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Juno/JIRAM infrared observations of Jupiter Aurorae: results of the first year.

A. Mura[1], A. Adriani[1], F. Altieri[1], B.M. Dinelli[2], M.L. Moriconi[2], A. Migliorini[1], S.J. Bolton[3], J.E.P. Connerney[4], J-C. Gerard[5], A. Cicchetti[1], R. Noschese[1], G. Sindoni[1], F. Tosi[1], G. Filacchione[1], F. Fabiano[2], G. Piccioni[1], D. Turrini[1], M. Amoroso[6], C. Plainaki[6], and A. Olivieri[6]

1. INAF-Istituto di Astrofisica e Planetologia Spaziali, Roma, Italy
2. CNR-Istituto di Scienze dell'Atmosfera e del Clima, Bologna / Roma, Italy
3. Southwest Research Institute, San Antonio, Texas, USA
4. NASA Goddard Space Flight Center, Greenbelt, Maryland, USA
5. Universitè de Liège, Belgium.
6. Agenzia Spaziale Italiana, Roma, Italy

Abstract

JIRAM (Jovian Infrared Auroral Mapper) is an imaging spectrometer on board the Juno spacecraft, which started the prime mission around Jupiter on August 2016. JIRAM is composed of two IR imager channels (L band and M band) and one spectrometer in the range 2-5 um, with a spectral resolution of less than 10 nm. The surface resolution of both the spectrometer (1D resolution) and the imager (2D) is, when Juno is close to Jupiter's poles, as low as 50 km. Combined with the unique vantage point provided by Juno, JIRAM observed the aurora with an unprecedented resolution. In fact, the Jovian aurorae are the primary scientific goal of JIRAM. Such aurorae are the most powerful among the planets in the Solar System, resulting from high-energy electrons falling along the planet's magnetic field lines into the upper atmosphere, leading to the formation of excited H3+, which then emit at different wavelengths. In particular, the main auroral oval emission is believed to be associated with upward field-aligned currents, driven by the breakdown of corotation between the planet and the plasma sheet. Such plasma is partially supplied as neutral gas by Io's volcanic activity.

JIRAM spectral range is designed to observe the auroral emission due to the H3+ ion. H3+ main roto-vibrational band has several possible transitions in the range 3.0-5.0 μm; however, observation of the infrared emission of H3+ is mainly possible in a spectral interval (3.2 to 4.0 μm) where the solar and thermal radiance emitted by the planet are very low due to the intense atmospheric methane absorption band, resulting in a high auroral contrast against Jupiter's dark disk.

For this reason, one of the two imager channels (L band) is centered at 3.455 μm (in the H3+ emission region). Images (256 x 432 pixels) are acquired every 30 seconds (one Juno rotation) to give a context information of auroral emission, for better understanding the spectrometer data, which allows, among others, retrieval of the H3+ column density and temperature.

Here we show results on JIRAM's data after one year of observations. Taking advantage of different orbital configurations of the Juno spacecraft during the year, these observations provide spatial, spectral and temporal distribution of the Jovian auroras. In addition to the study of the main oval, the footprints of Io, Europa and Ganymede have also been observed and characterized.