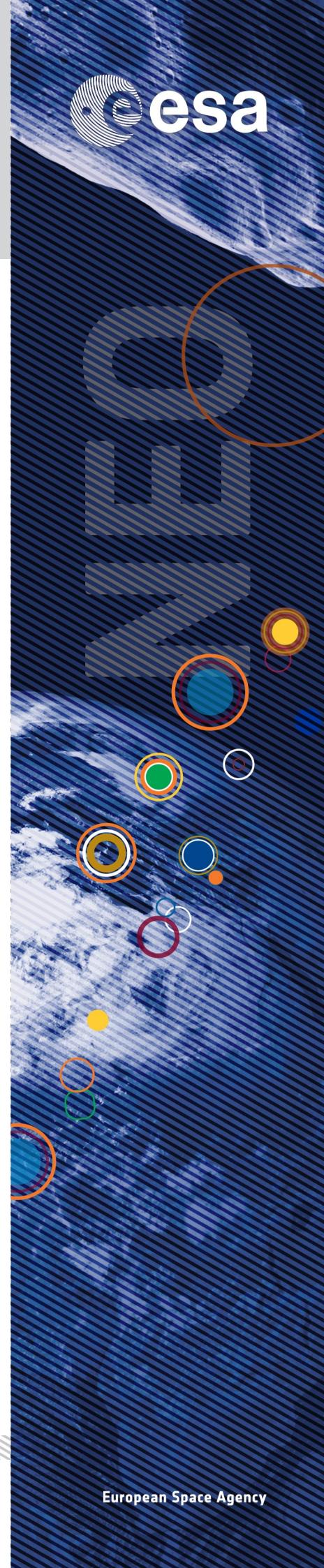

Figure 1: The orbit of asteroid 2015 HR182 is crossing both Earth and Mars orbit.

Please, send your reply before the proposed deadline to the following e-mail: neocc@ssa.esa.int.
Use as subject of your e-mail: "Riddle #6 – solution".
Moreover, please let us know if you would prefer not to have your name included in the list of correct replies.