Who checks NASA's DART project?

Sjaak Uitterdijk

Abstract – A digital model of the collision of DART with Dimorphos, the 'moon' of the asteroid Didymos, learns that the by NASA press released influence of this collision on the orbit of this 'moon' is most likely greatly exaggerated. It is considered much more likely that the influence lies within the uncertainty of the parameters of this orbit.

I Introduction

Reference [1] did say, under "Mission/impact", after the launch of DART on 24 November 2021:
"It is estimated that the impact of the 500 kg DART at 6.6 km/s will produce a velocity change on the order of 0.4 mm/s, which leads to a small change in trajectory of the asteroid system, *but over time, it leads to a large shift of path. Over a span of years, the cumulative trajectory change from such a small change in velocity could mitigate the risk of a hypothetical Earth-bound asteroid hitting Earth. The impact will target the center of figure of Dimorphos and should decrease the orbital period, currently 11.92 hours, by roughly 10 minutes."*
Reference [2], published 18 December 2021, claims that this prediction is incorrect.
Its conclusions are:

> "The modelling of the collision of DART with Dimorphos has learned that orbits in general have the following three remarkable properties:
> 1 An orbits' mean velocity equals the initial velocity.
> 2 Its shape and orientation is fixed at the time of the launch / collision, as these parameters are already determined by the initial position of the orbiting mass, relative to the centre mass, and by the direction and magnitude of the initial velocity.
> 3 Orbits will, after launch / collision, exactly end at the start position.
> 4 The predicted 10 minutes, *after many years*, is not correct, given the above mentioned properties."

It showed up that somewhere between the publishing date of reference [2] (18 December 2021) and the date of the impact (26 September 2022), the complete text in reference [1], as shown above under "Mission/impact", inclusive this header, had been removed.
It is still available on the Internet under reference [3] with literally the same words.

On the 11th of October 2022 NASA released the information that DART caused a significant different change in the orbital time of Dimorphos than predicted about a year ago: from 11 hours and 55 minutes (11.92 hours) to 11 hours and 23 minutes, instead of to 11 hours and 50 minutes. The originally predicted decrease of about 5 minutes has been calculated too by means of the simulation model in reference [2], *taking a mass of 300 kg instead of 500 kg.*

If the original 500 kg is taken, the decrease in orbital time is 8.5 minutes. All these figures are based on a relative velocity between DART and Dimorphos of 6.6 km/s, as expected that time.

In reality, this speed turned out to be 6.145 km/s.

Given the enormous, compared to the expected, decrease of the orbital time, now claimed by NASA, the collision is investigated more closely in the next section.

II Analysis of the collision possibilities

The collision can, in principle, take place from any direction between a frontal and a tail one. The model in reference [2] learns, surprisingly, that a side collision doesn't have influence worth mentioning on the orbital time of Dimorphos.
The model also shows that a frontal and tail collision do have exactly the same absolute influence, with the frontal one resulting in a decrease and the tail one in an increase of the orbital time.

Assuming the collision was a frontal one, the most optimistic, but simultaneously most unrealistic, outcome is a decrease of the orbital time of Dimorphos of 8 minutes, taking 6145 m/s as speed at collision and assuming a full inelastic collision. The last mentioned assumption leads to the expression: $m_2 \cdot v_2 - m_1 \cdot v_1 = (m_1 + m_2) \cdot v_2'$, with the index 1 related to DART and index 2 to Dimorphos. In such a situation the mass of DART is assumed to be maintained fully, *and added to Dimorphos as if it is glued to it.*

Because $m_1 << m_2$ the final speed of Dimorphos is $v_2' \sim v_2 - m_1/m_2 \cdot v_1$, with $m_1/m_2 \cdot v_1 = 0.64$ mm/s, leading to the already mentioned decrease of 8 minutes of the orbital time.

Conclusion

The by NASA released decrease of 32 minutes of Dimorphos orbital time is considered as unrealistic. NASA should release a theory that supports such an outcome.

Failing that, one might assume that no deviation from the original trajectory may have been observed at all.

On second thoughts: how could a mass of 5 hundred kg affect the orbit of a mass of 5 billion kg, emphasized by the fact that the 500 kg is pulverized in a collision?

An asteroid that pays a serious threat to Earth needs at least an atomic bomb as a measure. Maybe like "Little Boy", which contained 64 kg strongly enriched uranium.
N.B. Such an asteroid will, besides its enormous mass, also have an enormous speed relative to Earth!

Anyway, the fact NASA has been able to let DART collide with Dimorphos is a remarkable success, given the trajectory that Didymos has traveled during the 9 months after the launch of DART.

References

[1] https://en.wikipedia.org/wiki/Double_Asteroid_Redirection_Test

[2] https://vixra.org/abs/2112.0101 Model of Collision DART with Dimorphos

[3] https://www.academia.edu/es/63830570/Amos_Ariny_Astronomer_DART_Mission