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The intensity of energetic particles at the evolving Earth

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Energetic particles can drive the formation of prebiotic molecules in exoplanetary which are important for the origin of life. On the other hand, large energetic particle fluxes are known to be detrimental to developed life by damaging DNA. Thus, in order to understand the origin, and subsequent survival, of life on Earth it is necessary to first understand the energetic particle fluxes incident on Earth at that time. There are two types of energetic particles that are important: stellar energetic particles accelerated by their host star and Galactic cosmic rays.

I will present our recent results that model the propagation of these energetic particles through the wind of a Sun-like star during its lifetime. We find, at the time when life is thought to have begun on Earth, that Galactic cosmic ray fluxes were greatly suppressed in comparison to present-day values. However, I will show that stellar energetic particle fluxes would have been larger than present-day values. I motivate that the maximum stellar energetic particle energy increases for younger stars. This is extremely important because higher energy particles are more likely to impact the surface of a planet, in addition to its atmosphere. I will briefly discuss how we applied our model to an exoplanetary system and how this can be linked to upcoming observations.