TRAPPIST first post-perihelion production rates of the Interstellar comet 3I/ATLAS

ATel #17515; ***E. Jehin, S. Hmiddouch, K. Aravind, J. Manfroid (STAR Institute, University of Liege), Z. Benkhaldoun, and A. Jabiri (Cadi Ayyad University of Marrakech).***
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Credential Certification: Emmanuel Jehin (ejehin@uliege.be)

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The authors report that they obtained, using the TRAPPIST-North (Z53) robotic telescope installed at the Oukaimeden Observatory in Morocco, observations of the interstellar comet 3I/ATLAS during two hours before sunrise on three consecutive photometric nights, Nov. 22, 27, and 28. They used broadband B, V, R, I filters and cometary HB narrowband (gas and dust) continuum filters (Farnham et al. 2000, Jehin et al. 2011) and computed preliminary production rates from extracted profiles at 10.000 km from the optocenter of the comet using a Haser Model (Vp=Vd=1km/s) (Haser 1957). Zero Points were computed on the three nights using standard stars. The proxy to the dust production rates A(0)f(rho) were estimated by profile fitting at 10.000 km (A Hearn et al. 1984) and corrected for the phase angle (Schleicher 2007).

3I/ATLAS
Date UT=2025-11-29, r_h=1.76 au, Delta=1.93 au, DT=+31 days
Q(OH) = 1.67 +/- 0.27 E28 s-1
Q(CN) = 5.54 +/- 0.19 E25 s-1
Q(C2) = 6.13 +/- 0.21 E25 s-1
Q(NH) = 2.31 +/- 1.05 E25 s-1
A(0)fp(R) = 4659 +/- 28 cm
A(0)fp(RC) = 5493 +/- 20 cm
A(0)fp(BC) = 3454 +/- 47 cm

One month after perihelion, the radicals OH, CN, C2, and C3 are easily detected in the 20 minutes exposure with a 2x2 binning (1.2 arscec/pixel), except NH, which is very weak. The gas comae are several arcminutes large and spherical. No tail is visible, except a narrow ion tail in the CN filter, probably CO+. Our post-perihelion production rates of CN are similar to those obtained pre-perihelion at about the same heliocentric distance (1.85 au) with UVES at the VLT and reported by HutsemÃ©kers et al. (2025), but the OH production rates are much larger than those reported in the same paper at 2.19 au. The new Afrho values are also 4x higher than the TRAPPIST values at the same heliocentric distance showing a clear increase of activity. Unfortunately no TRAPPIST gas production rates were obtained before perihelion due to a technical issue and such comparison should be taken with caution as 3I activity was rising very fast approaching perihelion by the end of September. The results of the three different nights are in very good agreement, and show that the production rates are now slightly decreasing night after night, as well as the Afrho. Most surprising, the main and obvious difference is now the strong C2 emission (and the clear C3 emission), very well

detected with a high SNR in TRAPPIST images on the three nights, and resulting in a ratio log(QC2/QCN) of +0.04. It means that the 3I/ATLAS coma composition changed from a strongly C-chain depleted comet (around -0.6, Hutsemekers et al. 2025 and others) to a typical comet (A Hearn 1995). This will need to be confirmed by spectroscopy. Such a behaviour might be explained if the C2 and C3 outgassing were delayed until the comet was close enough to perihelion, or if the nucleus is inhomogeneous and was subject to some seasonal effect at perihelion. 3I/ATLAS has a rather high dust production, and a large dust/gas ratio of log(afrho/CN) = -22.0 +- 0.05 and log(afrho/OH) = -24.6 compare to Oort-Cloud comets (A Hearn 1995).

Notations: rh= heliocentric distance (in au), Delta=geocentric distance (in au), DT= Time to perihelion. OH, NH, C3, CN, and C2 are the HB gaseous narrowband filters for the corresponding species, and BC, GC, and RC are the blue, green and red dust continuum filters (Farnham et al. 2000).

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