Highlights of Spanish Astrophysics XII, Proceedings of the XVI Scientific Meeting of the Spanish Astronomical Society held on July 15 - 19, 2024, in Granada, Spain. M. Manteiga, F. González Galindo, A. Labiano Ortega, M. Martínez González, N. Rea, M. Romero Gómez, A. Ulla Miguel, G. Yepes, C. Rodríguez López, A. Gómez García and C. Dafonte (eds.), 2025

Habitability conditions and radio emission under calm space weather conditions around Proxima b

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Abstract

We present magneto-hydrodynamic (MHD) simulations to study the calm space weather conditions around Proxima b, and its effect on the habitability of the planet and the radio emission arising from them, using the PLUTO 3D MHD code. We consider both sub- and super-Alfvénic regimes for Proxima b, as well as different values of the planetary magnetic field and of the inclination of the magnetic field with respect to the stellar wind.
We find that the magnetopause standoff distance of Proxima b is large enough for any planetary tilt, but the most extreme (close to 90 deg), to shield the surface from the cosmic radiation, for an Earth-like magnetic field and under calm space weather conditions.
We obtain the somewhat paradoxical result that the magnetopause standoff radius is, for the same values of the planetary tilt and planetary magnetic field, smaller in the sub-Alfvénic regime than in the super-Alfvénic one. We also find that the energy dissipation at the bow shock is essentially independent of the angle between the planet's magnetic dipole and the incident stellar wind flow.
We also find that the radio emission from the reconnection regions can be as high as 7×10^9 erg/s in the super-Alfvénic regime, and is on average almost an order of magnitude larger than the radio emission in the sub-Alfvénic cases. The energetics are enough to account for the observed radio emission from Proxima b, although this would require that this energy travelled back to the star. While this is not expected in the Alfvén wing model, where both the planet and the star are interconnected via magnetic loops, in the magnetic reconnection scenario we could expect that a fraction of electrons could travel back to the star and eventually radiate at relatively high radio frequencies (1.7 GHz) via the electron-cyclotron mechanism.

My poster in zenodo.org can be found here