Magnetosphere-Satellite Coupling at Ganymede: Electron Precipitation and Surface UV Reflectance from Juno/UVS Observations

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Résumé

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Ganymede's ultraviolet (UV) aurorae provide a unique window into the coupling between its atmosphere, surface, and Jupiter's magnetosphere. Observed by HST and Juno/UVS, these emissions are dominated by the OI 130.4 and 135.6 nm lines, produced by electron impact on atmospheric species such as HO, O, and O. However, both the properties of the precipitating electrons and the impact of the magnetospheric precipitation on the surface remain poorly constrained.
In this work, we present a combined analysis of electron precipitation (Benmahi et al. 2025) and surface UV reflectance at Ganymede (Benmahi et al. 2026) using Juno/UVS observations acquired during the PJ34 flyby. We first retrieve the characteristic energy and flux of precipitating electrons by coupling the TransPlanet electron transport model with a non-local thermodynamic equilibrium (non-LTE) radiative transfer model. OI emission profiles are simulated for 17 auroral subregions, testing monoenergetic, Maxwellian, and kappa-type electron distributions. The I(135.6 nm)/I(130.4 nm) line ratio is used as a diagnostic of both electron energy and dominant target species.

Our results show that most auroral regions are best reproduced by monoenergetic electron populations with mean energies ranging from _˜17 to 300 eV and energy fluxes up to _˜2 mW m^2. Broader distributions generally require higher fluxes but lead to poorer spectral agreement, while discrepancies in some regions are attributed to low signal-to-noise ratios or non-ideal electron populations.

We also analyzed the sunlit auroral regions to constrain the spectral reflectance of Ganymede's surface in the 140–205 nm range using the same radiative transfer framework, including reflection of the incident solar flux. The derived reflectance varies strongly with both wavelength and location, spanning _˜0.1% to 8%, revealing pronounced surface heterogeneity. The absence of correlation with visible surface features suggests that UV reflectance is primarily shaped by long-term irradiation processes rather than geological morphology.

Together, these results provide a self-consistent characterization of electron precipitation and surface reflectance at Ganymede, and constitute a critical reference for future UV auroral studies in the context of the JUICE and Europa Clipper missions.

Bibliographiy:

- Benmahi, B. *et al.* (2025) " Precipitating electron properties of Ganymede's aurora retrieved from Juno/UVS observations during PJ34 ", *Astronomy & Astrophysics*. Disponible sur: https://doi.org/10.1051/0004-6361/202556996.

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