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Ammonia frost and Titan's atmospheric windows

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Introduction: NH_3 has long been considered an important component in the formation and evolution of the outer planet satellites. NH_3 is seen in clouds in the atmospheres of Jupiter and Saturn, but has yet to be detected on any of the satellites. This may be because all forms of NH_3 are unstable in the ambient conditins of the satellites surfaces or that its spectral features are altered by other components of the surface, and have not been identified. However, NH_3 has been suggested as a possible source for sustaining Titan's thick nitrogen-dominated atmosphere. There is a limited amount of data available on the spectra of NH_3 ice and mixtures containing NH_3 at the pressure and temperature regimes of icy satellites.

Discussion: The laboratory spectrum of a thick NH_3 frost at 77K and with an approximately 0.5 millimeter grain size. The Titan spectrum is dominated by absorption features of CH_4 gas, the principal absorping specie in Titan's atmosphere. The only areas where a relevant comparison to NH_3 on Titan's surface can be made are at the wavelengths where CH_4 is mostly transmitting, These 'windows' in the Titan atmosphere are at 0.93, 1.08, 1.27, 1.59, 2.01, 2.69, 2.79, and 4.98 μm. Note that the NH_3 absorptions at 1.51 and 1.68 μm appear to align with the absorptions on the sides of the CH_4 window, centered at about 1.55 μm, where inflections are apparent. The absorption at 2 μm aligns with the 2.01 window and would appear as a level change. The window at 2.69 μm is too opaque to strongly constrain evidence for NH_3.

Previous work by Fink & Sill [1], Roberts [2] and Pipes [3],employing thin film measurements provided absorption coefficients. The NH_3 absorption at $\sim$3.3 μm (ν1) for the thin film measurements appear to be shifted relative to the frost measurements, which is centered at 3.0.

References: [1] Fink, U. and Sill, G. (1982) *Comets* 164-202, U. Arizona Press, L. Wilkening editor. [2] Robertson et al. 1975, *JOSA 65, 432-435* [3] Pipes et al., 1978 AIAA 16, 984-990

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