Transitional near-Earth Objects: asteroids or comets?

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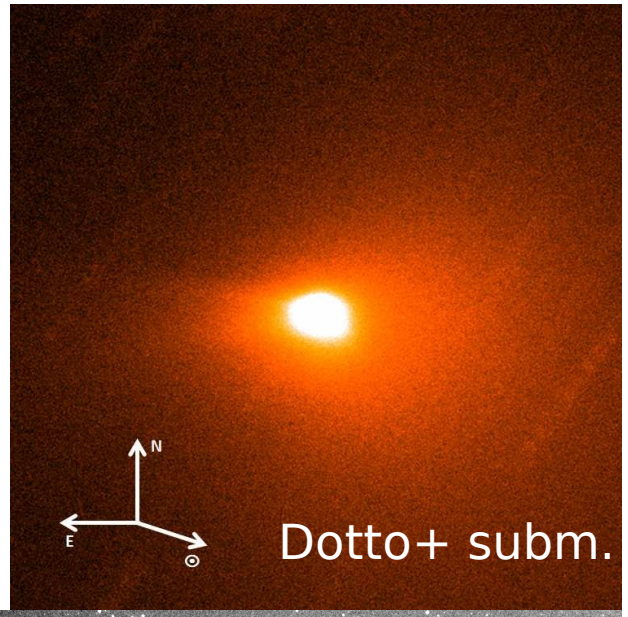
Transitional near-Earth Objects: asteroids or comets?

Science rationale

- Few NEOs discovered as asteroids but have subsequently shown intense activity (e.g. 333P / 2007VA85);

- others flagged as comets, but exhibit an asteroidal aspect (e.g. 107P / 4015 Wilson-Harrington).

These bodies, with often a double asteroid/ comet designation, are labeled as “Transitional NEOs”.



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Science rationale

The investigation of such asteroid/comet transitional objects are of paramount importance to:

- constrain evolutionary processes (i.e. planetary mixing, thermal processing, and delivery of volatiles to terrestrial planets);
- search for organic and prebiotic material in the SS.

Some of these frontier bodies have also been indirectly linked to the activity by association with meteor showers, such as 2019WN25 for the November i-Draconids (Ieva+ 2019), or (3200) Phaeton for the Geminids (Ishiguro+ 2022), future target of the DESTINY+ mission.

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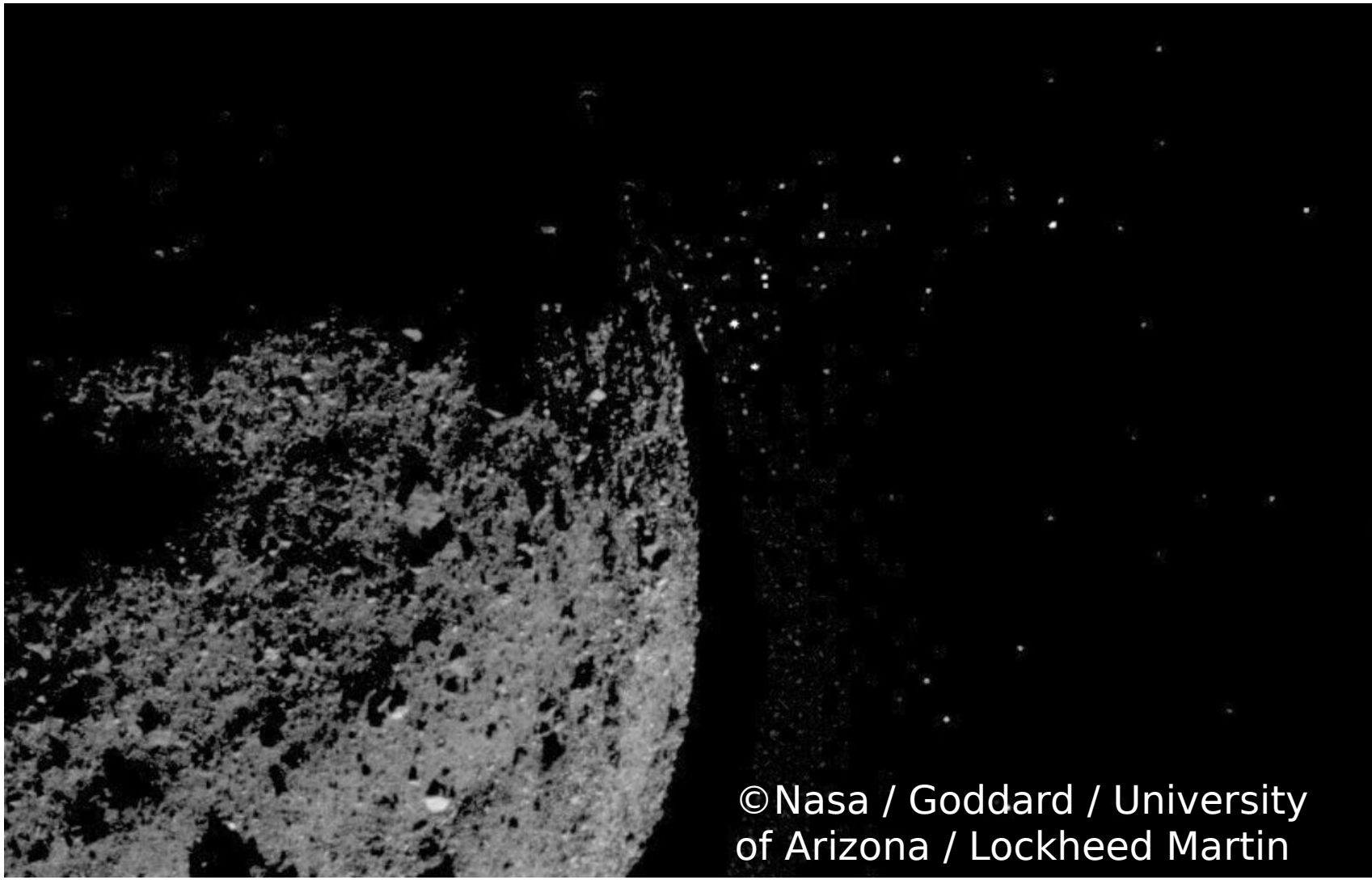
Even (101955) Bennu, target of the NASA OSIRIS-Rex mission, has been associated with activity.



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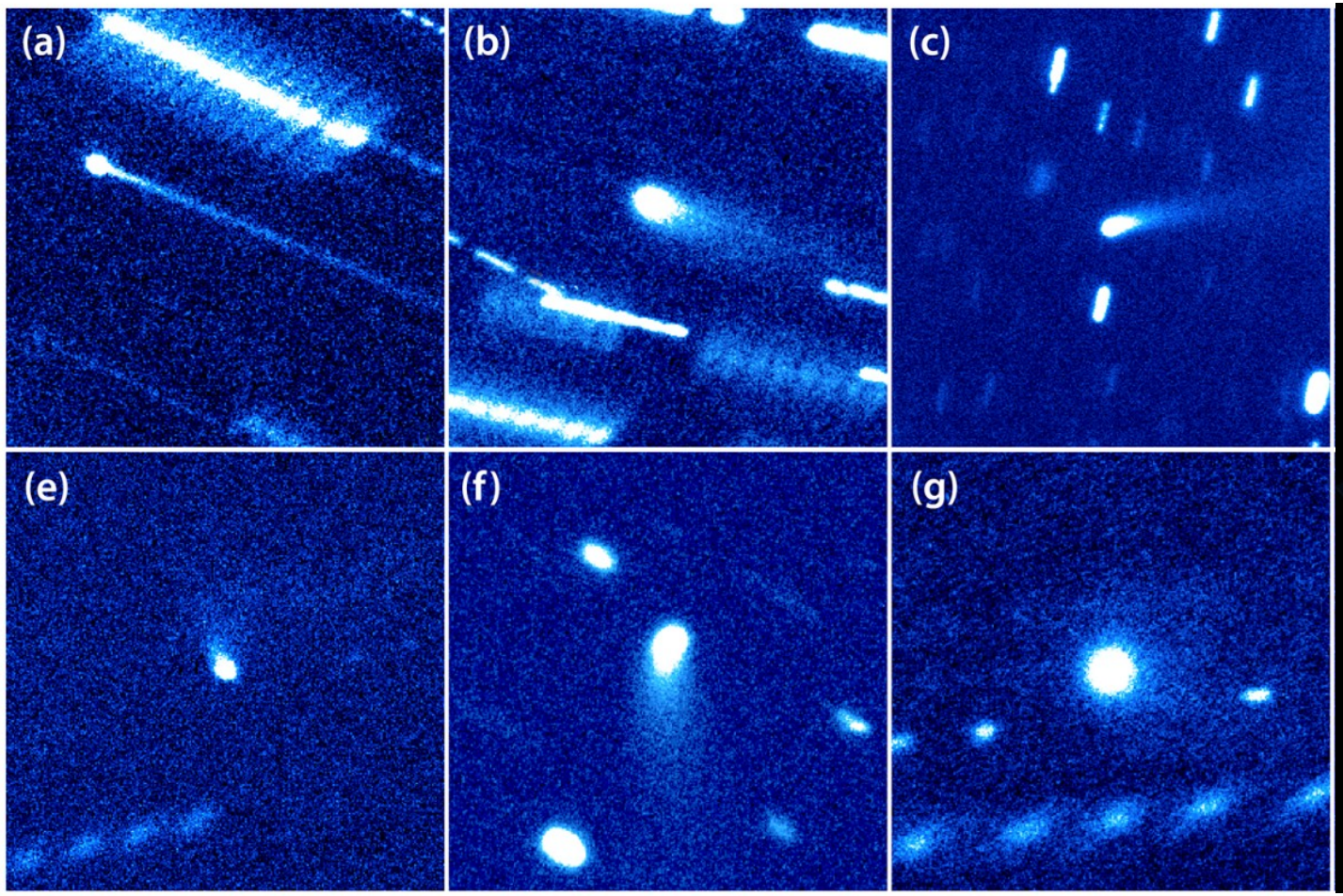
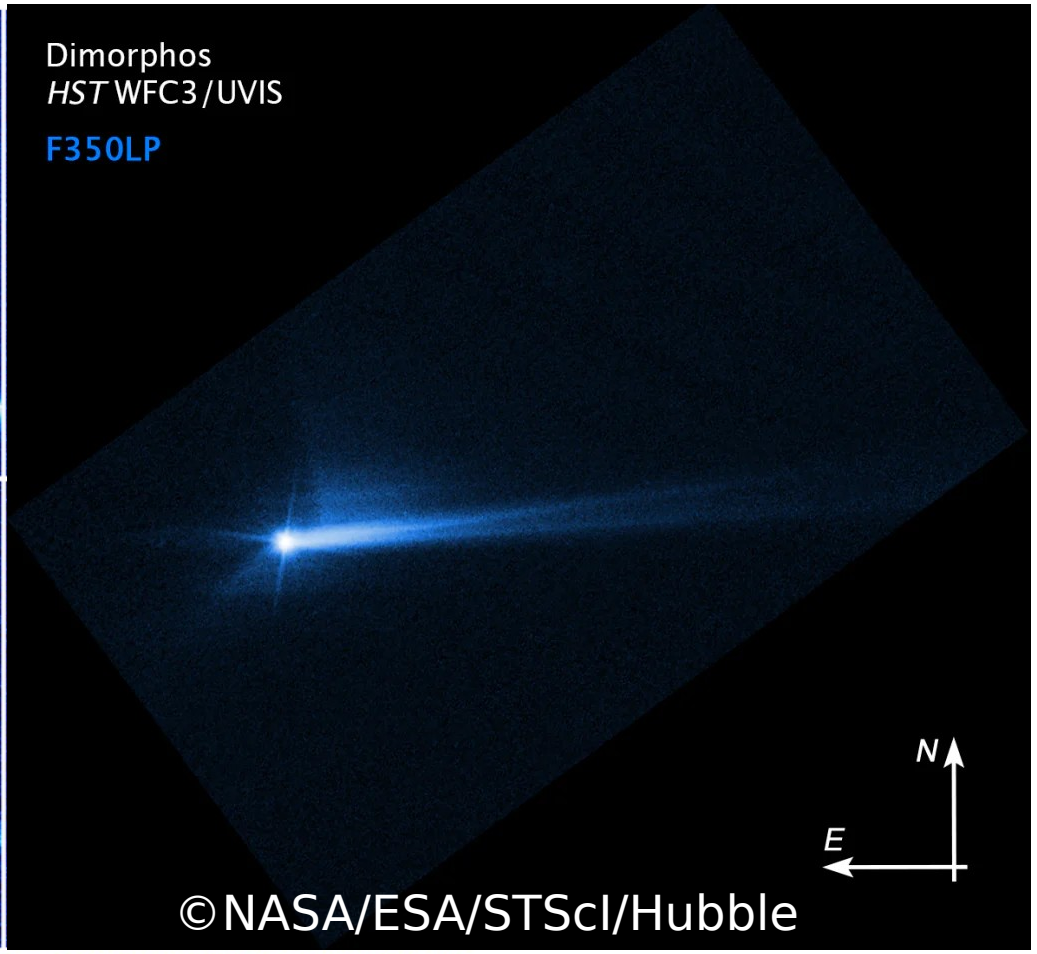
This is even more crucial after the DART impact...





Jewitt & Hsieh, 2022

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Objectives:

Characterization from Earth of other transitional objects are crucial:
- to better understand their formation mechanisms in the broader context of SS formation;
- to assess their possible contribution to the development of life;
- to provide scientific constraints useful for planning the DESTINY+ mission and assist the JAXA team in maximizing the scientific return and interpretation of data taken in situ.

In the framework of an already existing collaboration with professor Masateru Ishiguro, co-I of the DESTINY+ mission, the goal of this grant is to foster an international exchange between the planetology group at INAF-OAR and prof. Ishiguro’s team.

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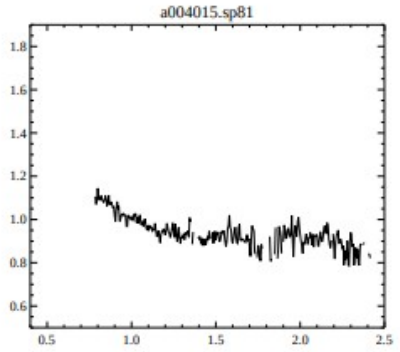
WP1 - Low resolution spectroscopy (Led by S. Ieva)

Acquisition of spectroscopy data, in the UVNIR range (0.3-2.5 um) on a competitive basis, in order to obtain low-resolution spectra and identify mineralogy and potential absorption bands linked with water, organics and prebiotic material on their surface.



WP2a/b – Short and deep photometry (Led by S. Ieva)

a) Acquisition of short-exposure visible photometry from several facilities in order to determine rotation period and axis, shape. We will also estimate diameter, assuming average density from taxonomy.

b) Long-exposure photometry acquired to investigate coma and tails, and constrain dust emission (e.g. Qd and Afρ parameter).

WP3 – Polarimetry (Led by M. Ishiguro)

Acquisition of polarimetric observations of transitional NEOs (107P, Phaeton…) to obtain physical information of their surface properties (texture roughness, grain size, albedo) and assess indirectly the degree of weathering of their surfaces.