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## Scientific interest for a UV spectrometer to study Uranus and its satellites

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**Scientific interest for a UV spectrometer to study Uranus and its satellites.** J-Y. Chaufray<sup>1</sup>, L. Lamy<sup>2,3</sup>, F. Leblanc<sup>1</sup>, V. Hue<sup>3</sup>, F. Montmessin<sup>1</sup>, E. Quémerais<sup>1</sup>, E. Marcq<sup>1</sup>, S. Guerlet<sup>3</sup>, G. Milcareck<sup>1</sup>, M. Barthelemy<sup>5</sup> Affiliation (<sup>1</sup> LATMOS/IPSL, CNRS, Paris-Saclay, Sorbonne Université, Guyancourt, France, [chaufray@latmos.ipsl.fr](mailto:chaufray@latmos.ipsl.fr)), <sup>2</sup>LESIA, Observatoire de Paris, PSL, Meudon, France, <sup>3</sup> Aix-Marseille Université, CNRS, CNES, Institut Origines, LAM, Marseille, France, <sup>4</sup>LMD, Paris, France, <sup>5</sup>IPAG, 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.

**Aurorae, 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- $\alpha$ ) and H<sub>2</sub> (Lyman and Werner bands).

The H Lyman- $\alpha$  and emissions from H<sub>2</sub> were first measured by the UV spectrometer of Voyager-2 [3], and more recently re-observed by HST/STIS [4]. The Lyman- $\alpha$  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- $\alpha$  photons, by Rayleigh scattering of the solar photons by the atmospheric H<sub>2</sub> [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  $\gamma$ -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 H<sub>2</sub> (absorption and Rayleigh and Raman scattering), and hydrocarbons species below 200 nm (Fig. 1) and by H<sub>2</sub> Rayleigh and Raman scattering and aerosol (from stratospheric haze) between 200 and 400 nm [10].

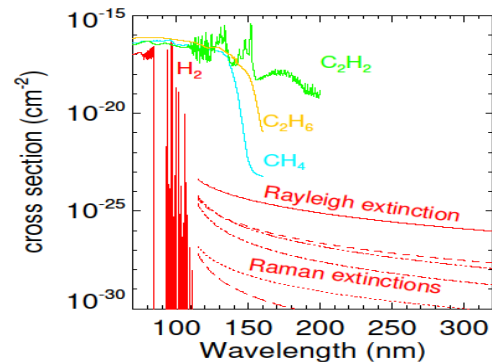


Fig. 1 UV extinction cross sections from the major gas species in the atmosphere of Uranus. Based on <https://phidrates.space.swri.edu>, and [11] for Rayleigh and Raman extinction by H<sub>2</sub> (at 100 K).

#### 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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