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# The Influence of SEPs and Cosmic Rays on the Early Earth Atmosphere

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Solar energetic particles (SEPs) and cosmic rays are high energy particles that impact Earth's atmosphere. One key way that these particles interact with the material in the atmosphere is by ionising atoms and molecules, resulting in changes in the atmosphere's chemistry. They may even have contributed to the formation of prebiotic molecules, the "building blocks"for life, on Earth's surface at the time when life is thought to have begun on Earth. Therefore, understanding the number of high-energy particles reaching the Earth's surface at this time is of key importance.

The intensity and energy of the energetic particles reaching the top of Earth's atmosphere depend heavily on the young Sun's magnetic field strength and solar wind velocity. I focus on energetic particles in a post-impact early Earth atmosphere which is different from the present-day Earth's atmosphere.

In this post-impact atmosphere scenario the number of cosmic rays at the top of Earth's atmosphere is lower than the present day as the solar wind's faster velocity and strong magnetic field strength suppress the cosmic rays diffusing into and through the solar system. SEP numbers at the top of Earth's atmosphere are increased in this scenario due to the higher activity expected from the younger Sun.
I will discuss how I simulate the transport of both SEPs and cosmic rays through this post-impact early Earth atmosphere and calculate the ionisation rate as a function of height due to these energetic particles. I will discuss how these ionisation rates can be used in chemical models to calculate the abundances of prebiotic molecules in a hydrogen-dominated atmosphere.

I will discuss how the position of the solar system in the Galaxy and in relation to star-forming regions influences the cosmic ray spectrum in the post-impact early Earth atmosphere.

## Collaboration(s)

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