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► To cite this version:

Jean-Yves Chaufray, Laurent Lamy, François Leblanc, V Hue, Franck Montmessin, et al.. Scientific interest for a UV spectrometer to study Uranus and its satellites. Uranus Flagship: Investigations and Instruments for Cross-Discipline Science Workshop, Jul 2023, Pasadena, United States. pp.LPI Contribution No. 2808, 2023, id. 8052. insu-04501879

HAL Id: insu-04501879

<https://insu.hal.science/insu-04501879>

Submitted on 12 Mar 2024

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Scientific interest for a UV spectrometer to study Uranus and its satellites. J-Y. Chaufray¹, L. Lamy^{2,3}, F. Leblanc¹, V. Hue³, F. Montmessin¹, E. Quémerais¹, E. Marcq¹, S. Guerlet³, G. Milcareck¹, M. Barthelemy⁵ Affiliation (¹ LATMOS/IPSL, CNRS, Paris-Saclay, Sorbonne Université, Guyancourt, France, chaufray@latmos.ipsl.fr), ²LESIA, Observatoire de Paris, PSL, Meudon, France, ³ Aix-Marseille Université, CNRS, CNES, Institut Origines, LAM, Marseille, France, ⁴LMD, Paris, France, ⁵IPAG, Grenoble, France.

Introduction: Uranus and its satellites remain poorly known and were only explored during the flyby of Voyager-2 in 1986 and a few observations from Earth. New UV observations of Uranus and its satellites on a future orbiter could provide important information about: i) the interaction of the Uranian ionosphere and its magnetosphere, ii) its atmospheric structure and composition and iii) the icy surface of its satellites.

Aurora, airglow and electroglow: The magnetosphere of Uranus is very different from the other giant planets magnetosphere due to its highly tilted magnetic field [1] and present large diurnal/seasonal variations. Like the other giant planets, the UV auroral emissions are confined near the magnetic poles [2] and dominated by the H (Lyman- α) and H₂ (Lyman and Werner bands).

The H Lyman- α and emissions from H₂ were first measured by the UV spectrometer of Voyager-2 [3], and more recently re-observed by HST/STIS [4]. The Lyman- α emission was found to be produced by the resonant scattering of the solar photons by atomic hydrogen in the corona, by resonant scattering of the interplanetary Lyman- α photons, by Rayleigh scattering of the solar photons by the atmospheric H₂ [3,5], and a possible additional unknown internal source. The Rayleigh scattering was not expected but suggested by the presence of a Raman emission near 128 nm and requires a depletion in hydrocarbons above 0.5 mbar possibly due to a very low eddy diffusion coefficient [3,6]. However, this low value has never been confirmed from later observations [7] and our estimate of the process using more recent atmospheric models of Uranus [8] suggests it could have been overestimated by [3]. The possible additional unknown internal source could be due to low energy impacts (“electroglow”) [1].

Atmosphere of Uranus: Planetary atmosphere can be investigated remotely in the UV either by reflectance measurement from nadir observations or by stellar occultations. Occultations of γ -Pegasi and the sun were obtained by Voyager-2/UVS to measure the vertical profiles of the absorbing species [9] leading to larger eddy diffusion compared to [3]. On Uranus, the atmospheric UV extinction should be mostly due to H₂ (absorption and Rayleigh and Raman scattering), and hydrocarbons species below 200 nm (Fig. 1) and by H₂ Rayleigh and Raman scattering and aerosol (from stratospheric haze) between 200 and 400 nm [10].

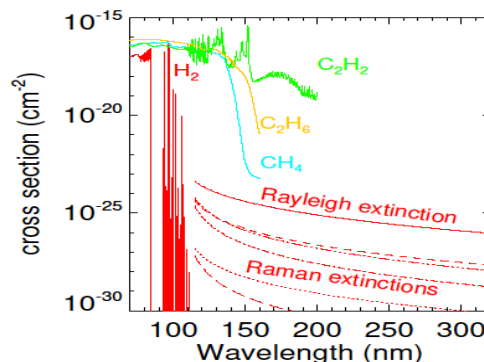


Fig. 1 UV extinction cross sections from the major gas species in the atmosphere of Uranus. Based on <https://phidrates.space.swri.edu>, and [11] for Rayleigh and Raman extinction by H₂ (at 100 K).

Surfaces of satellites:

The icy surface of the satellites of Uranus should have an albedo similar to other icy satellites in the solar system with a low albedo below 170 nm and a large albedo above 170 nm. Observations done by HTS/FOS instrument find a rather flat albedo for Ariel, Titania and Oberon between 220 and 1000 nm but with a possible small absorption near 280 nm and decreasing with increasing distance to Uranus. This absorption could be due to entrapped OH gas but needs to be confirmed [12].

In our presentation we will discuss the measurements from a UV spectrometer that would help on these three subjects and present our Monte Carlo model of Rayleigh/Raman extinction to study some UV emission lines.

References:

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Acknowledgements:

We acknowledge support from CNES and the CNRS/INSU programs of planetology (PNP- and heliophysics (PNST)).