Optical Properties of Titan and Early Earth Laboratory Analogs in the Mid-Visible

CHRISTA A. HASENKOPF[1], MELINDA R. BEAVER[2], MELISSA G. TRAINER[3], MIRIAM A. FREEDMAN[4], O. BRIAN TOON[1], CHRISTOPHER, P. McKAY[5], and MARGARET A. TOLBERT[4]

[1]*Department of Atmospheric and Oceanic Sciences, University of Colorado, Boulder, CO, United States 80309, Ph: (303) 492-1433, Email: Christa.Hasenkopf@colorado.edu*

[2]*Div. of Geol. and Planetary Sciences, California Institute of Technology, Pasadena, CA*

[3]*NASA Goddard Space Flight Center, Greenbelt, MD, United States*

[4]*Coop. Inst. for Research in the Env. Sci., University of Colorado, Boulder, CO, United States*

[5]*Space Science Division, NASA Ames Research Center, Moffett Field, CA, United States*

Scattering and absorption of sunlight by aerosols are integral to understanding the radiative balance of any planetary atmosphere covered in a haze, such as Titan and possibly the early Earth. One key optical parameter of an aerosol is its refractive index. We have simulated both Titan and early Earth organic haze aerosols in the laboratory and measured the real and imaginary portion of their refractive index at λ = 532 nm using cavity ringdown aerosol extinction spectroscopy. This novel technique allows analysis on freely-floating particles minutes after formation. For our Titan analog particles, we find a real refractive index of n = 1.35 ± 0.01 and an imaginary refractive index k = 0.023 ± 0.007, and for the early Earth analog particles we find n = 1.81 ± 0.02 and k = 0.055 ± 0.020. The Titan analog refractive index has a smaller real and similar imaginary refractive index compared to most previous laboratory measurements of Titan analog films, including values from [1]. These newly measured Titan analog values have implications for spacecraft retrievals of aerosol properties on Titan. The early Earth analog has a significantly higher real and imaginary refractive index than Titan analogs reported in the literature. These differences suggest that, for a given amount of aerosol, the early Earth analog would act as a stronger antigreenhouse agent than the Titan analog.

Keywords: Titan; early Earth; tholins; antigreenhouse effect; laboratory analogs.

References

[1] Khare, et al., *Icarus*, **60**, 127-137 (1984)