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Biomarker Response to Cosmic Rays on Planets orbiting in the Habitable Zone of M-Stars

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Our model predicts that biomarkers from planets orbiting in the Habitable Zone (HZ) of M-Dwarf stars with Earthlike atmospheres (hereafter "M-star worlds") may survive strong fluxes from Galactic Cosmic Rays (GCRs). These calculations included the effects of (albeit weakened) magnetospheric shielding. Our result refers to the effect of cosmic rays producing nitrogen oxides, NO_x(=NO+NO_2) in earthlike atmospheres which perturb the atmospheric chemistry hence remove ozone. Ozone on the M-star world is resilient to GCR-induced NO_x because high methane levels favour the ozone-producing "smog" mechanism, which is catalysed by NO_x as discussed by Grenfell et al. (2007) (Astrobiology Special Issue on M-stars). We have also performed an initial estimate of stellar cosmic ray (SCR) fluxes but these are currently upper estimate fluxes, based on our own Sun, assuming a completely unmagnetised planet scaled to 0.2 AU i.e. in the HZ. SCR results imply that up to 98