



HAL
open science

Contribution of meteoroids to the exosphere of Ganymede

Rozenn Robidel, François Leblanc, Jean-Yves Chaufray, Sébastien Verkercke,
Nicolas Altobelli, Claire Vallat

► **To cite this version:**

Rozenn Robidel, François Leblanc, Jean-Yves Chaufray, Sébastien Verkercke, Nicolas Altobelli, et al.. Contribution of meteoroids to the exosphere of Ganymede. Europlanet Science Congress 2024, Sep 2024, Berlin, Germany. EPSC Abstracts, 17, pp.EPSC2024-129, 2024, 10.5194/epsc2024-129 . insu-04674026

HAL Id: insu-04674026

<https://insu.hal.science/insu-04674026v1>

Submitted on 20 Aug 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Contribution of meteoroids to the exosphere of Ganymede

Rozenn Robidel¹, François Leblanc², Jean-Yves Chaufray², Sébastien Verkercke², Nicolas Altobelli¹, and Claire Vallat¹

¹European Space Agency, ESAC, Villanueva de la Cañada, Spain

²LATMOS-IPSL, CNRS, UVSQ, Paris-Saclay, Sorbonne Université, Guyancourt, France

The tenuous atmosphere of Ganymede was first suggested by [1], based on a stellar occultation observed from the ground. More than two decades later, Galileo Ultraviolet Spectrometer provided the first direct evidence of an atmosphere by detecting H Lyman- α emission line in the vicinity of Ganymede [2]. In addition, Hubble Space Telescope Goddard High Resolution Spectrograph (HST/GHRS) observed atomic oxygen through its emission lines at 130.4 and 135.6 nm [3]. Both detections were later confirmed by HST Space Telescope Imaging Spectrograph (HST/STIS) observations [4]. No other neutral species were detected in Ganymede's atmosphere despite several attempts with different instruments [5]. The surface-bounded exosphere of Ganymede is expected to be mostly composed of H₂O-related products (e.g. H₂O, O₂, H₂, O, H and OH), as its composition directly reflects the composition of Ganymede's surface. It is constantly replenished by processes related to the interactions between Ganymede's environment and its surface.

The in-situ observations of Ganymede's atmosphere are limited so most of our understanding is based on models. Most studies concentrate on solar irradiation (sublimation) and Jovian plasma irradiation (sputtering and radiolysis) and usually neglect meteoroids as a source for the neutral atmosphere [6-12]. However, meteoroids directly impact the surface of airless bodies, producing impact debris and shaping the resulting exosphere. They release surface species into the exosphere by impact vaporization and ejection of dust grains. They also participate in the space weathering of the surface materials and their impacts contributions are important to understand the aging of the surface and the relationship between endogenous and exogenous sources of surface materials [13]. Therefore, we now include the effects of meteoroid impact vaporization in the Exospheric Global Model (EGM), the 3D time-dependent Monte Carlo model previously applied to the description of Ganymede's atmosphere [7,9,11].

Very few models describe the dust environment in the outer solar system. We use the interplanetary dust flux modeled by [14] at Jupiter and compare with the model at Ganymede from [15].

Finally, the contribution of meteoroid impacts to Ganymede's exosphere is measured against other processes' contributions. This study aims to better constrain the balance between exogenic and endogenic alteration processes to understand the moon's surface history. It is essential in the context of the future missions to the Jovian system, ESA's JUICE, and NASA's Europa Clipper.

References:

- [1] Carlson et al., 1973
- [2] Barth et al., 1997
- [3] Hall et al., 1998
- [4] Feldman et al., 2000
- [5] Brown et al., 1997
- [6] Marconi et al., 2007
- [7] Turc et al., 2014
- [8] Plainaki et al., 2015
- [9] Leblanc et al., 2017
- [10] Vorburger et al., 2022
- [11] Leblanc et al., 2023
- [12] Vorburger et al., 2024
- [13] Galli et al., 2021
- [14] Poppe et al., 2016
- [15] Miljkovic et al., 2012