Potential Lunar Subsolar Hydration Feature

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Why the Moon's Mineralogy is Important

Scientific Insight into Processes
Assessment of Dynamic Process of the Moon and its Environment
Previously, the Moon has been considered anhydrous.

Future Exploration
In Situ Resource Utilization for Human Exploration
Spectra with Different 3 μm Features

121 Hermione
- Sharp 3 μm feature
- C-type (Cybele group)
- $a = 3.44$ AU
- Sharp Group
- (CM/Ca-Me phyllosilicates)

361 Rononia
- Rounded 3 μm feature
- DP type (Hilda Family)
- $a = 3.98$ AU
- Rounded Group
- (water-ice frost)

10 Hygiea
- Ceres-like 3 μm feature
- C-type (Hygiea Family)
- $a = 3.14$ AU
- Ceres Group
- (carbonates/NH, phyllosilicates)

52 Europa
- 3 μm band centered at ~3.15 μm
- CI-type
- $a = 3.10$ AU
- Europa Group
- (water-ice and organics)
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<th>Spacecraft</th>
<th>Year</th>
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<td>Cassini</td>
<td>1999</td>
<td>Hydration Found At the Poles and Highlands of the Moon</td>
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<td>Moon Mineralogy Mapper on</td>
<td>2009</td>
<td>Water Molecules on the Poles of the Moon</td>
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Image Credit: NASA/JSC
When and Where Do We Find Hydration

*If any...*
Observations and Data Collection
Instrument: SpeX

- LXD_short
- Resolution ~ 2500
- 1.67-4.2 um
- 0.3x15" slit
NEATM: Near Earth Asteroid Thermal Model

- The basis of the STM is the assumption of instantaneous equilibrium between insolation and thermal emission and a simple temperature distribution on a smooth spherical (Lebofsky et al.)
- The near-Earth asteroid thermal model (NEATM) (Harris and Lagerros) is an improved version of STM that takes into account the surface roughness and thermal inertia.
- The sub-solar temperature of the Moon is calculated by assuming equilibrium between solar insolation and emitted thermal flux. The temperature across the disk is then assumed to vary as $|\cos(i)|^{0.25}$.
- The Planck function is then integrated over the visible surface of the disk to get the emitted intensity, which is multiplied by the solid angle to get the flux as seen at the earth.

$$s_{\text{vol}} = \pi \frac{D^2}{4} S(1 - A)$$

$$A = A_v = q \rho_v$$

$$T(\phi) = T(0) \cos^{1/4} \phi$$

$$T(0) = \left[\frac{(1 - A)S/(\eta \varepsilon \sigma)}{(1 - A)}\right]^{1/4}$$
Best Results from Three Nights of Data

Reduced Subsolar Spectrum from 180627

Thermally Corrected Spectrum from 180627
In Summary

- Absorption Feature Detected Using NEATM
- Consistent with Hydration Feature at Lunar Noon
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