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Evidence of Jovian acoustic global modes

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Abstract

We report the detection of global acoustic modes on Jupiter and measurement of its fundamental frequency. The observations have been obtained thanks to the instrument SYMPA [2], a specially designed instrument able to produce Doppler velocity maps of the visible surface of Jupiter and monitor small variations in time. We will describe briefly the principal of the instrument, the observations and the performances.

We will focus this presentation on the data processing and the results. After a treatment adapted to the instrument [1] to produce the time series for each modes, we applied a procedure widely used in asteroseismology in order to detect the signature of possible global modes. A clear excess of power is present in the frequency range where the Jovian modes are expected in the Power Density Spectrum of the time series corresponding to the l=1 modes, and the measured amplitude is compatible with theoretical expectations for acoustic modes.

The spectrum exhibits a series of peaks, regularly distributes in frequency, with a mean spacing of 155.5±1.5 µHz, compatible with the signature of low degree global modes. After showing that this signal cannot be attributed to any instrumental noise, we also eliminated the solar modes and the Jovian surface inhomogeneities as the origin of the observed spectrum. The parameter measured on the spectrum, namely the large frequency separation, is compared to calculated values for different model of Jupiter. The value is compatible with most of the recent Jovian models, but excludes older models.

We conclude that the signal we have found is due to acoustic modes on Jupiter and we give the mean amplitude and frequency range where these modes are excited. The mean frequency spacing, being a integrated number, does not allow to discriminate between different models. A more precise value of the large separation, or an identification of the individual modes would provide strong constraints on the models, particularly on the mass of the core.

References

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