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Retrieving the electron precipitation spectra from color ratio: an uncertainty analysis

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Abstract

Inferring the electron precipitation spectrum during an aurora is a necessary but difficult task: it is not always possible to conjugate an auroral observation with a satellite fly-by with adequate sensors or with incoherent scatter radar measurements that would lead to a reliable inversion of the electron density. In addition, for planetary studies, it is of interest to have a global view of electron precipitation mechanisms and their impact on the atmosphere, and derive techniques that can complement the limited number of instruments and observations. The inversion techniques based on airglow observations to retrieve electron precipitation spectra are therefore of crucial importance to global aeronomy studies.

However, it is also necessary to estimate the uncertainties of these techniques before using them in other contexts. In this paper, we study the influence of the atmosphere, the electron precipitation shape, and the cross section uncertainties for several color ratios at Earth, and especially the N2+ 391.4 nm / 427.8 nm ratio (see Figure 1). In addition, we study how this ratio could be useful to diagnose electron precipitation events at Titan.

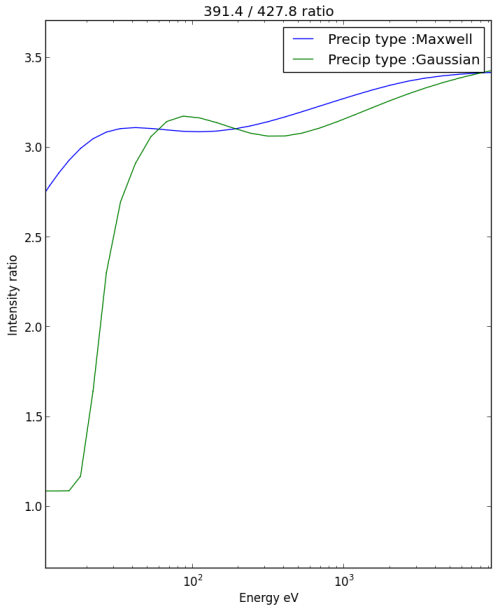

Figure 1: The N_2^+ 391.4 nm / 427.8 nm ratio computed in function of the energy of the precipitating electron and of the type of the precipitation spectra. The retrieval of the precipitation parameters is, in this case, very dependent on the type of precipitation: the hypothesis of a Gaussian precipitation while it is a Maxwellian one leads to an important overestimation of the electron energy peak.