→ RIDDLE #7

ESA's NEO Coordination Centre

Help Santa to save the world!

Yesterday ESA's Flyeye telescope detected a 200 meter sized asteroid that is on a collision course with the Earth. (This is fictitious!!) And not like in the riddle of last month, where the asteroid was approaching quite slowly and had a possible impact in 2049. No! This time the asteroid is coming on a retrograde orbit (inclination of 180 degrees) with an aphelion at 20 au and a perihelion of 1 au, with a predicted impact velocity of 71 km/s, pretty similar to the orbits of the Leonid meteoroids. And the predicted impact on Earth is on 24 December 2022. We have just 2 years to react.

What are our options? Let's look at Figure 1 where the Planetary Defenders have designed mitigation scenarios as function of warning time and size of the approaching asteroid. For a gravity tractor it is clearly too late, nuclear detonations are too risky and also not needed, but for civil defence (like evacuation) the asteroid is too big.

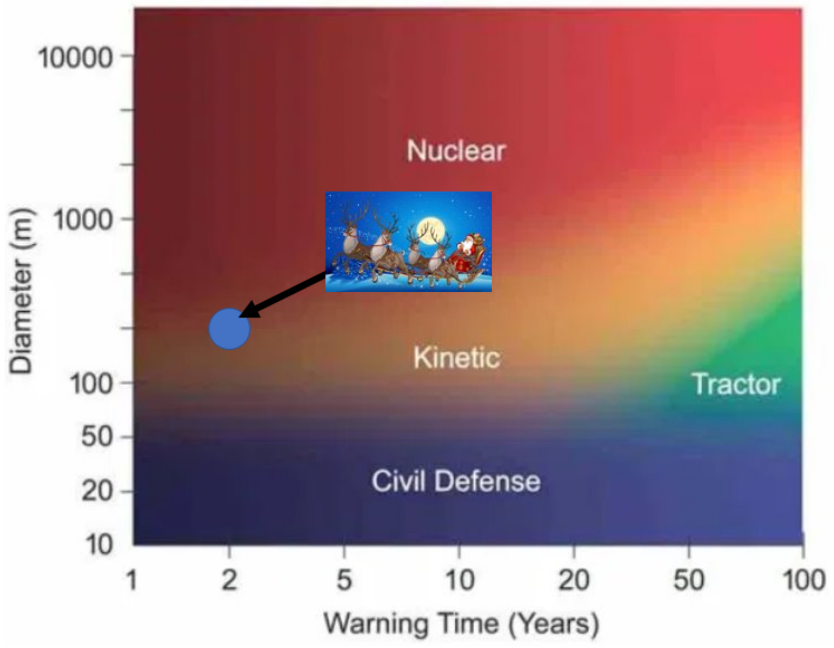

Figure 1: Planetary defence options as function of warning time and size of the asteroid. Image Courtesy of Tim Warchocki.

We need a kinetic impactor to deflect the asteroid! Unfortunately, ESA, NASA and all other space-faring nations are not yet ready to launch a deflection mission in such a short time. But Christmas time is coming up and Santa Claus has already his sledges in low-Earth orbit, ready to be loaded with the presents for all 120 million children living in Europe.

The only way to save the Earth is to load a fraction of the presents into an extra sledge and slam this sledge into the asteroid to deflect it from its fatal trajectory.

And this is the Christmas riddle: How many grams needs each of the 120 million presents be reduced if this mass is used for the required impactor? Assume a launch of the Santa Claus sledge on 24 Dec 2020 into exactly the same orbit as the asteroid, but prograde (perihelion = 1 au, apohelion = 20 au, inclination = 0 deg) and ignore the dry mass of the sledge. Assume further a circular Earth orbit with a semi-major axis of 1 au, a specific density of the asteroid of 2.0 t/m^3, and assume a central impact with impulse conservation, i.e. the energy of the impactor is transferred 100% to the asteroid. The effect of the impact is such that the new perihelion of the asteroid will be 15 000 km lower as before the impact.

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 #7 – solution".

Moreover, please let us know if you would prefer not to have your name included in the list of correct replies.