CONSEQUENCES OF THE DART IMPACT ON DIMORPHOS' SPIN STATE AND SURFACE MASS

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I.U. de Física Aplicada a las Ciencias y las Tecnologías

➔ **The DART (NASA) spacecraft shall impact Dimorphos**, the secondary of the binary NEA 65803 Didymos, in early fall 2022, at 6.2-6.7 km/s.

Motivation

➔ **Investigate the possible reaction of Dimorphos to the DART collision.**

➔ **Evolution of Dimorphos internal structure/post-impact state depend on:**

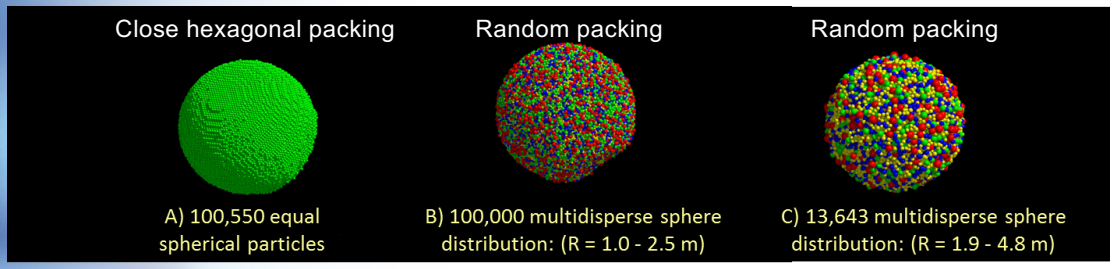
a) propagation of system linear & angular momentum (conserved)

b) propagation of residual kinetic energy from impact

➔ Residual kinetic energy: ~0.25% according to cratering experiments goes into kinetic energy of the target.

Methodology

Tested target structures



- 'Real' DART: V_i = 6.65 km/s, m_i = 650 kg.
- Didymos reference model (M, D, ρ, T_{spin})
- ε_N =0.3. f_{KE} = 0.0025 (1/400).

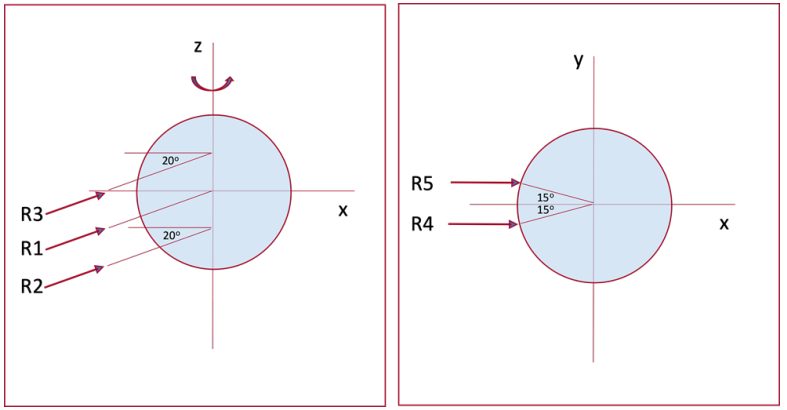
Scale DART spacecraft mass *and* velocity to synthetic projectile
conserving linear & angular momentum and preserving fraction (f_{KE}) of impact kinetic energy

➔ Assumption:
Dimorphos is a spherical rubble-pile.

➔ Tool:
(SSDEM pkdgrav: Schwartz, 2012)
to study the dynamical evolution of target components.

➔ Impact target and follow dynamical evolution and energy propagation

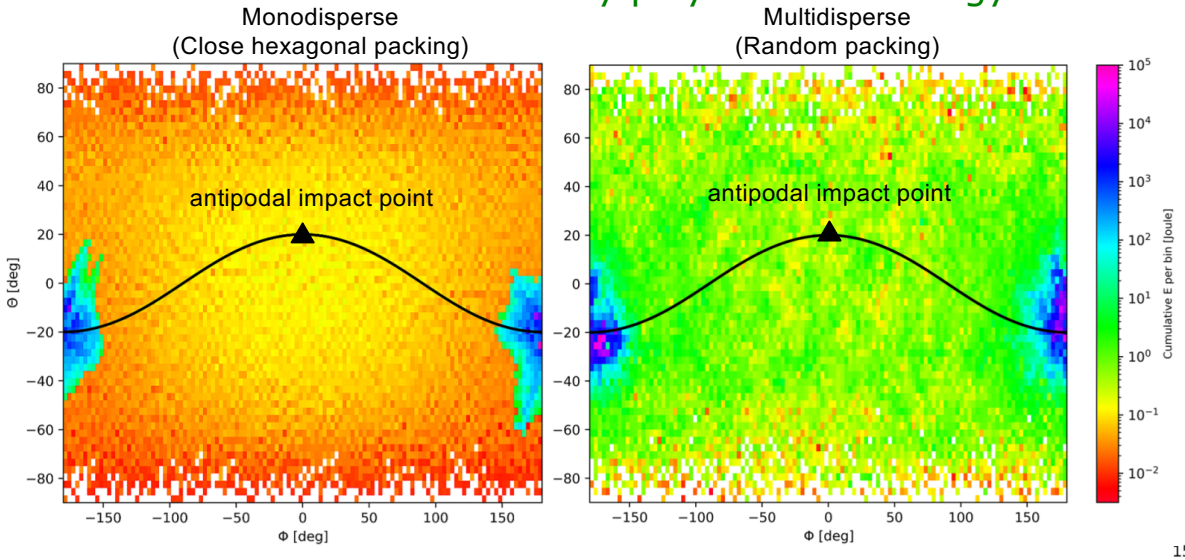
Different impact geometry tested

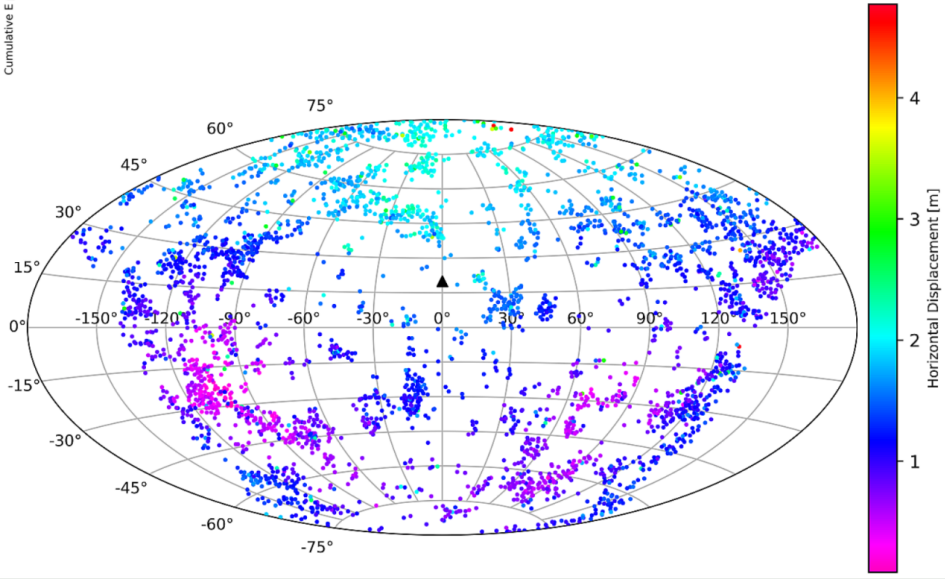


Results (effects on the surface)

Mono and multi-disperse nominal cases transfer residual impact energy to the surface away from the impact region in different ways. (multidisperse case transfer 8 times larger energy to the surface)

➔ The internal structure may play a role in energy transmission.





Boulder motion (R<2.5 m) limited to 4.7 m displacement found in multidisperse nominal case.

➔ potentially detectable by comparing LICIA and Hera observations.

Results (spin period and axis orientation)

Spin period and **axis orientation** changes depending on impact geometry:

- Spin period: up to -30’ change.
- Spin axis: up to 3 deg change.
- Spin axis is tilted with respect to angular momentum vector by about 0.1 deg with motion around the latter following a spin motion.