EGU21-8189
https://doi.org/10.5194/egusphere-egu21-8189
EGU General Assembly 2021
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

A self-consistent simulation of proton acceleration and transport near a high-speed solar wind stream

Nicolas Wijsen[1], Evangelia Samara[2,1], Àngels Aran[3], David Lario[4], Jens Pomoell[5], and Stefaan Poedts[1,6]

[1]Centre for mathematical Plasma Astrophysics, Dept. of Mathematics, KU Leuven, Belgium
[2]Royal Observatory of Belgium, Brussels, Belgium
[3]Department of Quantum Physics and Astrophysics, Institute of Cosmos Sciences (ICCUB),Universitat de Barcelona (IEEC-UB), Spain
[4]NASA, Goddard Space Flight Center, Heliophysics Science Division, USA
[5]Department of Physics, University of Helsinki, Finland
[6]Institute of Physics, University of Maria Curie-Skłodowska, Lublin, Poland

Solar wind stream interaction regions (SIRs) are often characterised by energetic ion enhancements. The mechanisms accelerating these particles as well as the locations where the acceleration occurs, remains debated. Here, we report the findings of a simulation of a SIR-event observed by Parker Solar Probe at 0.56 au and the Solar Terrestrial Relations Observatory-Ahead at 0.96 au in September 2019 when both spacecraft were approximately radially aligned with the Sun. The simulation reproduces the solar wind configuration and the energetic particle enhancements observed by both spacecraft. Our results show that the energetic particles are produced at the compression waves associated with the SIR and that the suprathermal tail of the solar wind is a good candidate to provide the seed population for particle acceleration. The simulation confirms that the acceleration process does not require shock waves and can already commence within Earth's orbit, with an energy dependence on the precise location where particles are accelerated. The three-dimensional configuration of the solar wind streams strongly modulates the energetic particle distributions, illustrating the necessity of advanced models to understand these particle events.

This research has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870405 (EUHFORIA 2.0).