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JWST Detects Methane on Interstellar Comet 3I/ATLAS — First Chemical Fingerprint

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SCIENCE & TECH

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JWST Detects Methane on Interstellar Comet 3I/ATLAS — First Chemical Fingerprint

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✓ Every fact web-verified against primary sources

Scientists using **NASA's James Webb Space Telescope (JWST)** detected **methane** in the chemical fingerprint of **interstellar comet 3I/ATLAS** — the **first direct methane detection in any interstellar object** and the first peek at the chemical composition of material from another star system. The findings were published in *The Astrophysical Journal Letters*.

3I/ATLAS — THE OBJECT

PARAMETER	DETAIL
Designation	3I/ATLAS ("I" = interstellar)
Discovery	Discovered in July 2025 — by the NASA-funded ATLAS (Asteroid Terrestrial-impact Last Alert System) survey telescope in Chile
Type	Confirmed interstellar object passing through our solar system
Status	By early 2026: beyond Jupiter's orbit , exiting the solar system
Significance	Only the 3rd confirmed interstellar object in history

THE THREE INTERSTELLAR VISITORS

OBJECT	YEAR	TYPE	KEY FEATURE
1I/'Oumuamua	2017	Unusual (possibly flat slab or hydrogen iceberg)	No outgassing detected; non-gravitational acceleration
2I/Borisov	2019	Comet	First interstellar comet; CO/H ₂ O detected
3I/ATLAS	2025-26	Comet	Methane detected by JWST — first in any interstellar object

THE DETECTION — JWST MIRI

- **Instrument: Mid-Infrared Instrument (MIRI)** on JWST.
- **Method:** Spectroscopy — analysing the wavelengths of light absorbed or emitted by the comet as it was heated by the Sun. Different molecules have unique spectral “fingerprints.”
- **What was found: Methane (CH₄)** — a key organic molecule; also implies the presence of other volatile ices.
- **Observations:** Conducted during **late 2025** (two sessions as the comet headed out at ~205 and ~236 million miles from the Sun) — results announced June 2026.

WHY METHANE ON AN INTERSTELLAR OBJECT MATTERS

- ① **Chemical record of another star system** — The comet formed around a different star billions of years ago; its composition reflects the chemical conditions of that planetary system.
- ② **Volatile inventory** — Methane is a **highly volatile “supervolatile”** (boils off at very low temperatures); its presence suggests the comet was stored in a very cold environment (in a distant Oort-Cloud-like reservoir around another star) before being ejected.
- ③ **Building blocks of life** — Methane + CO₂ + H₂O are key molecular building blocks; detecting them in an interstellar visitor provides data on the universality of organic chemistry in the cosmos.
- ④ **Planetary formation** — The chemical mix of 3I/ATLAS tells us about the outer solar nebula of its parent star — widening our understanding of how planetary systems form.

ABOUT JWST

FEATURE	DETAIL
Launch	Launched in December 2021
Orbit	L2 Lagrange point (~1.5 million km from Earth, on the Sun-Earth line)
Mirror	6.5 m primary (segmented beryllium+gold mirrors)
Speciality	Infrared observation — can see through dust; observe earliest galaxies; detect atmospheric signatures of exoplanets
Partners	NASA, ESA, CSA

INDIA & SPACE SCIENCE CONTEXT

- JWST complements India's own deep-space ambitions: **Aditya-L1** (solar observation, L1 point, 2023), **Chandrayaan-3** (lunar south pole, 2023), and planned **Shukrayaan** (Venus orbiter).
- India is not a partner in JWST but uses public JWST data for research through **IIA (Indian Institute of Astrophysics)**, **IUCAA**, and **TIFR**.

UPSC RELEVANCE

PAPER	RELEVANCE
GS3	Science & Tech — JWST, interstellar objects, spectroscopy, comets, planetary science
Prelims	3I/ATLAS (3rd interstellar object); 1I/'Oumuamua (2017), 2I/Borisov (2019); JWST (launched in Dec 2021; L2 orbit; NASA+ESA+CSA); MIRI instrument; methane (CH ₄)

FACTS CORNER

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3I/ATLAS:

Only the 3rd confirmed interstellar object in history

Discovered in July 2025 by ATLAS telescope (NASA-funded), Chile

JWST MIRI detected methane — first methane detection in any interstellar object

Published: *Astrophysical Journal Letters*

INTERSTELLAR OBJECTS HISTORY:

1I/'Oumuamua (2017) — unusual; no outgassing; non-gravitational acceleration

2I/Borisov (2019) — first interstellar comet; CO/H₂O detected

3I/ATLAS (2025-26) — methane detected by JWST

JWST: LAUNCHED IN DECEMBER 2021; L2 LAGRANGE POINT; 6.5 M MIRROR; NASA+ESA+CSA; INFRARED OBSERVATORY

METHANE SIGNIFICANCE: SUPERVOLATILE; SUGGESTS COLD ORIGIN; ORGANIC CHEMISTRY IN ANOTHER STAR SYSTEM

Sources: NASA, *Astrophysical Journal Letters*

Source: JWST Detects Methane on Interstellar Comet 3I/ATLAS — First Chemical Fingerprint — Ujjayi.com |
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