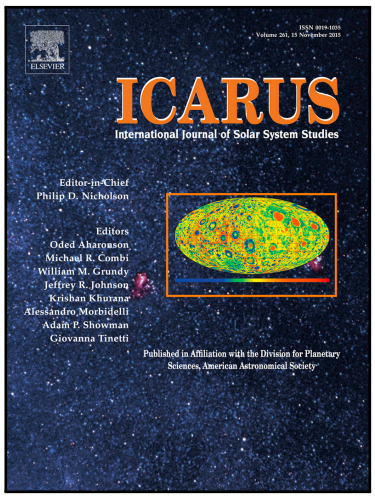

New Horizons Constraints on Charon's Present Day Atmosphere

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Abstract

We report on a variety of standard techniques used by New Horizons including a solar ultraviolet occultation, ultraviolet airglow observations, and high-phase look-back particulate search imaging to search for an atmosphere around Pluto's large moon Charon during its flyby in July 2015. Analyzing these datasets, no evidence for a present day atmosphere has been found for 14 potential atomic and molecular species, all of which are now constrained to have pressures below 0.3 nanobar, as we describe below, these are much more stringent upper limits than the previously available 15-110 nanobar constraints (e.g., Sicardy et al. 2006); for example, we find a 3σ upper limit for an N_2 atmosphere on Charon is 4.2 picobars and a 3σ upper limit for the brightness of any atmospheric haze on Charon of $I/F=2.6\times10^{-5}$. A radio occultation search for an atmosphere around Charon was also conducted by New Horizons but will be published separately by other authors.

1. Introduction

Pluto's largest satellite, Charon, is very close to half of Pluto's diameter and has a surface gravity that is also close to half of Pluto's. Although the surface composition of Charon has long been known to only display involatile materials (water ice, ammonia/ammonium hydrate, and tholins; e.g., Stern 1992; Stern et al. 2015; Grundy et al. 2016 and references therein), searches for an atmosphere around Charon have nonetheless been conducted almost since it was discovered (e.g., Stern 1992 and Sicardy et al. 2006).

The exploration of the Pluto system by New Horizons (Stern et al. 2015a) employed a variety of techniques to search for an atmosphere around Charon. These included: (1) a search for the absorption of ultraviolet (UV) sunlight by key molecular species candidates during a solar occultation; (2) searches for far/extreme UV airglow emissions form a variety of possible molecular and atomic species; (3) high phase, panchromatic imaging above the limb by the New Horizons Long range Reconnaissance Imager (LORRI; Cheng et al. 2008) camera after closest approach: and (4) searches for refractive atmospheric refraction and