Ammonia Ice - Detectability Through Titan’s Atmospheric Windows. W. D. Smythe¹, R. M. Nelson¹, J. H. Shirley¹, and M. C. Boryta², ¹Jet Propulsion Laboratory, m/s 183-601, 4800 Oak Grove Drive, Pasadena, CA 91109, wsmythe@lively.jpl.nasa.gov, ²Mount San Antonio College, Walnut, CA USA, mboryta@oca.net.

Introduction: NH₃ has long been considered an important component in the formation and evolution of the outer planet satellites. NH₃ 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 NH₃ are unstable in the ambient conditions of the satellites surfaces or that its spectral features are altered by other components of the surface, and have not been identified. However, NH₃ 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 NH₃ ice and mixtures containing NH₃ at the pressure and temperature regimes of icy satellites.

Discussion: Figure 1 shows the laboratory spectrum of a thick NH₃ frost at 77K and with an approximately 0.5 millimeter grain size. Figure 2 shows this spectrum scaled by 0.2 to match the I/F levels of an average spectrum of Titan. The Titan spectrum is dominated by absorption features of CH₄ gas, the principal absorbing specie in Titan’s atmosphere. The only areas where a relevant comparison to NH₃ on Titan’s surface can be made are at the wavelengths where CH₄ 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 NH₃ absorptions at 1.51 and 1.68 µm appear to align with the absorptions on the sides of the CH₄ 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 NH₃.

Previous work by Fink & Sill [1] employing thin film measurements is shown in Figure 3 and the corresponding absorption coefficients are shown in Figure 4. Absorption coefficients were also reported by Roberts [2] and Pipes [3]. The absorption at ~3.3 µm (ν1) for the thin film measurements appear to be shifted relative to the frost measurements, which is centered at 3.0.