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Exploring the interactions of M dwarf winds and cosmic rays

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Citation

Mesquita, A. L. (2022, October 25). *Exploring the interactions of M dwarf winds and cosmic rays*. Retrieved from <https://hdl.handle.net/1887/3484534>

Version: Publisher's Version

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Exploring the interactions of M dwarf winds and cosmic rays

1. M dwarfs can have Earth-like Galactic cosmic ray fluxes in their habitable zone (Ch. 3 and Ch. 4).
2. Old, less active stars are dominated by diffusion which leads to little (or no) suppression of cosmic rays. In these cases, the size of the astrosphere does not affect the Galactic cosmic ray fluxes (Ch. 3 and Ch. 4).
3. Young, more active stars are dominated by advection which leads to a strong suppression of the cosmic rays. In these cases, the size of the astrosphere can strongly affect the Galactic cosmic ray fluxes (Ch. 5).
4. M dwarfs could have larger chromospheres extending to 18% to 180% of the stellar radius (Ch. 2).
5. Particle drifts caused by gradients and curvatures in the stellar magnetic field are not only relevant for the propagation of cosmic rays in the solar system but also for M dwarfs (Ch. 5).
6. Observable properties, such as X-ray luminosity, magnetic field strength/flux, and the mass-loss rate are important to better constrain stellar wind and cosmic ray simulations.
7. Cosmic ray fluxes in exoplanet atmospheres will be constrained with future exoplanet atmosphere observations with space telescopes, such as JWST and ARIEL.
8. Galactic cosmic ray fluxes should be more relevant in the astrospheres of old, less active stars. On the other hand, stellar cosmic rays (stellar energetic particles) should be more relevant in young, more active stellar environments.
9. A PhD should be considered a job everywhere and paid fairly.
10. Therapy is important to have good mental health, even when it seems pointless.

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Leiden, 25 October 2022