**FAN-SHAPED DUST EMISSION FROM THE NUCLEUS OF COMET 3I**

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Subject: Optical, Comet

We analyzed HST images (P.I.: D. Jewitt) and images coming from the 2-meter telescope of the LCOGT node at Siding Spring and Haleakala Observatory (Group ID: C/2025 N1 and 3I-2m-JoseMPerez-INS\_Alcarras, respectively) of the interstellar comet 3I:

Date Filter Site Proposal ID

LCO coj 2m 2025.07.04 g,r,z,i Siding Spring (Australia) TSO2025A-001

HST 2025.07.21 FP350L Space 17830

LCO ogg 2m 2025.08.13 g,r,z,i Haleakala (Hawaii) TSO2025B-001

LCO ogg 2m 2025.08.14 g,r,z,i Haleakala (Hawaii) TSO2025B-001

LCO ogg 2m 2025.08.15 g,r,z,i Haleakala (Hawaii) TSO2025B-001

LCO ogg 2m 2025.08.16 g,r,z,i Haleakala (Hawaii) TSO2025B-001

The coma shows in the HST images and in the subsequent LCO images taken on August 13-16 a prominent elongation in the W quadrant, with a peak brightness at PA 285° and an estimated amplitude of ≈30° (Figure 1). This appears related to an anisotropic ejection of dust towards the Sun modulated by direct insolation and by radiation pressure, confirming what had been previously reported by Jewitt et al. (arXiv 2508.02934v2, 2025), who observed on the HST image a broad fan along PA 280±10.

The elongation was already visible in the LCO images of July 4, although hardly identifiable as an anisotropic dust emission (Figure 2a and 2b). In fact, it was initially described as a diffuse tail along PA 280±10° by Jewitt et Luu (ATEL #17263, 2025), who observed it with the Nordic Optical Telescope on July 2, 2025. However, the projected PA of this emission seemed inconsistent with a tail produced by radiation pressure.

Jewitt et al. (arXiv 2508.02934v2, 2025) identified the comet’s tail later on the HST images as a very faint emission in the anti-solar direction. This observation was confirmed by analyzing the 2-m LCO telescope images taken on August 13-16, when the tail became more evident in PA 100°, consistent with the calculated PsAMV, as the projected length of the tail increased following the increase of the phase angle from 9° to 19°(Figure 3a and 3b).

The coma extension visible on all the images appears fan-shaped as a result of the projection onto the plane of the sky of an emission cone emerging from a high-latitude discrete source on the sunlit side of the rotating nucleus. A numerical model of the inner coma reproduced a realistic simulation of the fan on all of the images as a result of the nucleus rotation by setting a discrete source at a latitude of ≈75°, with a radius of the dust particles between 5 and 100 μm (assuming a dust density of 103 kg·m-3) and corresponding emission velocities of ≈25 to 5 m·s-1. The modelling allowed to estimate an orientation of the north pole of the nucleus within a circle of 5° centered at RA 154° and Dec +25° (or RA 334° and Dec -25°). Further high-resolution images are, however, needed to confirm these preliminary findings.

With these estimated coordinates, the spin axis orientation should remain relatively stable in the next few weeks. The geometric conditions of the observation will also remain stable, no major modifications in the appearance of the fan-shaped dust emissions are expected.

As the comet approaches perihelion in mid-October, if the direction of the rotation axis is invariant, the pole of the hemisphere where the active source is located should appear from Earth considerably tilted behind the sky plane. At the same time, as a result of the comet’s path on its orbit, the subsolar point on the nucleus will move to increasingly higher latitudes in the hemisphere opposite to the source of the fan, which should then be in umbra, so the fan should disappear.

Figures and captions are available at:

<https://web.oapd.inaf.it/bedin/files/PAPERs_eMATERIALs/ATel/C2025N1/>