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A Radiative Transfer model for the atmosphere of the Outer Planets

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In view of the Italian participation to the NASA New Frontiers mission Juno to Jupiter, whose launch is planned for 2011, Italy extends its contribution by the addition of JIRAM (Jovian InfraRed Auroral Mapper) to the scientific payload.

In order to show the possibilities of JIRAM to observe the Jupiter atmospheric water content, we have simulated the H_2O measurements inside a hot spot that, for its particular dynamical structure, is characterized by low optical depths. This fact allows an imaging spectrometer like JIRAM to sound the tropospheric layers in deeper levels than on the rest of the planet. The simulation of the H_2O measurements was performed using a radiative transfer code named ARS. This code is based on the spectroscopic database HITRAN (HIgh TRANsmission molecular absorption database), and uses the line-by-line technique to compute transmissivity calculations. The simulation of the atmospheric emission was performed in the spectral interval between 4.5 and 5.3 μm where the atmospheric radiation comes from the inner regions of the planet.

The chemical model takes into account the main molecules which the atmospheres of giant planets are made of: H_2O, $^{12}CH_4$, $^{13}CH_4$, CH_3D, NH_3, PH_3, CO, GeH_4, and H_2 (continuum). All these species are spectroscopically and optically active in the 4.5-5.4 μm range.

To test the method used to simulate Jupiter emission, the same program (obviously with a different atmospheric model) has been applied to simulate the Saturn's hot spots emission and the results have been compared with a wide selection of VIMS measurements. VIMS (Visible Infrared Mapping Spectrometer) is one of the instru-

ments on board of the Cassini satellite that is orbiting around the main ringed planet, sending its data to Earth.

The simulations for Saturn, has shown the possibility to investigate the internal dynamic of the hot spots using the phosphine (PH_3) abundance as a tracer. Phosphine plays a very important role for the comprehension of the upwelling forces generate by the thermal energy. Phosphine is formed at the deeper levels of the atmosphere of Saturn and then is destroyed by photodissosciation in the stratosphere.

For the analysis of VIMS spectra, and to verify the goodness of the model, a synthetic spectra database has been created and used to find the best fit between the observed spectra and the synthetic ones. This database is valid for both planets (Saturn and Jupiter) in the sounded spectral interval.

Moreover, the database can be used for different simulations that can be completely independent by the actual data.