Contribution ID: **29** Type: **not specified**

Non-ideal MHD simulations of hot Jupiter atmospheres

Tuesday 8 July 2025 11:35 (1 minute)

Hot Jupiters are gas giant exoplanets that orbit their parent stars at very close distances, experiencing intense stellar irradiation. These extreme conditions lead to inflated radii, with most HJs exhibiting sizes larger than predicted by standard planetary cooling models. One possible mechanism contributing to this inflation is Ohmic heating, driven by the dissipation of currents generated through the interaction between atmospheric winds and magnetic fields. In this study, we perform 1D plane-parallel magnetohydrodynamic (MHD) simulations of HJ atmospheric columns, considering the wind and thermodynamic profiles at the substellar point coming from global circulation models of different exo-planets. We quantitatively investigate the expected effects of magnetic field winding, Ohmic dissipation, Hall drift and ambipolar diffusion. We explore several scenarios, considering profiles coming from models for different planets, with and without atmospheric magnetic drag, various background magnetic field strengths, and different domain sizes for the simulations. The main effect is the generation of strong (~ 101 − 102 G) azimuthal magnetic field in the shear region, driven by meridional currents that generate an estimated ohmic dissipation with local efficiencies from 10−6 to 10−1, depending mainly on the atmospheric temperature, which control the conductivity. Additionally, the Hall term introduces a meridional component which can compete with the background field in the uppermost layers. In the same region, the ambipolar diffusion can become non-negligible and tends to limit the currents perpendicular to the magnetic field. The study highlights the complexity of the MHD and the need to include its effects in atmospheric modelling to determine the wind profiles and the magnetic induction.

Presenter: SORIANO, Clàudia (Institute of Space Sciences (ICE-CSIC))

Session Classification: Poster Session