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Modeling particle acceleration and transport during high-energy solar gamma-ray events: Results from the HESPERIA project

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The EU/H2020 project "High Energy Solar Particle Events foRecastIng and Analysis" (HESPERIA) has an objective to gain improved understanding of solar energetic particle (SEP) acceleration, release and transport related to long-duration gamma-ray emissions recently observed by Fermi/LAT. We have performed simulation studies for particle acceleration and transport for the 17 May 2012 event, which is also a Ground Level Enhancement (GLE) of solar cosmic rays. The particle event is modeled assuming that it is accelerated by the shock wave driven by the erupting coronal mass ejection (CME). We first analyze the 3-dimensional propagation of the shock through the corona using imaging observations from SDO, SOHO and STEREO spacecraft. The derived kinematics of the shock is combined with magnetohydrodynamic and potential field modeling of the ambient corona to derive the evolution of the shock parameters on a large set of field lines. We then employ the self-consistent Coronal Shock Acceleration (CSA) simulation model of the University of Turku to study the acceleration process on selected field lines and combine it with a new model of downstream particle transport to assess the energy spectrum and time profile of accelerated particles precipitating in the dense surface regions below the corona. We also employ the Shock and Particle (SaP) simulation model of the University of Barcelona to analyze the interplanetary counterpart of the Fermi event.

In this paper, we will present the observations of the event, our approach to the modeling and the first results of the analysis. The work has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 637324 (HESPERIA).