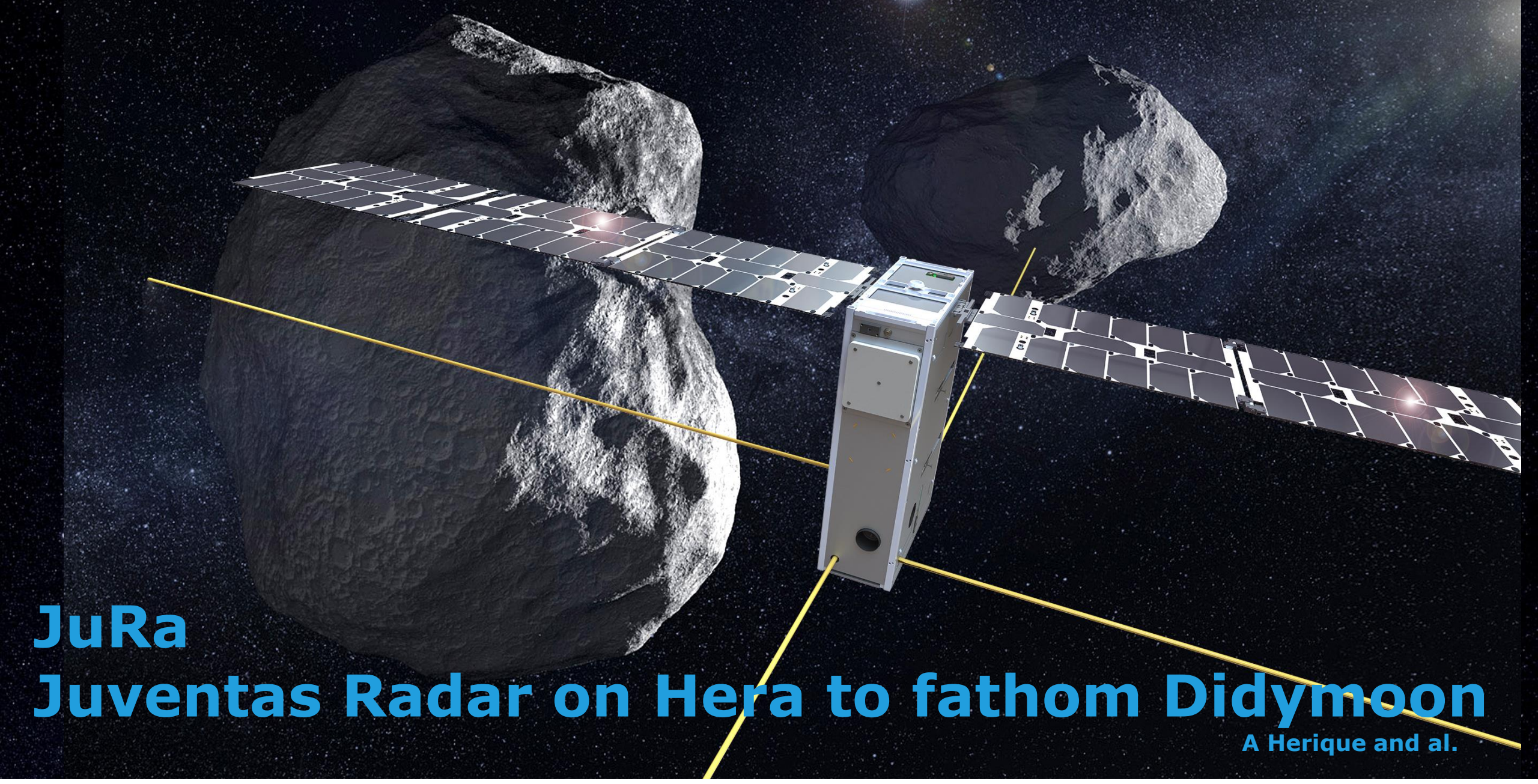

JuRa
Juventas Radar on Hera to fathom Didymoon

A Herique and al.

IPAG Institut de Planétologie et d'Astrophysique de Grenoble
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TECHNISCHE UNIVERSITÄT DRESDEN
electronics and software solutions EmTroniX
BRNO UNIVERSITY OF TECHNOLOGY
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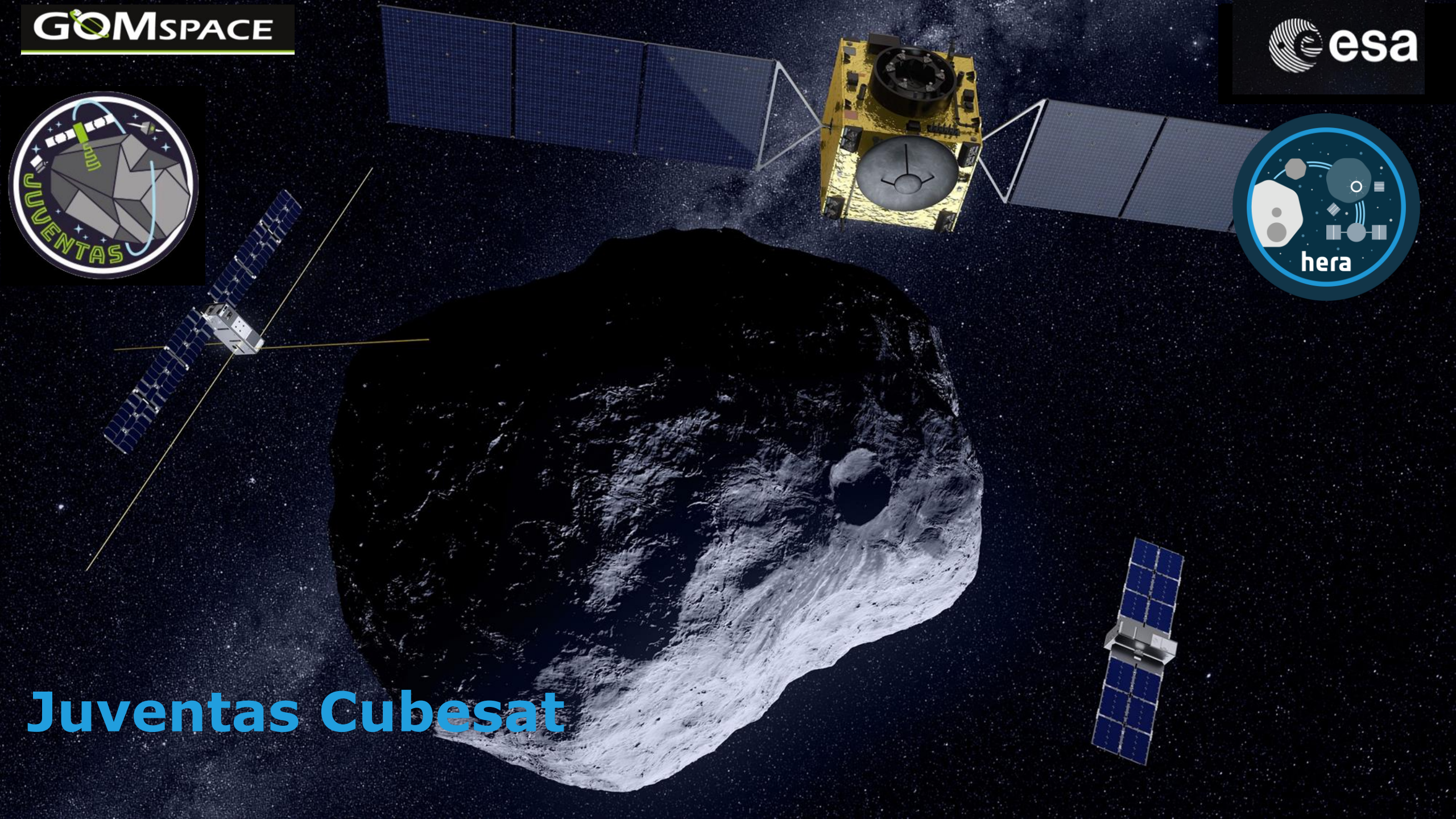
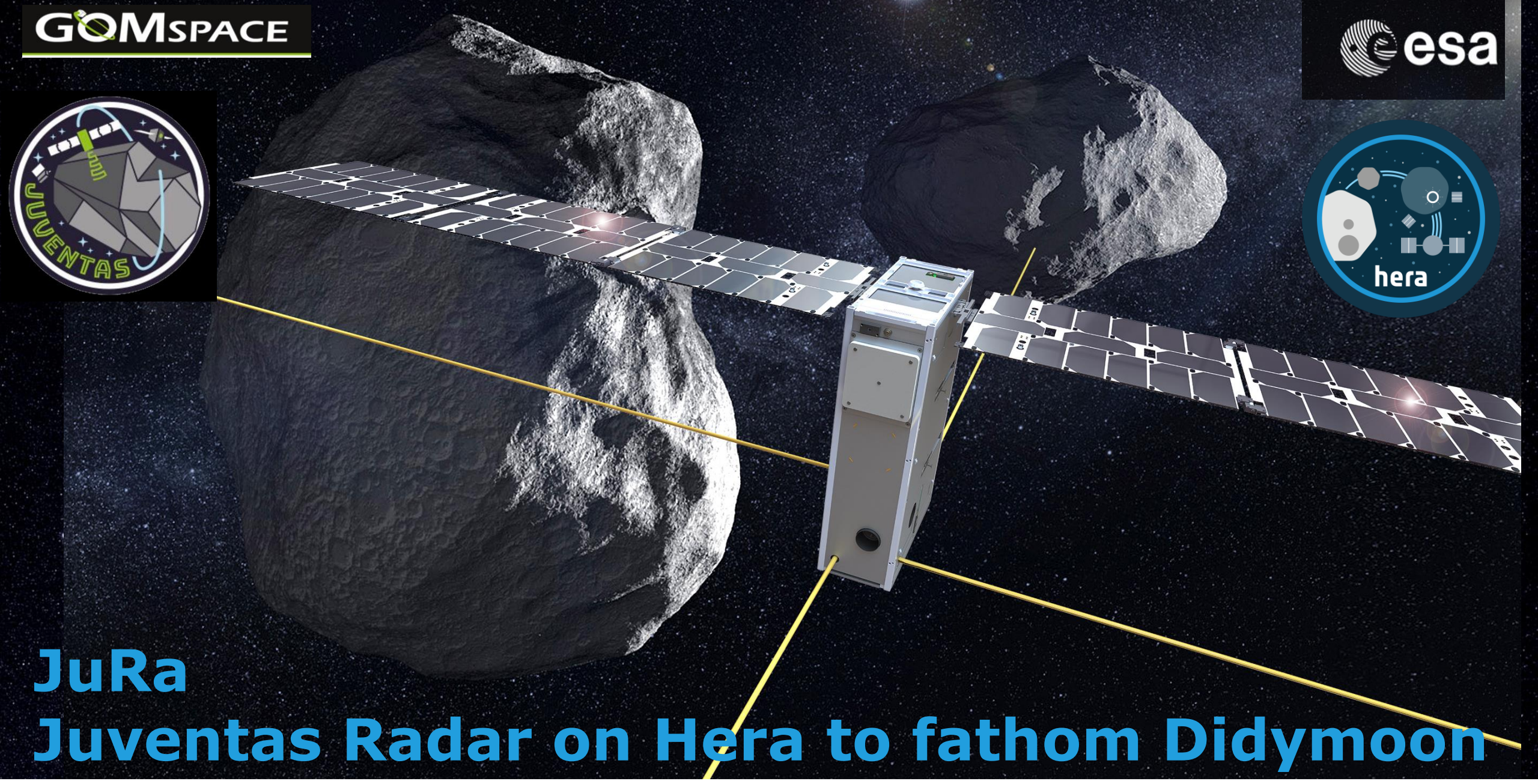
Hera mission - Didymos binary system


GOMSPACE
esa
JUVENTAS
hera
Juventas Cubesat



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Fathom internal structure of asteroids

Science

- To validate and to improve our understanding of the asteroid's evolution from accretion to now
- to better model low gravity mechanics
  - Aggregate structure, stability conditions and binary formation
  - Regolith origin, mechanical and thermal properties

Spacecraft interactions with asteroids

- Planetary defense, Exploration, Sample return, …
  - Momentum transfer and mass redistribution

Radar to characterize heterogeneities
from metric scale to global scale

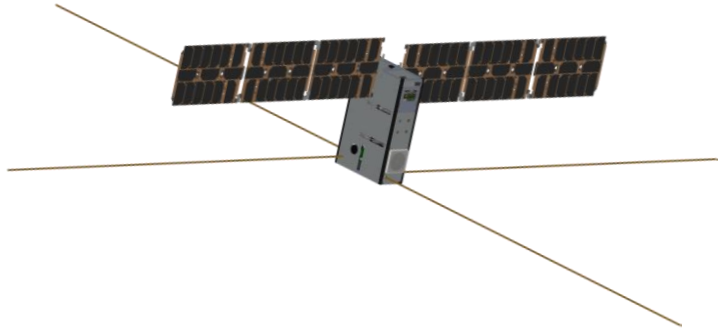
JuRa: the Juventas Radar on Hera to fathom Didymoon

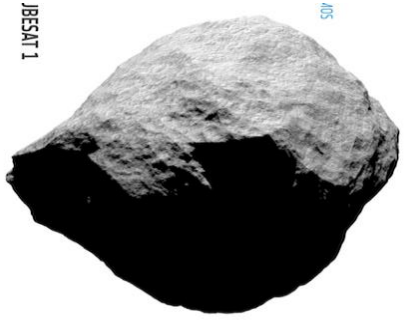
Monostatic radar

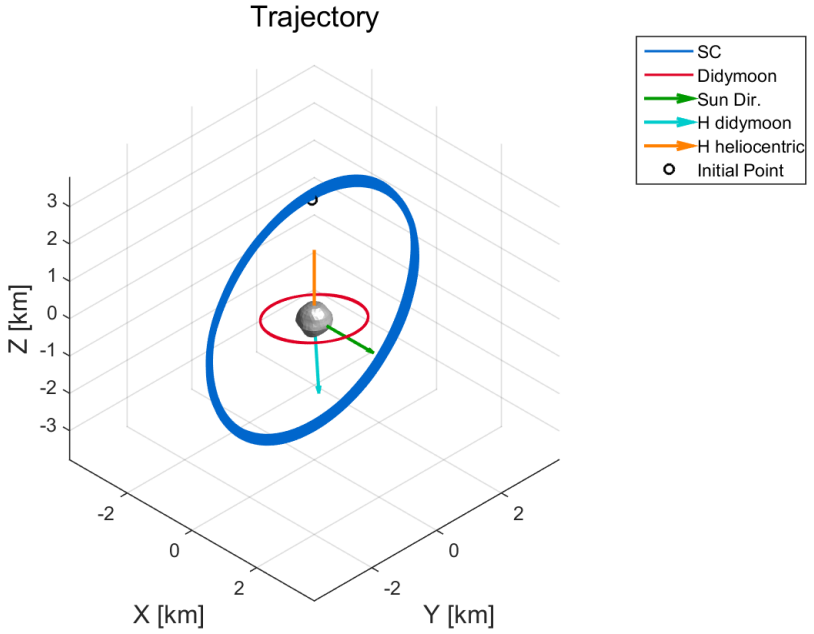
- @ 60 MHz
- Full circular polar

Operation

- Launch 2024
- Operation 2027
- Terminator orbit
- 1 month @ 3 km radius
- 1 month @ 2 km radius (300 m)







	JuRa
carrier	60 MHz
signal	BPSK
BW	20 MHz nominal 30 MHz extended
Resolution	10 – 15 m (1D)
Polarization	Full linear
Tx power	6 W
NEσ_0	-40 dB.m^2/m^2 (Goal)

JuRa : Tomographic SAR

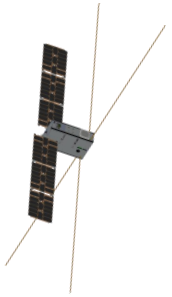
Synthetic Aperture Radar 60 MHz

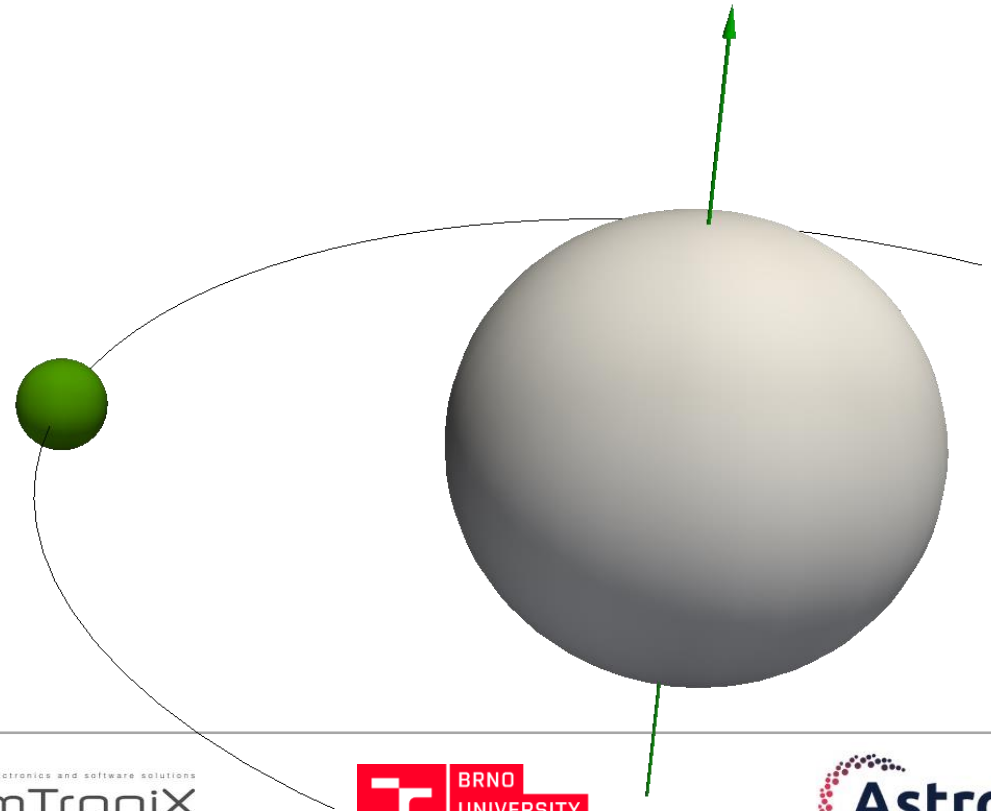
Backscattering coefficient mapping (power)

Penetration several tens of meters => full?

Performances given by the acquisition geometry.

- range measurement (1st dim.)
- moon / main motion (2nd dim.)
- S/C motion : multipasses acquisition (3rd dim.)





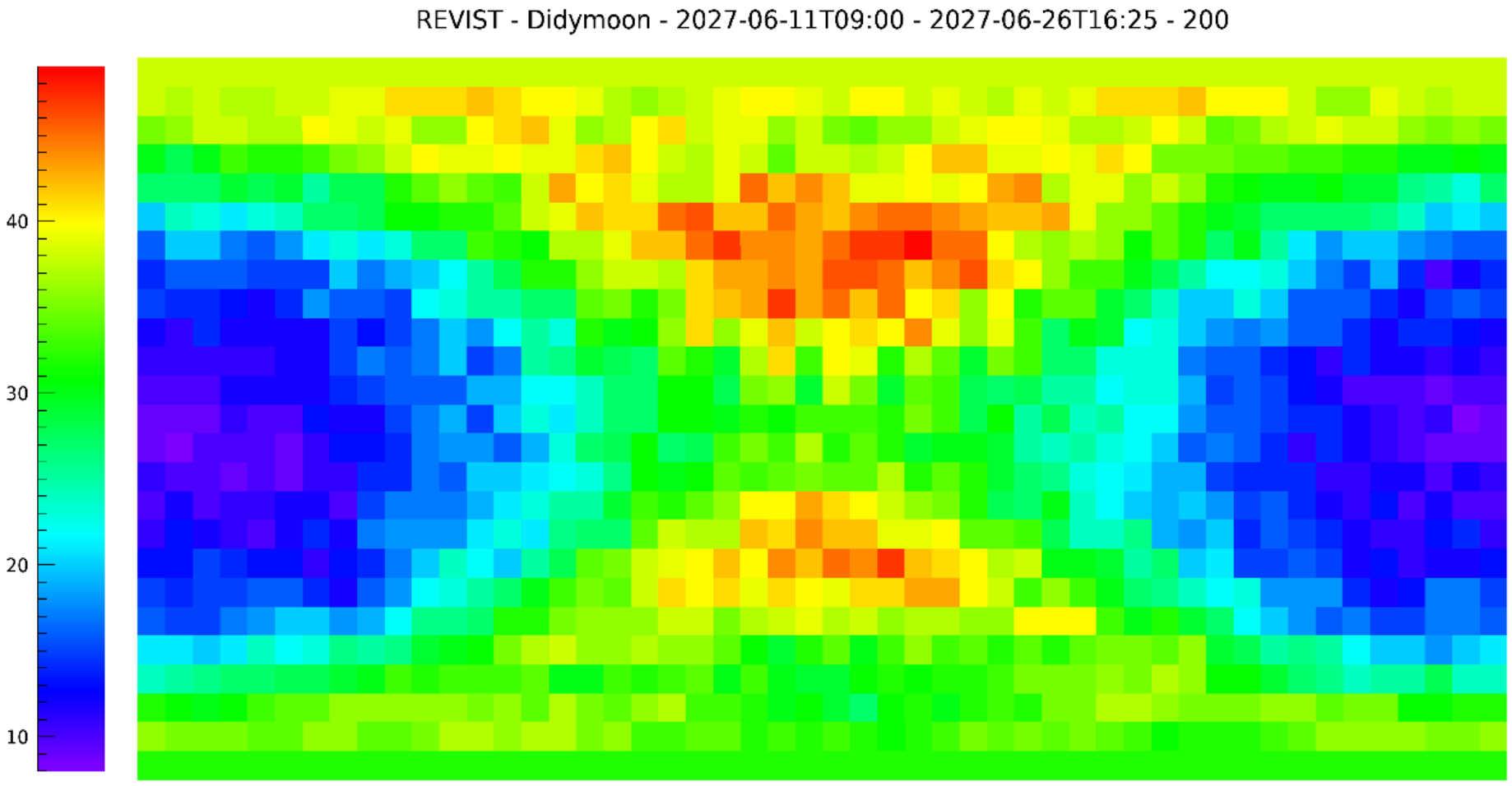
JuRa : Tomographic SAR

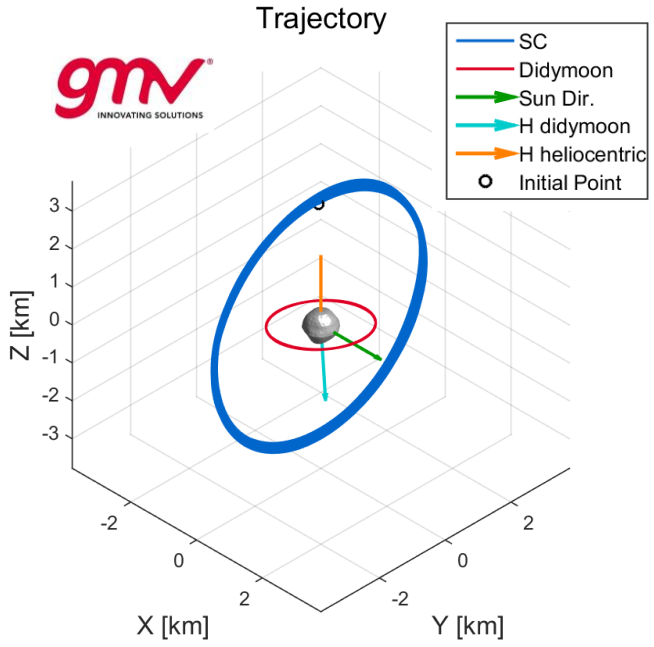
Measurements: With one sequence of operations, SAR processing integrates several thousand measures along acquisition orbit to provide 2D image, mixing in the same resolution cell (pixel) features from surface and subsurface.

If Radar waves penetrate the whole moonlet, signal returned from the opposite side jointly to shape model gives the direct access to the average dielectric permittivity which is related to the composition and to the propagation regime (heterogeneity scales) as done with a bistatic radar;

Multi-pass acquisitions with different geometries allow 3D tomography processing to access vertical distribution of materials. Tomography performances are mainly limited by the number of acquisition sequences and therefore by the overall data volume and by the orbit constraints. With full penetration, the tomography would benefit of the absolute measurement of the propagation delay

JuRa : Tomographic SAR





duty cycle : 45' measurement every 110 minutes

JuRa objectives

JuRa is mapping backscattering coefficient (σ_0) of the surface or subsurface
related to the degree of heterogeneity at the scale of the wavelength
and to the dielectric contrast of heterogeneities,
sub-metric texture of the constitutive material and larger scale structure.

First objective: moonlet interior structures

- to identify internal structure like layers, voids, sub-aggregate,
- to bring out the aggregate structure
- to characterize it constitutive blocks in terms of size distribution, heterogeneity at different scale (from sub metric to global)
    - $\Rightarrow$ Binary system formation and stability conditions
    - $\Rightarrow$ Impact crater characterization (with limited resolution)

JuRa objectives

JuRa is mapping backscattering coefficient (σ_0) of the surface or subsurface related to the degree of heterogeneity at the scale of the wavelength and to the dielectric contrast of heterogeneities, sub-metric texture of the constitutive material and larger scale structure.

First objective: moonlet interior structures

Second objective: average permittivity and its spatial variation

- to retrieve information on composition and porosity
  - $\Rightarrow$ Full tomography if waves penetrate the whole moonlet
  - $\Rightarrow$ Impact crater characterization (with limited resolution)

JuRa objectives

JuRa is mapping backscattering coefficient (σ_0) of the surface or subsurface related to the degree of heterogeneity at the scale of the wavelength and to the dielectric contrast of heterogeneities, sub-metric texture of the constitutive material and larger scale structure.

First objective: moonlet interior structures

Second objective: average permittivity and its spatial variation

<u>Secondary objective : The same characterization applied to the main</u>

- to identify internal structure
- to retrieve information on composition and porosity
- to detect difference in structure, texture and composition

  $\Rightarrow$ Mass redistribution, Aggregate structure

  $\Rightarrow$ Binary system formation and stability conditions

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Instrument Delivery
EM in progress. September 2021
QM February 2022
FM November 2022

Acknowledgments
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- Juventas and JuRa are developed under ESA contract supported by national agencies.
- JuRa is built by Emtronix (Lux), UGA/IPAG (Fr), TUD (Gr), Astronika (Pl) and BUT (Cz).
- Juventas is built by Gomspace (Lux).

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