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About the interest of adding a polarimeter on UV instruments in the frame of the future missions to Jupiter

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Abstract

Since the discovery of the polarisation of thermospheric emissions on the Earth oxygen red line, it has been shown that the polarisation is a useful observable for planetary space environment studies. In the jovian case the polarisation of H_3^+ IR emissions have been discovered recenlty. The FUV H-Lyman lines and H_2 Werner and Lyman systems are very important in the jovian auroral emissions. The polarisation of these emissions could be really important to obtain information on the precipitating particles in the jovian auroral regions and on the structure of the jovian magnetic field. Due to this facts, we propose to add a FUV polarimeter in front of the FUV instrument on the next missions to Jupiter (EJSM).

H-Lyman polarisation by electron impact

Electrons impacts on atomic hydrogen gives variable polarisation rates versus the energies as shown by James et al. [1][2]. In the Lyman α case the rate reaches 30% just above the threshold. The polarisation rate vanished for energies around 170eV and reach negative values around -10 % at higher energies. The polarisation is thus a way to investigate the particles of lower energies. The slightly different different curve for the Lyman β line could give some additional information.

Technical problems

Building a FUV polarimeter presents some difficulties. Since the Lyman lines especially the Lyman α ones are really intensive the low transmission rates of LiF plate at 121.6 nm can be solved. James et al [2] proposed a system of two silica mirrors. This solution has the advantage to still work at Lyman β which is not the case for LiF plates. The best technical issue to build such an instrument is not yet defined, but some specification have to be taken into account especially the minimisation of moving pieces.

interpretation of the data

The H-Lyman lines are optically thick in the jovian atmosphere. Due to this, some depolarisation processes can occur in the atmosphere in presence of a magnetic field due to Hanle effect. This will concern the core of the line more than the wings. By modelling with a high resolution polarised radiative transfer the Lyman α emission we will be able to get the polarisation information. In another way the H_2 Werner and Lyman systems presents some intensive optically thin lines. The polarisation of such lines could in that case add new observable.

conclusions

Since the technical solution is not evident, it seems really important to be able to send such a polarimeter in the next missions to Jupiter to add an observable that could help to characterise the dynamics of the auroral regions.

References

[1] James et al. (1998) *Phys rev A*,57, 1787 – 1797.

[2] James et al. (2001), *Phys rev A.*, 66, 42710. 32, A74.