

# M dwarfs can have Earth-like fluxes of Galactic cosmic rays in their habitable zones

## The propagation of Galactic cosmic rays through M dwarf astrospheres

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### Summary

Mesquita et al. (in review)

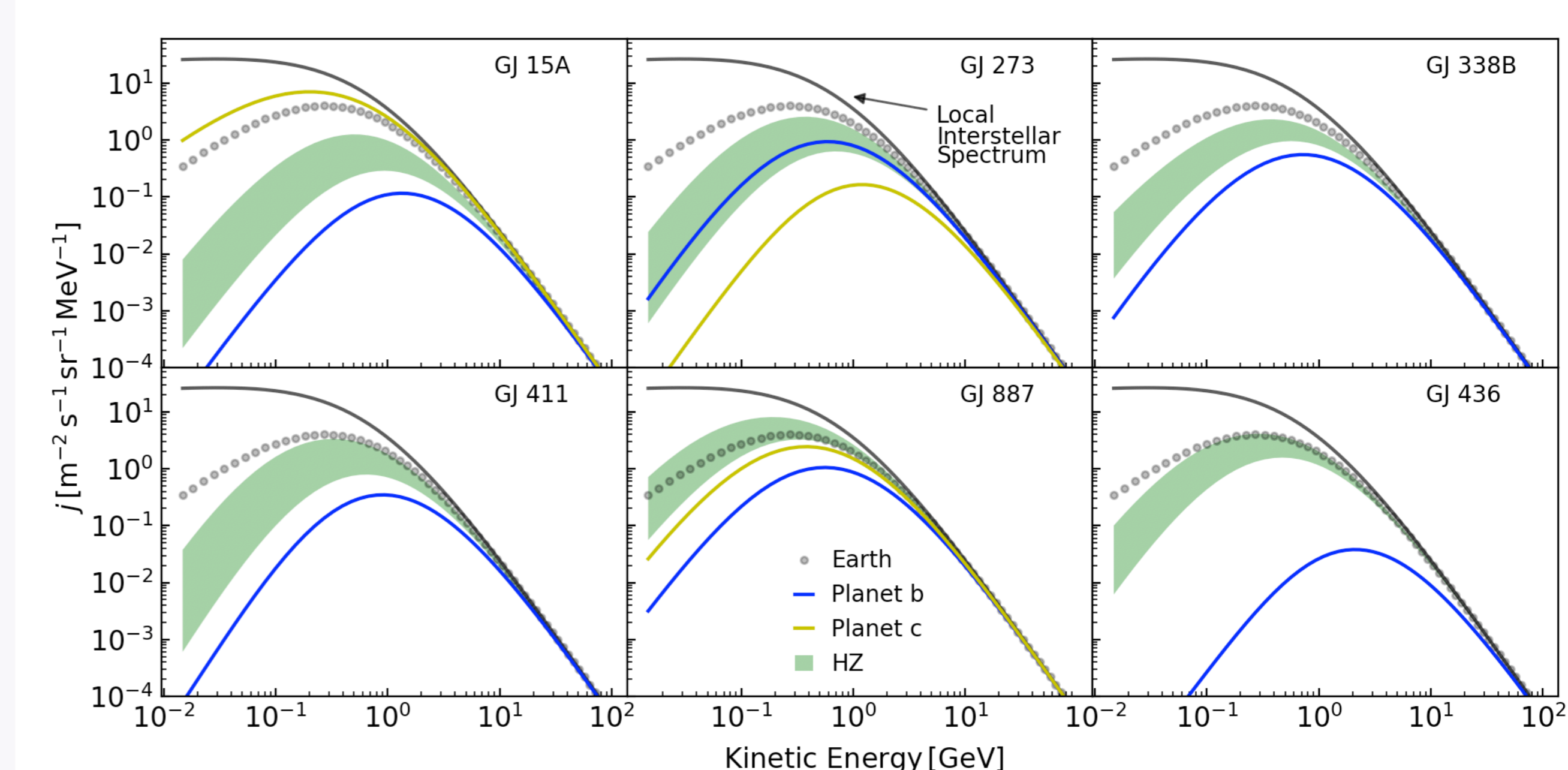
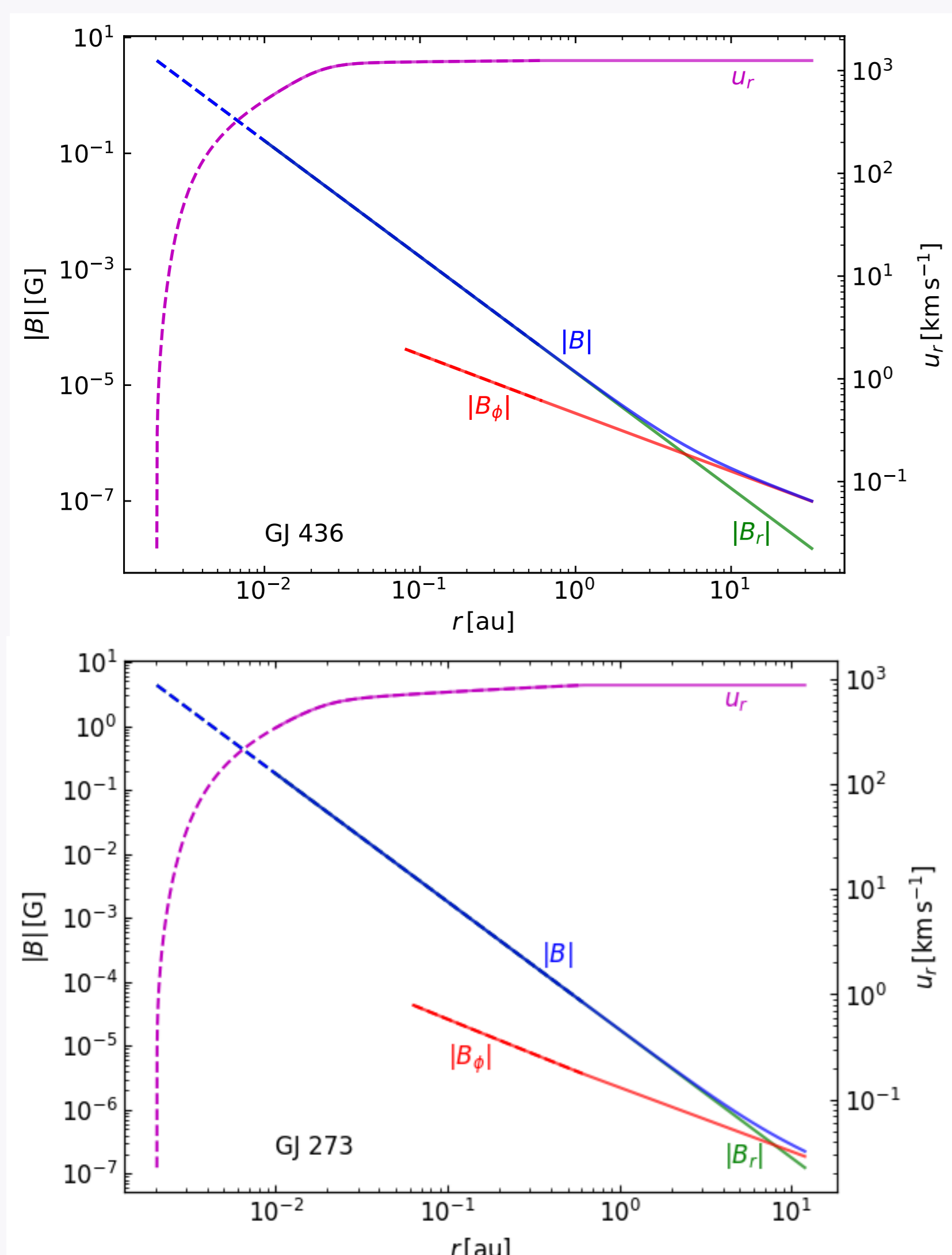
- We model the stellar wind of M dwarfs, using an Alfvén-wave driven wind model (Mesquita & Vidotto, 2020).
- We model the propagation of Galactic cosmic rays through the astrospheres of six M dwarfs.
- The habitable zones of GJ 411, GJ 436 and GJ 887 have comparable levels of Galactic cosmic ray values as observed at Earth.
- In our sample, GJ 273b is the only known planet orbiting the habitable zone of its host star and it receives a lower flux of Galactic cosmic rays, when compared with Earth.

### Stellar wind modelling and astrosphere size

- We use an Alfvén-wave-driven wind model.
- Our winds are accelerated by the heating and the transfer of momentum from the Alfvén waves to the plasma.
- The astrosphere size is defined by the balance between the wind ram pressure and interstellar wind ram pressure.

### Galactic cosmic ray fluxes

- Magnetic field and stellar wind velocity profiles affect the propagation of Galactic cosmic rays.
- Most of the exoplanets have a significantly lower flux of cosmic rays than values observed at the Earth.
- Some M dwarfs have cosmic rays fluxes comparable with Earth's around their much closer-in habitable zones.



**Figure 2:** Differential intensity of Galactic cosmic rays around the habitable zones of six M dwarfs and around their host exoplanet orbits.

Why do we care about Galactic cosmic rays fluxes? Because they may be important for the origin of life.

**Figure 1:** Stellar wind models of GJ 436 and GJ 273 with astrosphere sizes equal to 33 au and 12 au.