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2D-model of oxygen emissions lines for Europa

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The Jovian moon Europa is an interesting case study as an archetype for icy satellites, and will be one of the primary targets of the ESA JUICE mission which should be launched in 2022. Hosting a thin neutral gas atmosphere mainly composed of O_2 and H_2O, Europa can be studied by its airglow and dayglow emissions. A 1D photochemistry model has first been developed to assess the impact of the solar UV flux on the visible emission, such as the red and green oxygen lines (Cessateur et al. 2016). For limb polar viewing, red line emissions can reach a few hundreds of Rayleigh close to the surface.

The impact of the precipitating electrons has also been studied. The density and temperature of the electrons are first derived from the multifluid MHD model from Rubin et al. (2015). A 2D emission model has thus been developed to estimate the airglow emissions. When electrons are the major source of the visible emissions, the solar UV flux can be responsible for up to 15% of those emissions for some specific line of sight. Oxygen emission lines in the UV have also been considered, such as 130.5 and 135.6 nm. For the latter, we did estimate some significant line emissions reaching 700 Rayleigh for a polar limb viewing angle close to the surface. Oxygen emission lines are significant (higher than 10 R) for altitudes lower than 100 km for all lines, except for the red line emissions where emissions are still above 10 R up to 200 km from the surface. A sensitivity study has also been performed in order to assess the impact of the uncertainties relative to the dissociative-excitation cross sections.

Cessateur G, Barthelemy M & Peinke I. Photochemistry-emission coupled model for Europa and Ganymede. J. Space Weather Space Clim., 6, A17, 2016
Rubin, M., et al. Self-consistent multifluid MHD simulations of Europa's exospheric interaction with Jupiter's magnetosphere, J. Geophys. Res. Space Physics, 120, 3503–3524, 2015