NEO Characterization from the 4.3-m Lowell Discovery Telescope

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Lowell OBSERVATORY

Planetary Defense Conference | 7 May 2025

Lowell Discovery Telescope (LDT)

- Diverse instrument suite
- Virtual impactors
  (e.g. 2024 YR4, 2025 FA22)
- Imminent impactors
  (e.g. 2022 WJ1, 2024 XA1)
- Low delta-v objects
  (e.g. 2024 PT5)

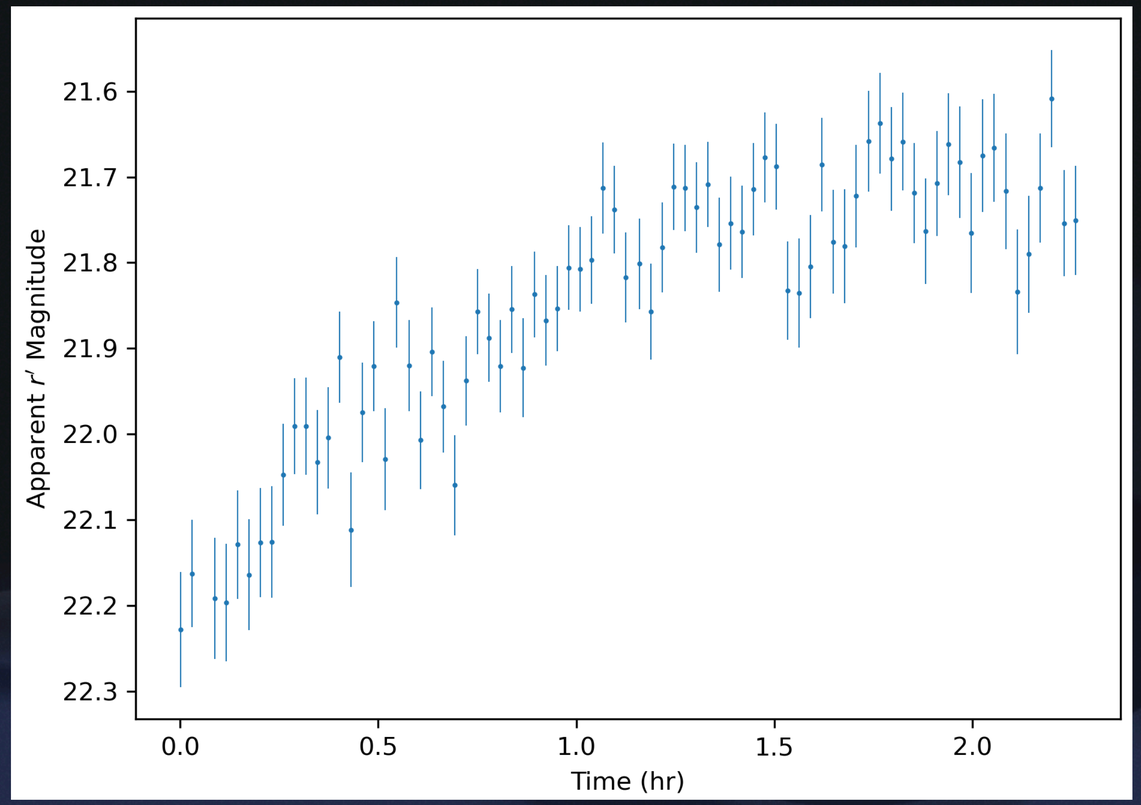
Instrument Suite

	IMAGING	SPECTROSCOPY
CURRENT	LMI • Visible (0.3-1 μm) • Lightcurves & colors, V<23 • Astrometry, V<26	DeVeny • Visible (0.3-1 μm) • Taxonomy, V<19 NIHTS • Near-infrared (0.8-2.4 μm) • Taxonomy, composition, V<19
FUTURE	RIMAS (arriving mid-2025) • Near-infrared • Built at NASA Goddard 	RIMAS • Near-infrared (0.8-2.5 μm) • Taxonomy, composition, V<21 New spectrograph (arrives 2027-2028) • Visible (0.3-1 μm) • Taxonomy, V<21

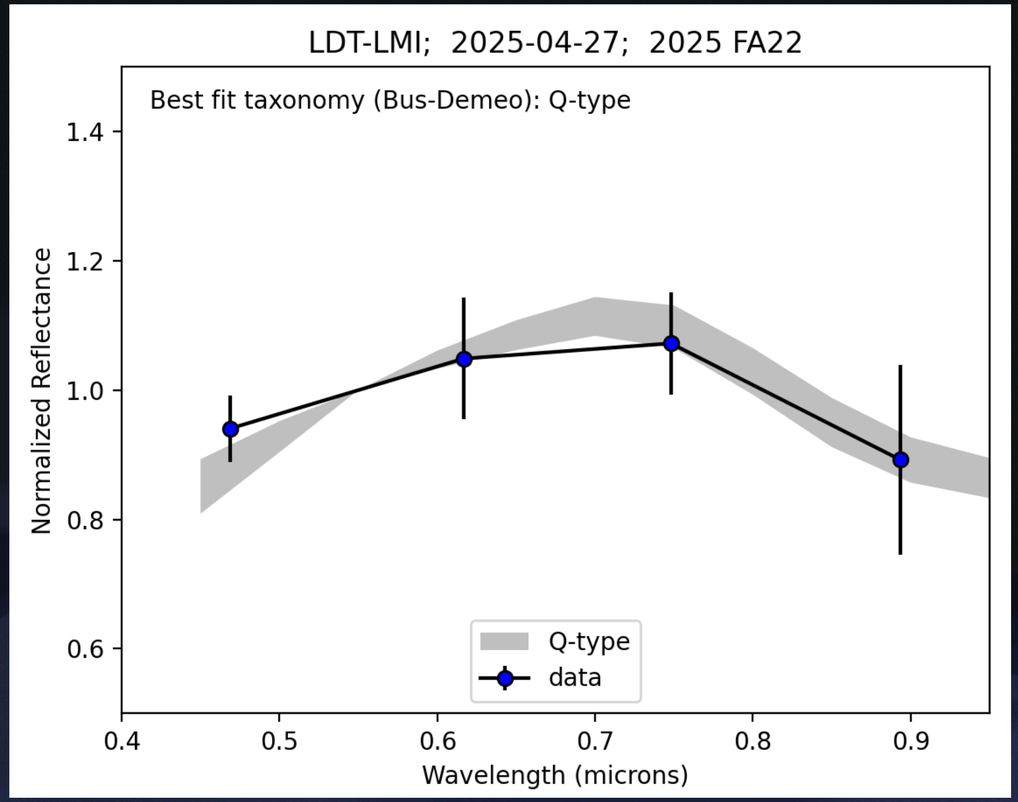
Currently seeking new partners,
talk to me if you are interested in LDT access

Virtual impactor: 2025 FA22

- Latest object with Torino scale = 1
- LDT observations 27 April 2025
- Favorable next apparition Sept 2025: V~15.5, radar accessible



Lightcurve photometry
→ rotation period >> 2hr



Colors → Q-type taxonomy

Imply albedo ~ 0.3 → diameter ~ 120m

Imminent impactors

The Planetary Science Journal, 5:253 (18pp), 2024 November https://doi.org/10.3847/PSJ/ad8b22

Telescope-to-Fireball Characterization of Earth Impactor 2022 WJ1

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2022 WJ1
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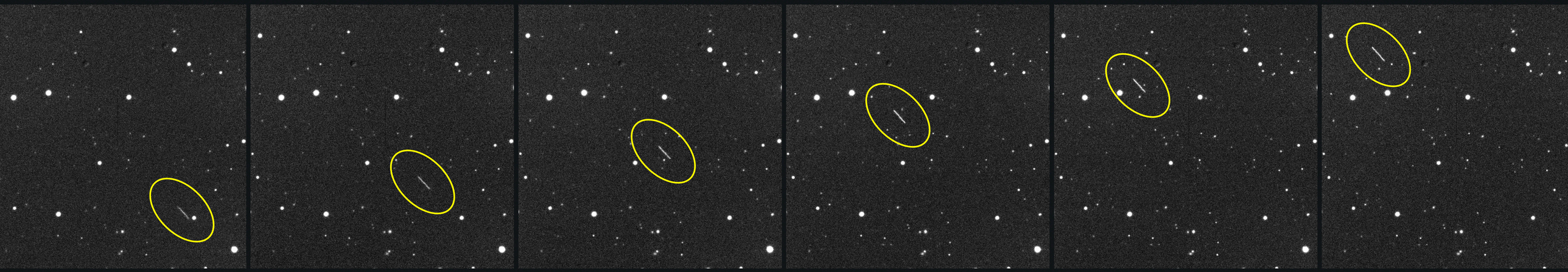
perezmedia.net

2022 WJ1

2022-11-19 at 07:30 UTC (1 hr before impact)
10s exposures



2022 WJ1

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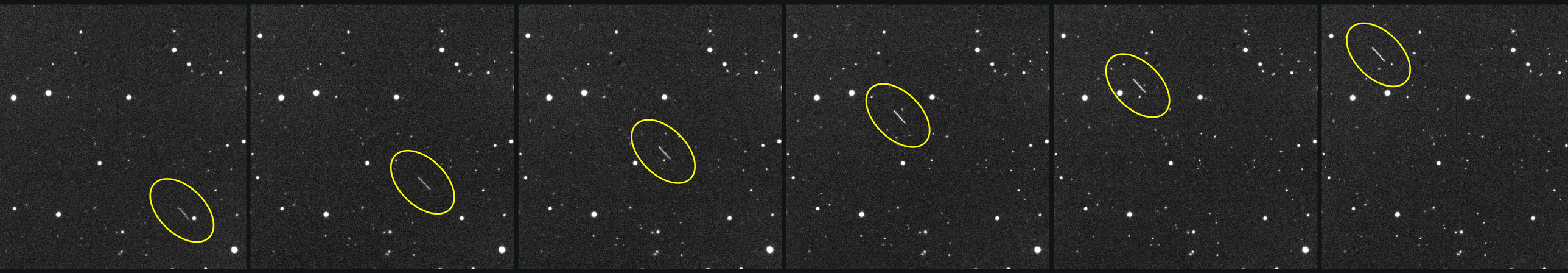

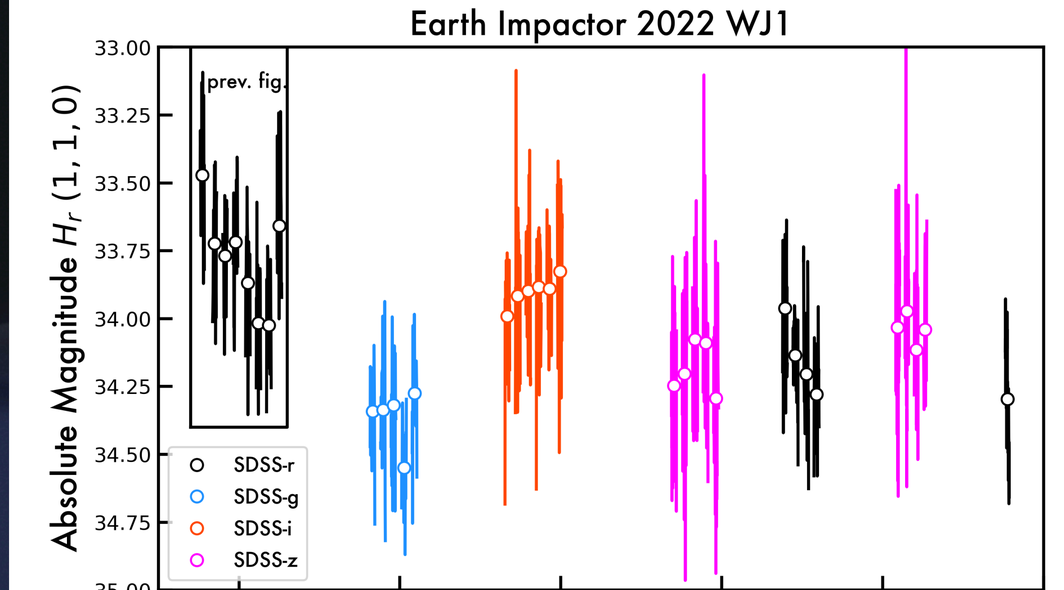

- Brightness variations → rapid rotation (<<1 min) and slightly elongated body
- Colors → silicate-rich surface like ordinary chondrite meteorites
- Inferred albedo suggests ~50 cm body
- **Highly consistent orbit (σ~40m) and composition from telescope and fireball data**

Low delta-v

The Astrophysical Journal Letters, 979:L8 (15pp), 2025 January 20 https://doi.org/10.3847/2041-8213/ad9ea8

On the Lunar Origin of Near-Earth Asteroid 2024 PT5

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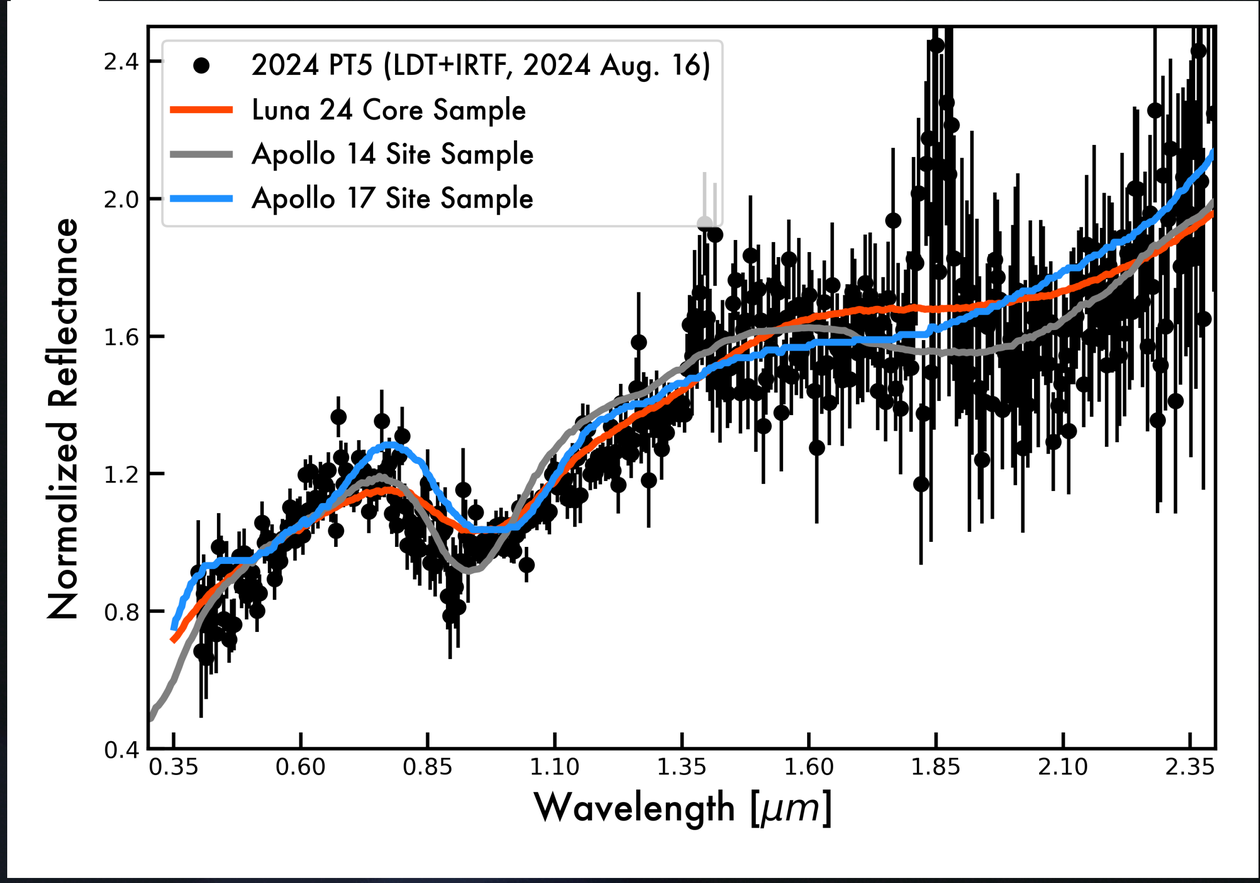
2024 PT5

- Delta-v = 3.9 km/s (lowest 0.1% of NEOs)
- Possible origin: Main Belt, lunar ejecta, artificial
- LDT + NASA IRTF spectra



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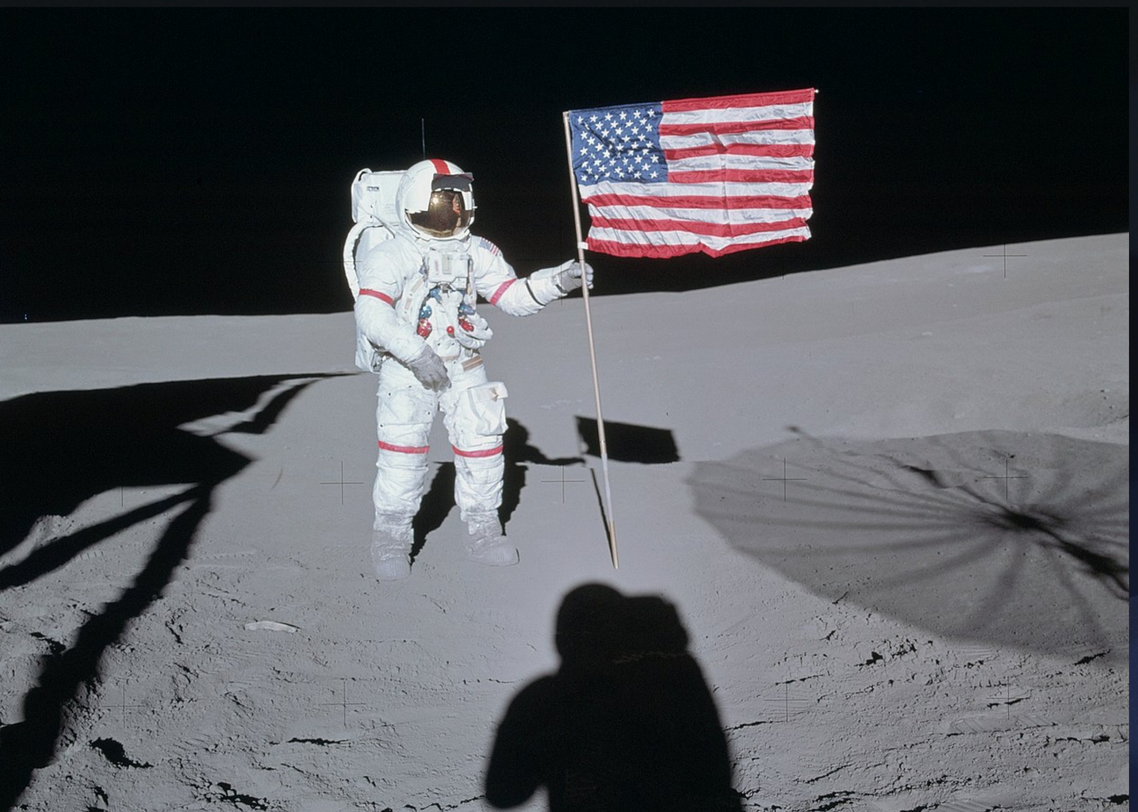

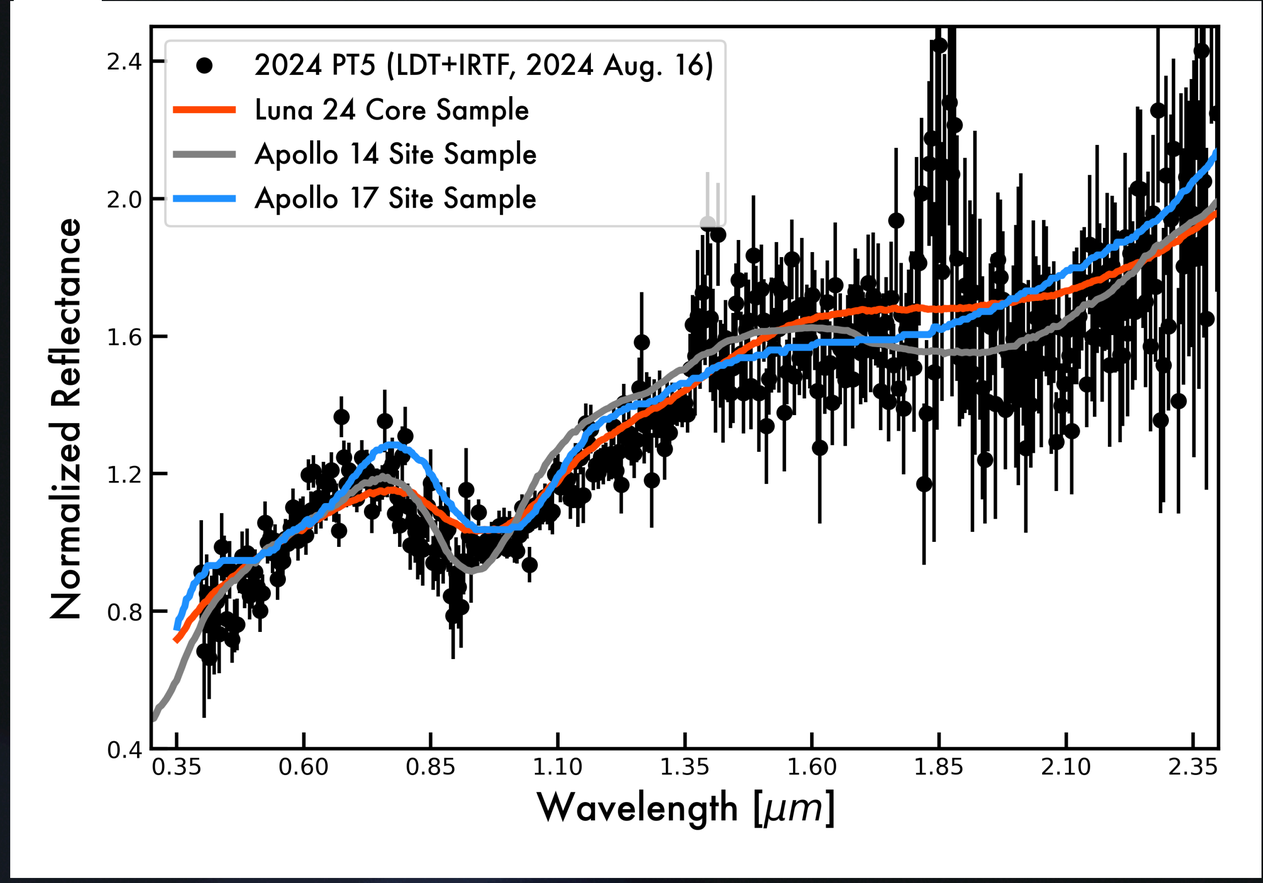

- Compositional match to lunar highlands
  - *PT5 is 2nd confirmed NEO from the Moon*
- **Could be ~100 known NEOs with lunar origin**
- **Unclear how lunar ejecta influence impact rates and NEO population models**

NEO Characterization from 4.3-m LDT

- Virtual impactors — 2025 FA22
- Imminent impactors — 2022 WJ1
  - Orbit and composition from asteroid and fireball are highly consistent
- Low delta-v objects — 2024 PT5
  - 2nd confirmed lunar ejecta amongst NEOs
  - Could be ~100 known NEOs with lunar origin
  - Unclear how lunar ejecta influence impact rates and NEO population models

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