Spectroscopic Observations of Eris and Pluto

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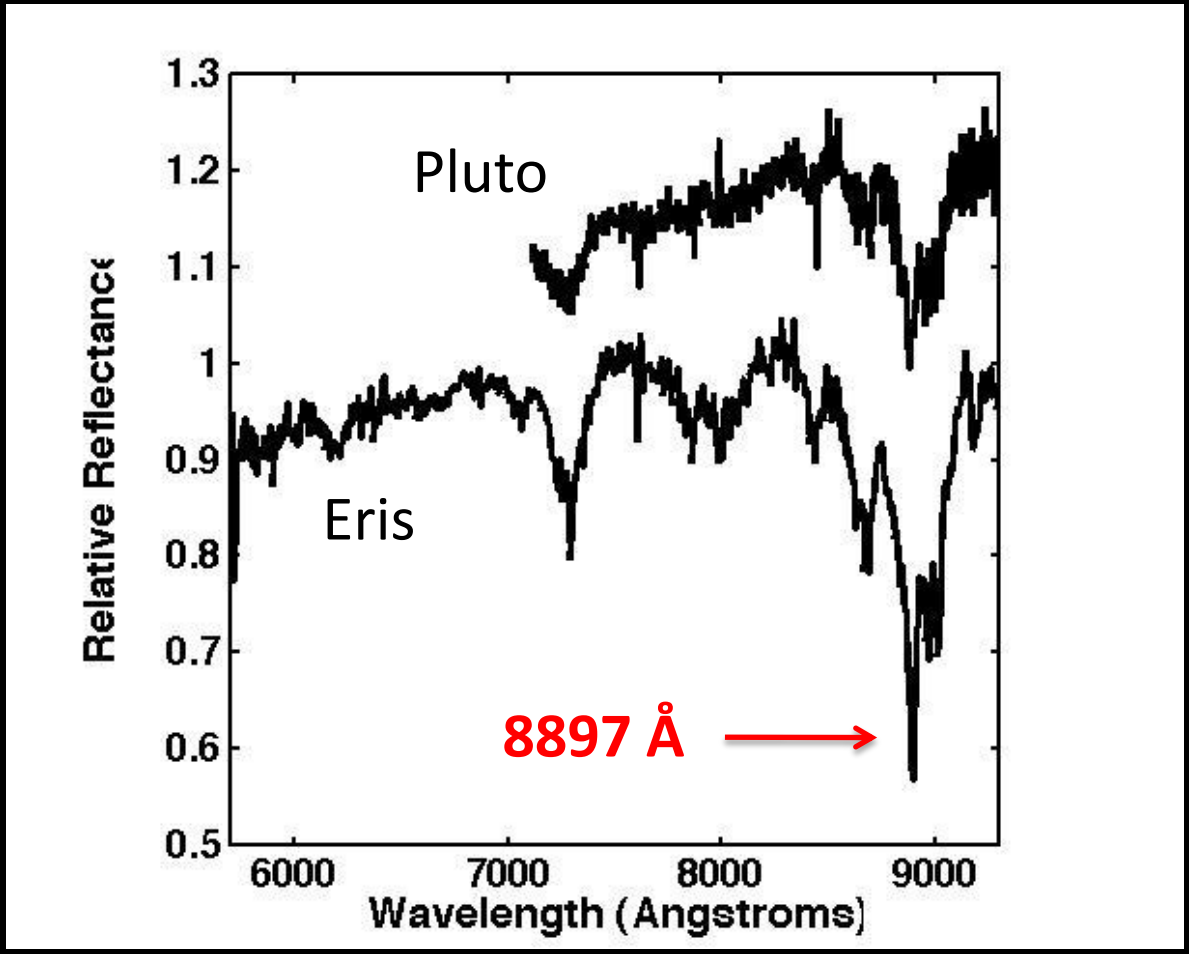
Some Physical and Orbital Parameters

	Eris	Pluto
D (km)	2600	2300
Albedo (%)	86	49 - 66
CH_4 Bands	Opt-NIR	Opt-NIR
N_2 Band	No	2.15μm
q (AU)	38	30
Q (AU)	98	49

Example Optical Spectra of Pluto and Eris

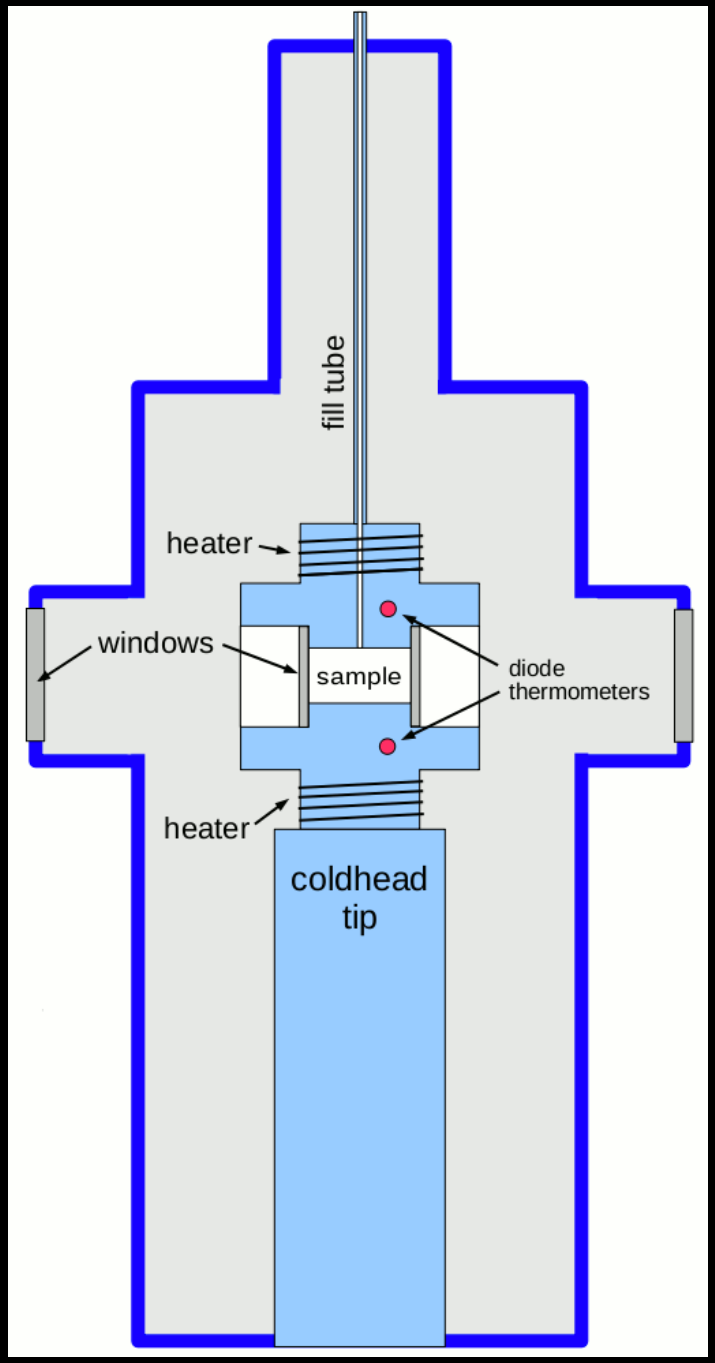


Pluto:
90 Inch
B & C
2007 Jun 19 UT
Exp Time 40 min

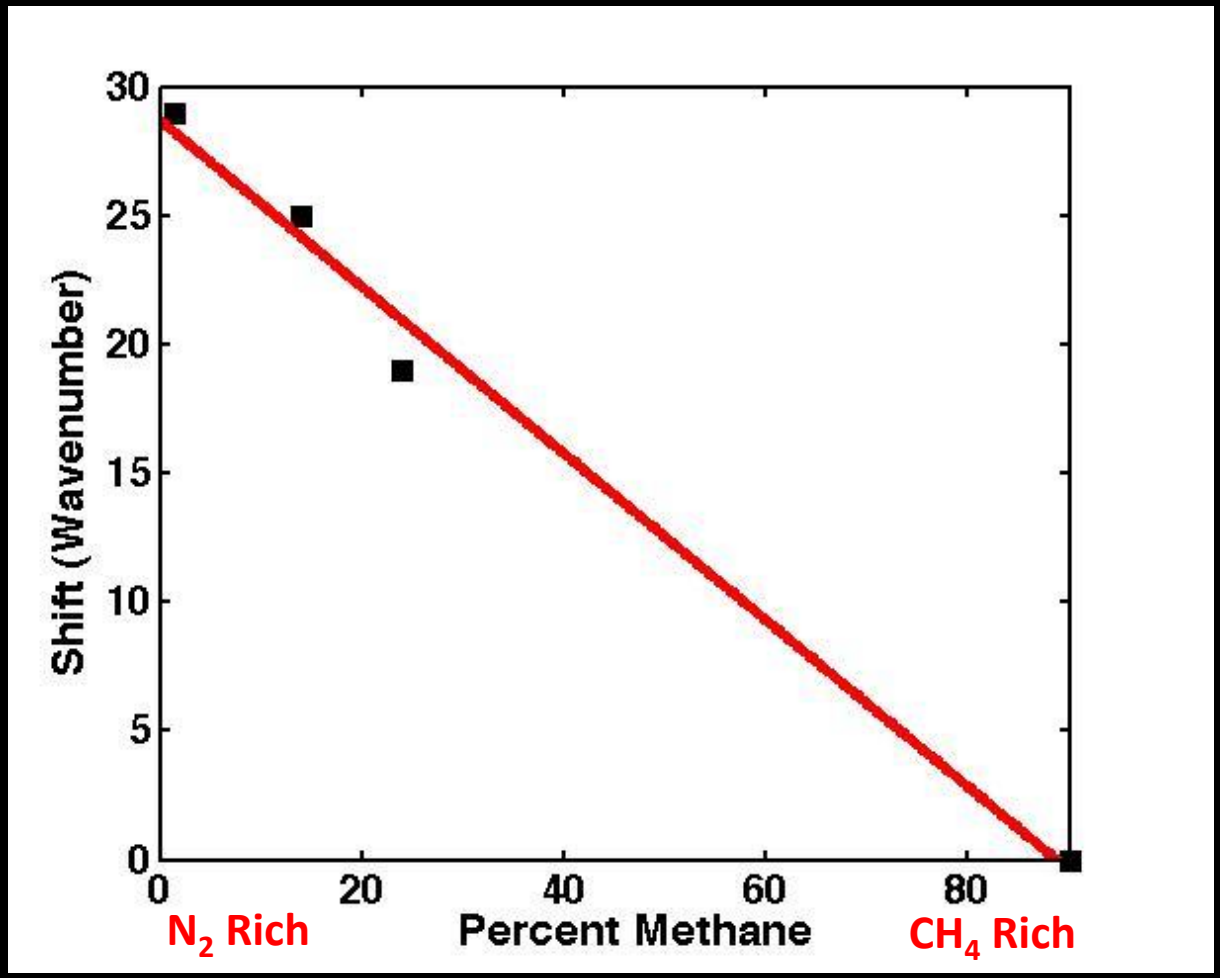
Eris:
MMT
Red Channel
2008 Oct 03 UT
Exp Time 240 min

Northern Arizona University Ice Laboratory

- Grow 1-2 cm Thick CH_4/N_2 Ice Samples (very long path lengths)
- Ultra-High Vacuum
- $30 < T < 70$ °K
- Optical and Near-IR Transmission Spectra of Ice Mixtures for Comparison to Eris and Pluto

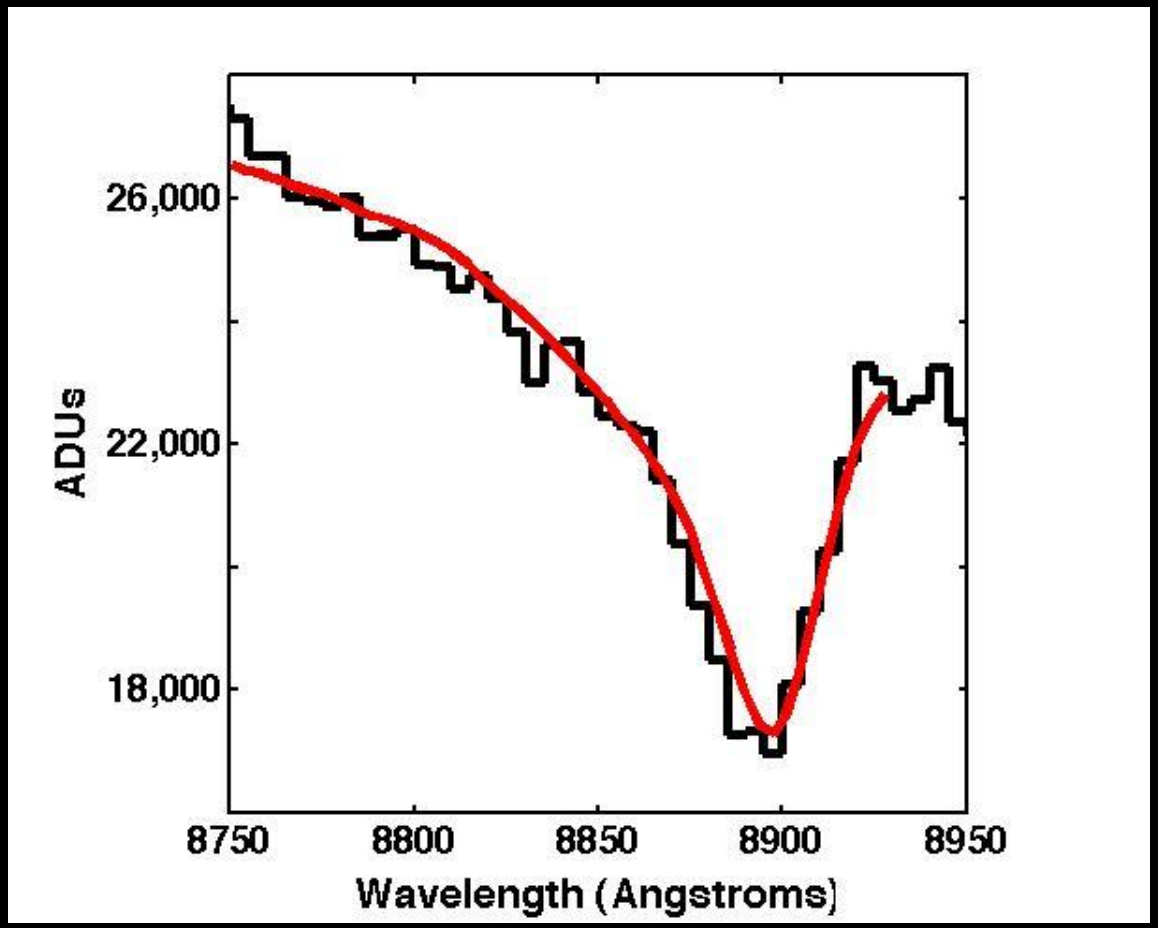


LAB Shifts of Methane 8897 Å Band In CH_4/N_2 Mixtures



The Greater the Blue Shift, the Greater the N_2 Abundance

Example of Astronomy and Lab Spectra Comparison



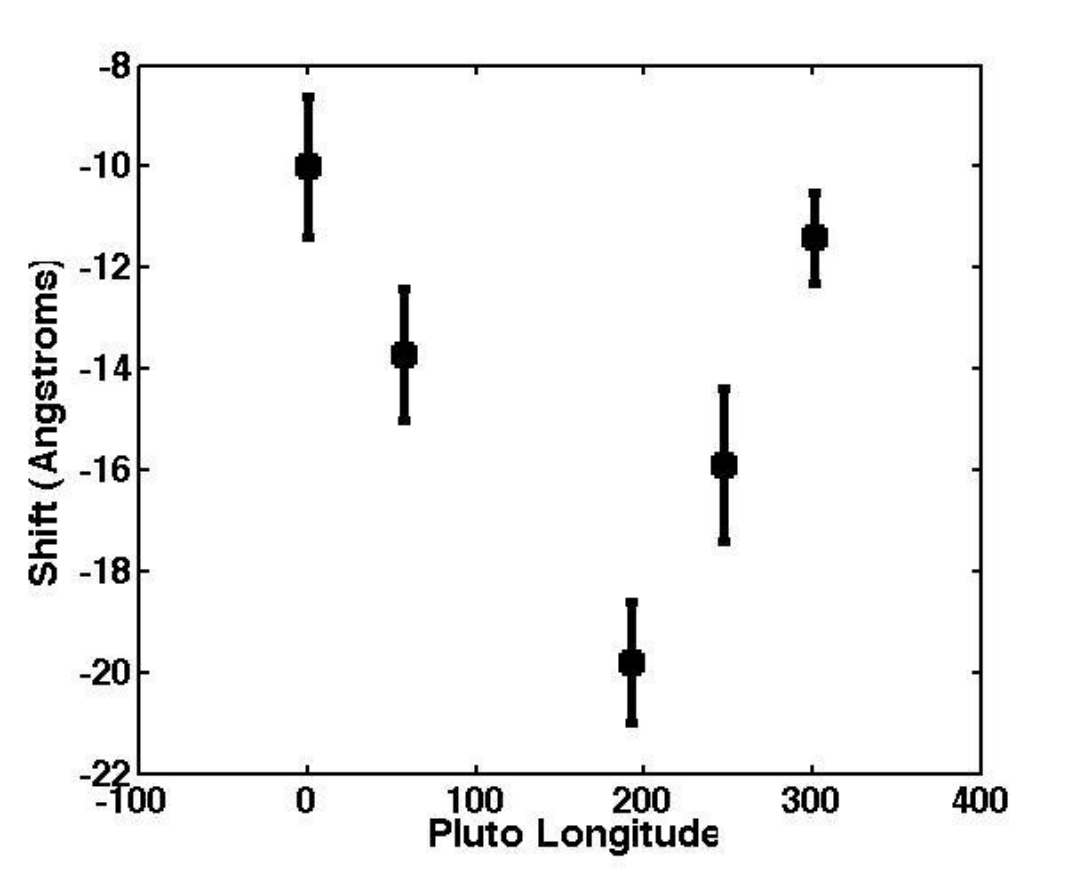
Black: MMT Eris Spectrum

Red: Pure Methane Lab Spectrum

<u>Cross-Correlation Experiments:</u>

Eris Band Is Blue Shifted By 5 ± 1 Å (6 ± 1 cm^{-1}) Relative to Pure Methane

PLUTO'S 8897 Å Methane Band Shifts From 90-Inch



Blue Shifts

- 10 – 20 Å (13 – 25 cm^{-1})
- Largest Shift Near Longitude of 180°
- Largest N_2 Abundance Near Longitude of 180°, i.e. the Anti-Charon Facing Hemisphere

Maleszewski 2009 (NAU MS Thesis)

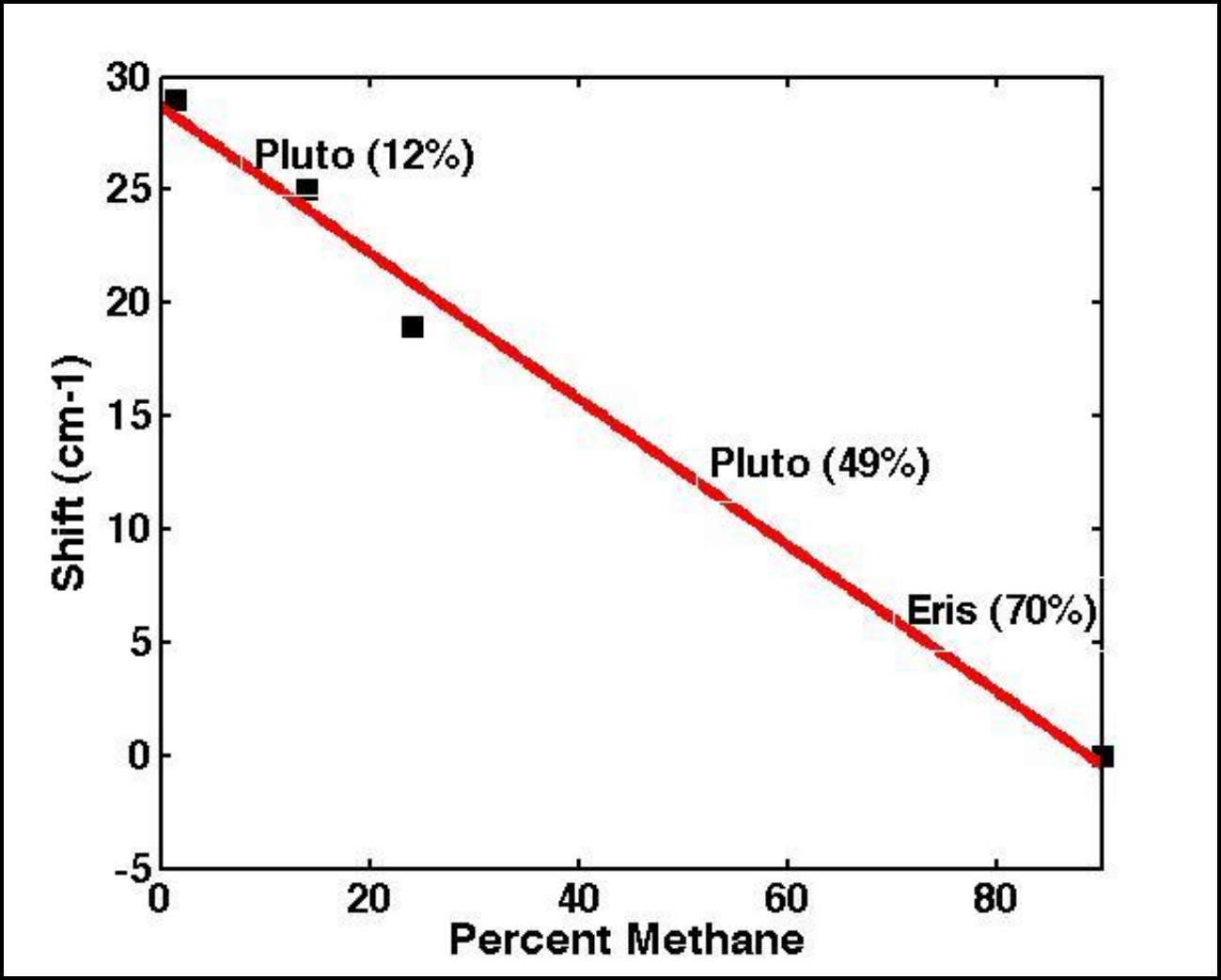
ERIS' 8897 Å Methane Band Shifts From MMT

UT Date	Shift (Å)
2007 Sep 09	4.9 ± 0.8
2007 Sep 10	5.1 ± 1.0
2007 Sep 11	3.1 ± 2.3
2008 Oct 02	4.9 ± 0.7

Same Shifts on Four Nights:

- Homogeneous Surface Composition
- Pole-On Orientation
- Sampling Same Hemisphere Four Times

Using Shifts to Measure CH_4/N_2 On Pluto and Eris



<u>Pluto:</u>

(10 – 20)Å

(13 – 25)cm^{-1}

(49 – 12)% CH_4

<u>Eris:</u>

5Å

6cm^{-1}

70% CH_4

Conclusions

Pluto:

- Heterogeneous Surface
- 12% $< CH_4 <$ 49%

Eris:

- Homogeneous Surface, or Pole-On Orientation, or Same Hemisphere on All Four Nights
- $CH_4 \sim 70\%$ (First Ever Estimate)

Why the Composition Difference?

- Eris at Aphelion and Pluto at Perihelion (Atmospheric Collapse On Eris)?
- Primordial Compositional Difference?