

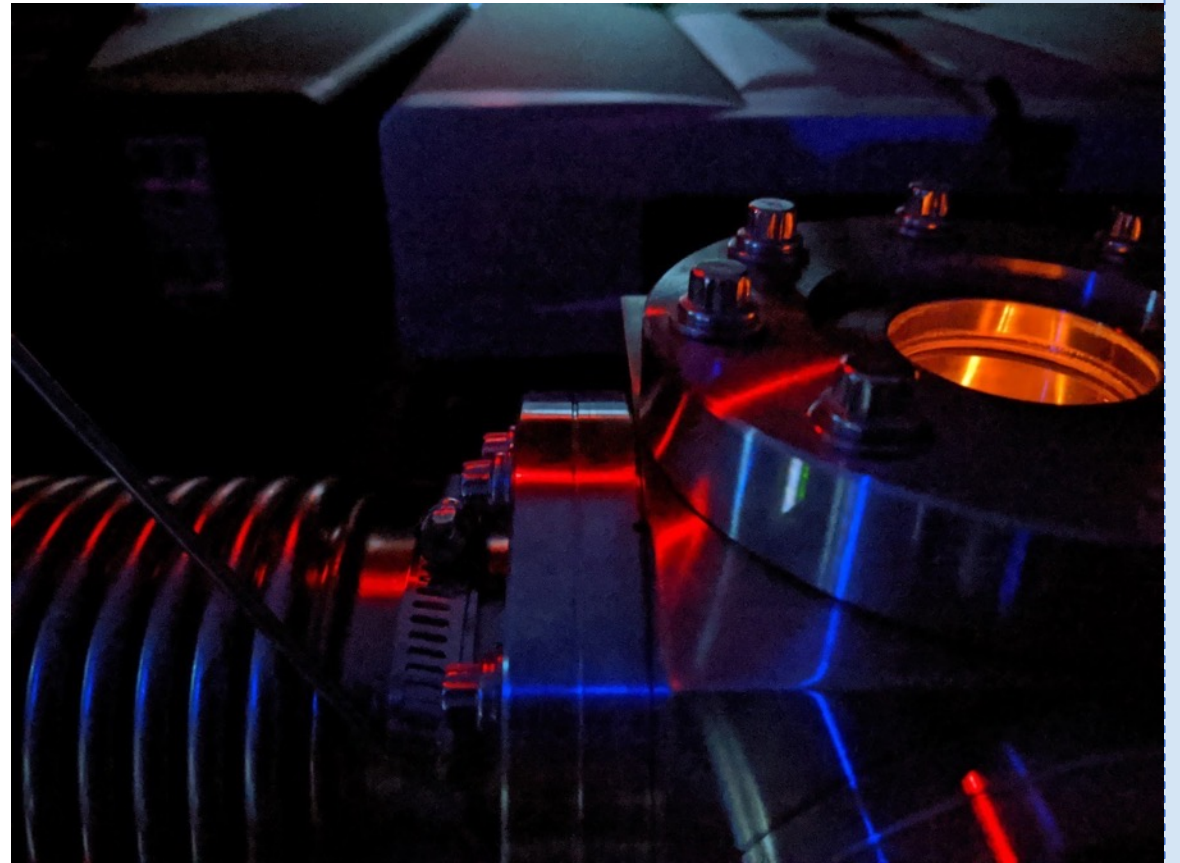
Telescopic and Laboratory Investigations of The Surfaces of Active and Cometary Near Earth Objects

Teddy Kareta^{1,2}, Vishnu Reddy²,
Walter M. Harris²

DPS 53, PhD talk, Press Edition

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¹: Lowell Observatory, ²: Lunar
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Talk Topics & Publication Overview

- The Origin of the Geminids Meteor Shower
- Observations of 2005 UD and (3200) Phaethon
- Newly built vacuum heating chamber
 - Spectra of increasingly heated sample of the rare meteorite CI Orgueil (up to 1075 Celsius / 1350 Kelvin / 1970 F!)

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Investigating the Relationship between (3200) Phaethon and (155140) 2005 UD through Telescopic and Laboratory Studies

Theodore Kareta¹ , Vishnu Reddy¹ , Neil Pearson² , Juan A. Sanchez² , and Walter M. Harris¹ 

¹Lunar and Planetary Laboratory, University of Arizona, 1629 E University Boulevard, Tucson, AZ 85721, USA; tkareta@lpl.arizona.edu

²Planetary Science Institute, 1700 East Fort Lowell, Suite 106, Tucson, AZ 85719, USA

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(3200) Phaethon & The Geminids

- Parent: Geminid meteor shower
- Not *really* active.
- Sungrazing, not a comet orbit.
- Blue (B/F), non-cometary surface reflectivity.

How do you make an object like this? How did it produce the Geminids? Why inactive?

Better find out before DESTINY+



Phaethon... and 2005 UD

Phaethon is *thought* to be related to a smaller object called (155140) 2005 UD. Similar visible color, similar rare orbits, similar meteor showers!

(3200) Phaethon, Diameter ~ 5.7 kilometers

2005 UD, Diameter ~ 1.6 kilometers



Are their orbits similar enough?
What is their relationship?
NIR Observations?

Phaethon... and 2005 UD

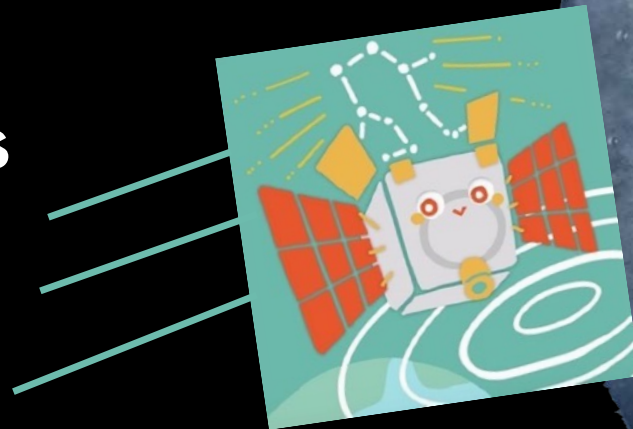
Perhaps *most* exciting is that Phaethon and possibly 2005 UD will be visited by JAXA's DESTINY+ spacecraft later this decade.

(3200) Phaethon, Diameter ~ 5.7 kilometers

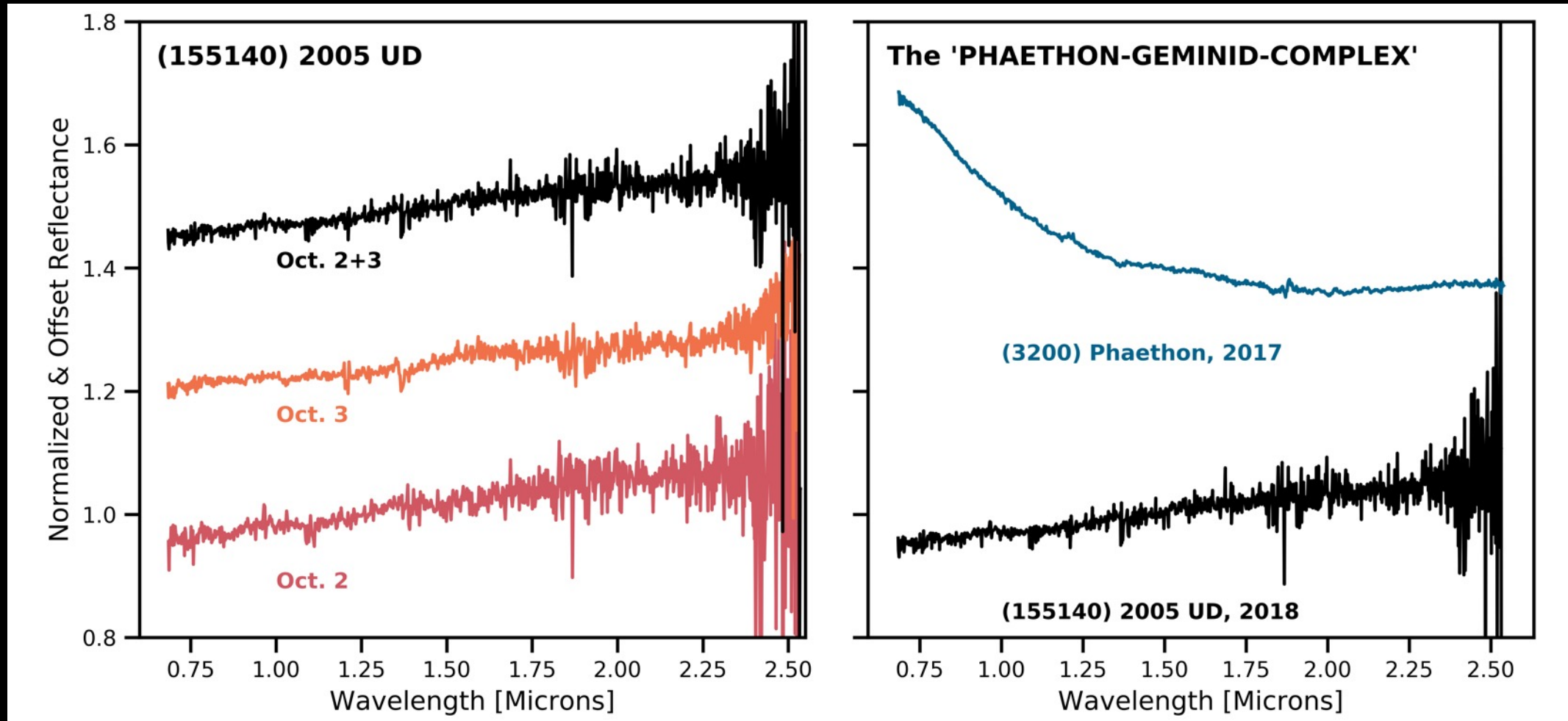
2005 UD, Diameter ~ 1.6 kilometers



What observations and studies are useful *now*?

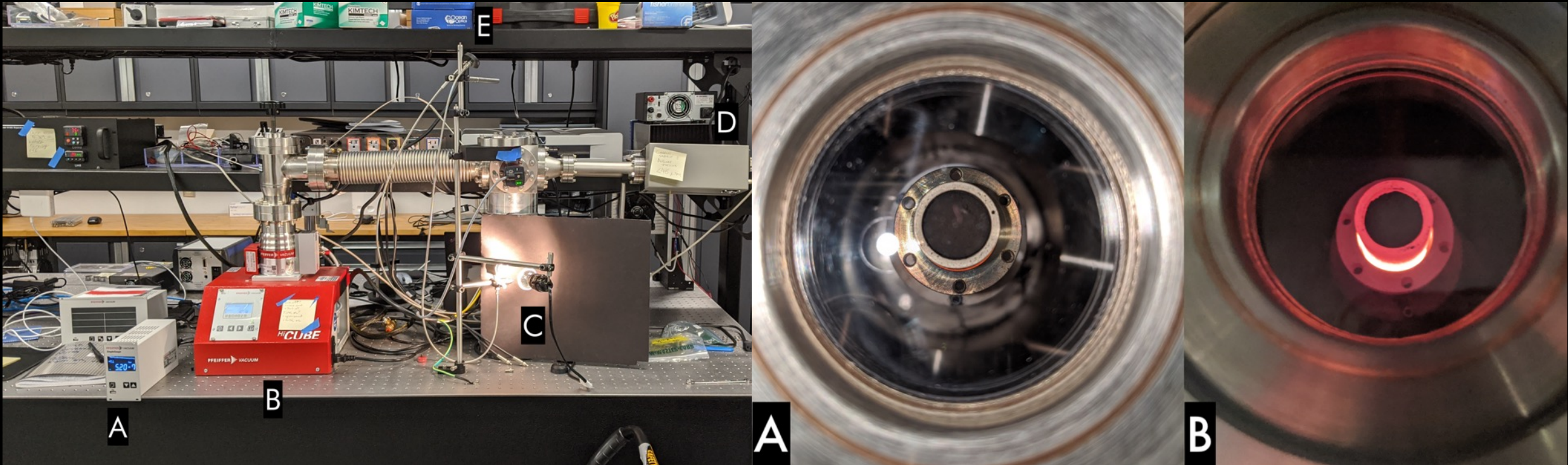


Phaethon spectrum is rotationally-averaged, from Kareta+ 2017.



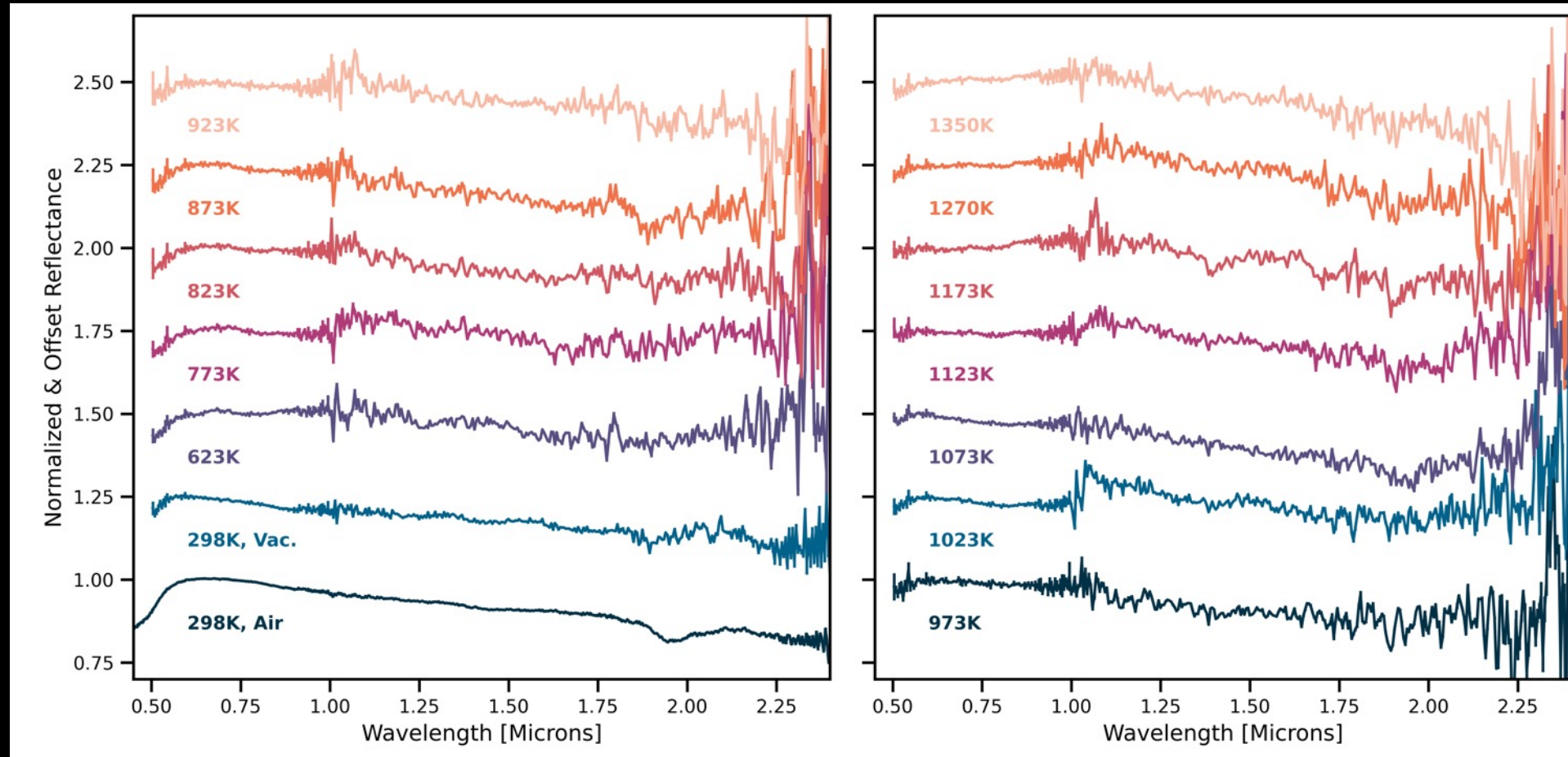
We observed **2005 UD** on three nights in 2018 and found it to be red-sloped and linear in the NIR. Challenging to explain its different spectra from **Phaethon** – but we had some ideas.

Idea: the two objects are made of the same material but have been heated to different extents. **Problem:** existing laboratory data does not go to high enough temperatures.



Solution: We built a chamber that can pump down to a near-vacuum to heat meteorites to successively higher temperatures and measure how their reflectivity changes.

So, what did the heating do?



When heated to a temperature similar to Phaethon's peak temperature, the heated meteorite looks *similar* to Phaethon. Not the same for 2005 UD. We argue that they only have similar properties *coincidentally*.

Talk Summary

(email: tkareta@lowell.edu, twitter: [@teddykareta](https://twitter.com/teddykareta))

- First NIR obs. of ‘mini-Phaethon’ 2005 UD, red and linear, not similar to Phaethon’s surface.
- New laboratory dataset of heated CI Chondrite spectra for comparison with near-Sun objects. Decent match for Phaethon, not 2005 UD.

Accepted in PSJ , on ArXiv at:
<https://arxiv.org/abs/2109.01020>



Thanks for watching my talk! Please feel free to send me an email about any of this!