OPTICAL PROPERTIES OF TITAN HAZE LABORATORY ANALOGS USING CAVITY RING DOWN SPECTROSCOPY.

C.. A. Hasenkopf [1,2], M. R. Beaver[2,3], M. A. Tolbert[2,3], O. B. Toon[1,4] and C. P. McKay[5], [1]Department of Atmospheric & Oceanic Sciences, UCB 311, University of Colorado, Boulder, CO 80309-0311, United States [2]Cooperative Institute for Research in Environmental Sciences, 216 UCB, University of Colorado, Boulder, CO 80309-0216, United States [3]Department of Chemistry and Biochemistry, UCB 215, University of Colorado, Boulder, CO 80309-0215, United States [4]Laboratory for Atmospheric and Space Physics, 1234 Innov tion Drive, 80303-7814, CO 80303-7814, United States [5]Space Sciences Division, NASA Ames Research Center, Moffett Field, CA 94035, United States.

Introduction: The most visible aspect of Titan is the organic haze layer that completely covers this moon of Saturn. The haze has an "anti-greenhouse" effect on Titan due to strong absorption at solar wavelengths combined with low opacity in the thermal wavelengths. To understand the thermal structure of Titan, accurate optical constants for the haze are needed. In addition, if accurate optical constants for various model haze particles were well established, the optical retrievals from Titan could be used to extract information on the chemical and physical properties of the haze particles. Past work has provided optical constants for Titan haze by analyzing thin films that model the haze particles [1], [2], [3]. While these pioneering studies have provided the basis for Titan aerosol retrievals, lingering questions remain about the effects of long collection times for the particles and the influences of depositing the particles on a plate for analysis. In the present work, we present the first measurements of Titan haze optical properties for freely floating particles that have not been collected or subjected to ambient air.

Experimental: The current studies use the recently developed technique of aerosol cavity ring down (CRD) spectroscopy to determine the optical properties of particles "on the fly." The technique is so sensitive that single sized particles can be selected from an initial broad distribution of particle sizes. The particle extinction as a function of particle size is then used to extract the real and imaginary refractive index of the particles.

In the current work we generate Titan-like particles by exposing a gas mixture of 0.1% CH_4 in N_2 to ultraviolet radiation. An aerosol mass spectrometer (AMS) is used to determine the chemical composition of the generated particles. Particles are then size selected from 0.06 to 0.5 μm diameter using a differential mobility analyzer (DMA) and the single-sized particles are sent to the CRD cell. Aerosol extinction at λ = 532 nm within the CRD is determined using the ring-down time within the cell.

Results: We present extinction cross-sections and extinction efficiencies at λ = 532 nm for the organic haze particles. We then use the size dependence of the extinction data to determine the total refractive index of the particles. Applying Mie theory to our data, we have inferred an estimate of the total refractive index of n = 1.55 ± 0.05 and k = 0.025 ± 0.005. This is the first time optical constants extracted from Titan haze *particle* analogs have been reported. We also compare our data to previous thin film results in the literature. Ongoing studies are probing different gas compositions and additional extinction wavelengths.

References:

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