SPH simulations for space defense

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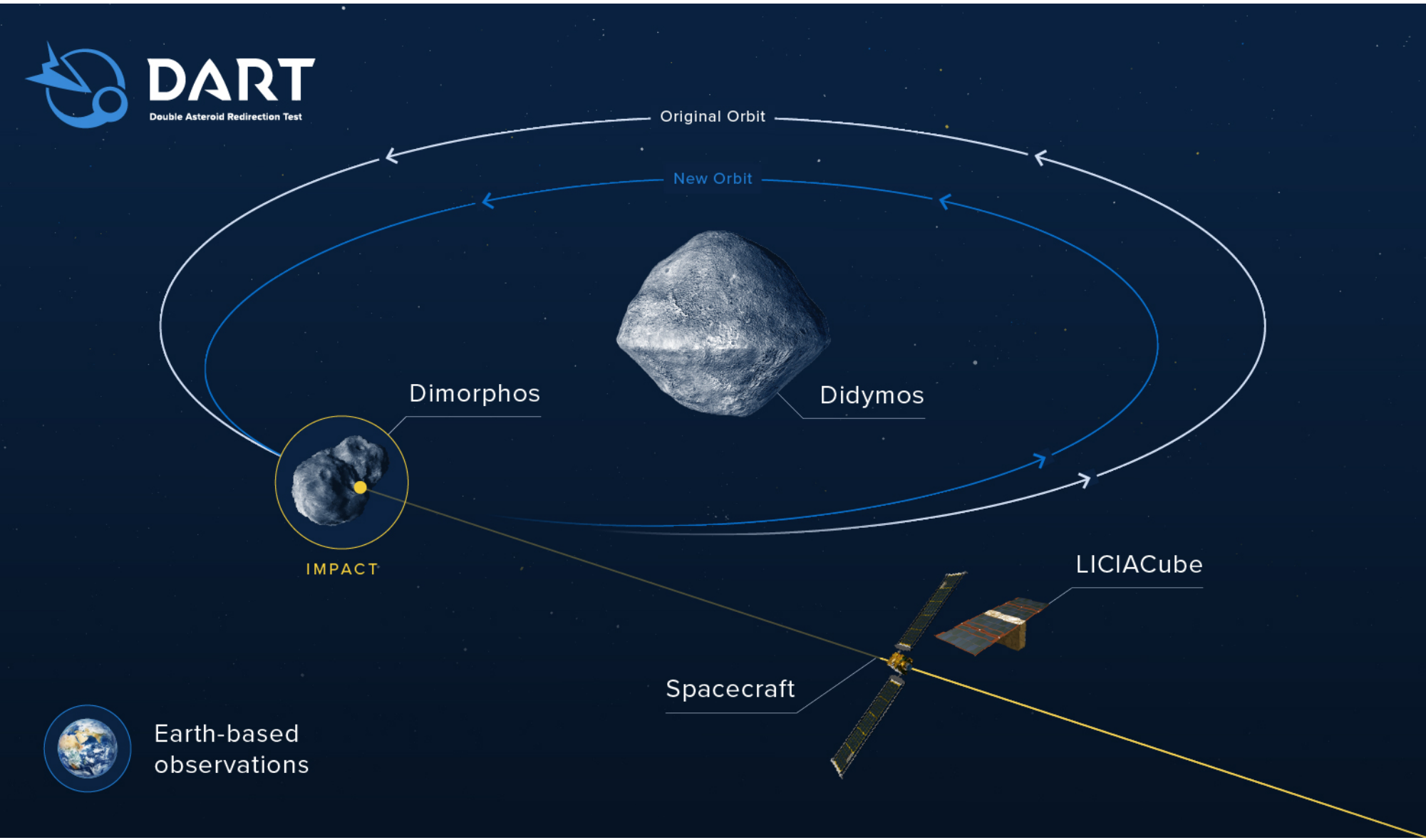
July 14, 2020

Roadmap

1. Dart and Hera Missions
2. SPH setup
3. SPH results


DART
Double Asteroid Redirection Test
Original Orbit
New Orbit
Dimorphos
Didymos
IMPACT
LICIACube
Spacecraft
Earth-based
observations

Dart Mission

- Launch in July 2021 atop a SpaceX Falcon 9
- Impact in fall 2022
- 11 million kilometers distance to earth
- Observations with LICIACube and earth based telescopes

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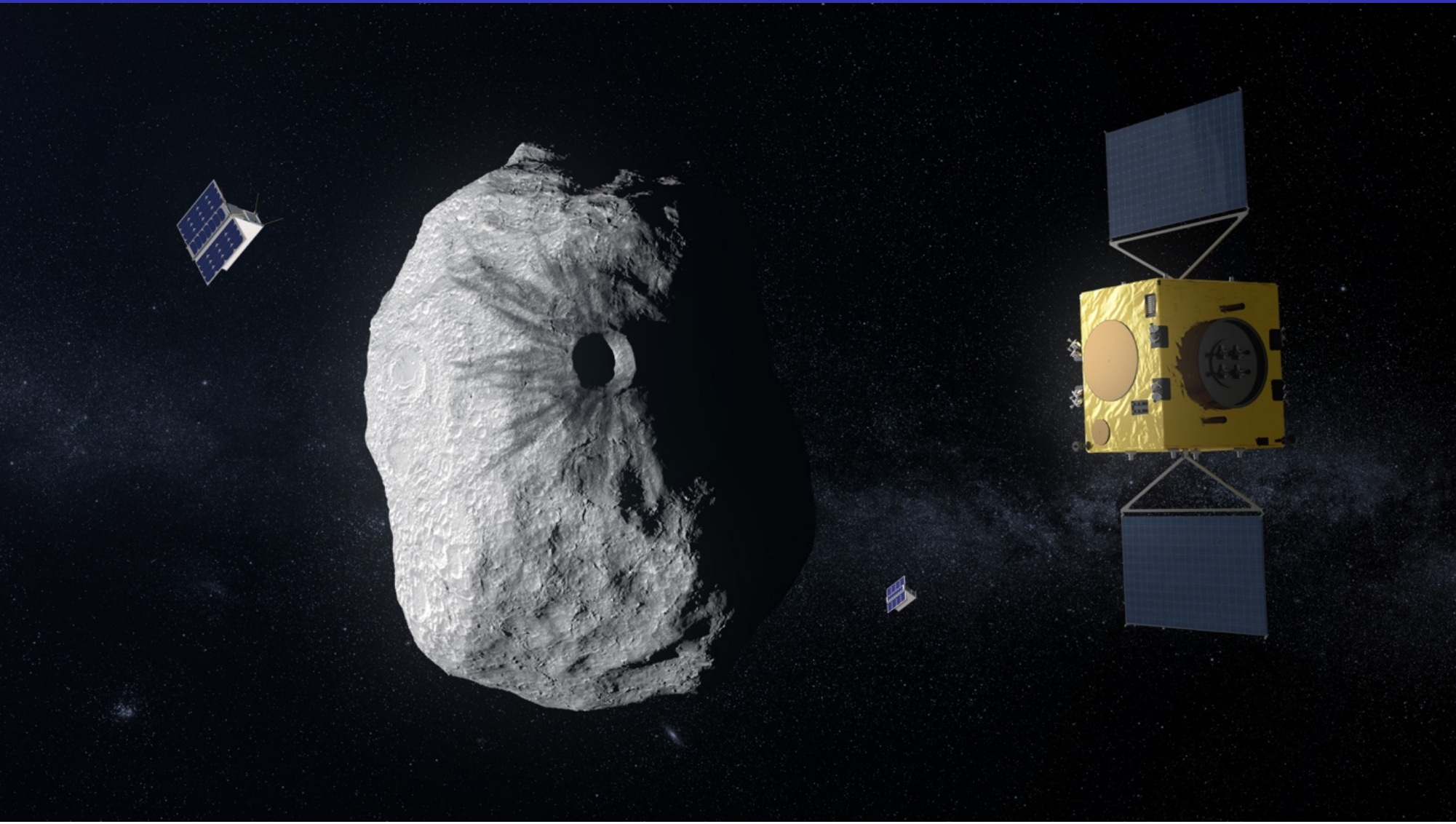
Hera Mission



Hera Mission

- Launch in 2024
- Arrival in 2026
- Why a second mission?
  - Dust cloud after impact
  - Reduce uncertainty of orbit shift
  - Politics ...

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Target

https://www.nasa.gov/planetarydefense/dart Dimorphos orbiting Didymos

Impactor

https://dart.jhuapl.edu/Mission/Impactor-Spacecraft.php

SPH method

Smoothed particle hydrodynamics

Miluphcuda

Smoothed particle hydrodynamics

Miluphcuda setup

- x^3 Kernel function
- artifical viscosity
- Runge Kutta fourth order
- no self gravity
- p-α porosity - micro vs macroporosity

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smoothing length

- how can resolution be locally increased with SPH method (different radii and sml) - limit of sml -¿ 0 is normal hydrodynamics??

Beta factor

Comparision with grid codes

Raducan

Impact angle

Not seen in 2d grid codes Raducan

Conclusion