Gamma-rays, EUV Wave (Shock), and SEPs Associated with the M1.5 Behind-the-limb Flare on 2013-Oct-11

Pesce-Rollins, Melissa (1), melissa.pesce.rollins@pi.infn.it; Nicola Omodei (2); Vahe' Petrosian (2); Wei Liu (2, 3); Fatima Rubio Da Costa (2); and Qingrong Chen (2).
(1) Italian National Institute of Nuclear and Particle Physics (INFN), Pisa, Italy
(2) Stanford University, Stanford, CA, USA
(3) Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA

On 2013-Oct-11 Fermi detected its first behind-the-limb flare, an M1.5 flare about 10-deg behind the solar limb emitting gamma-rays up to 3 GeV for ~30 minutes. The gamma-ray spectra can be adequately described by a power law with a high-energy cutoff, or as a result of the decay of pions produced by accelerated protons and heavy ions. RHESSI detected hard X-rays produced by electrons well above the limb from the top of the flare loop whose footpoints were occulted. SDO/AIA observed a global extreme-ultraviolet (EUV) wave, likely the low-corona counterpart of a shock (associated with a type II radio burst) which was driven by a fast (~1200 km/s) coronal mass ejection (CME). Both STEREO spacecraft detected energetic electrons, protons, and heavy ions. This rich data set of multi-wavelength observations provides a unique, new opportunity to investigate the relative importance of particle acceleration in the flare vs. CME-driven shock. Our calculation suggests two equal possibilities for the origin of the detected gamma-rays, which can originate from behind the limb and penetrate the solar interior at a grazing angle, or some ions, e.g., accelerated in large loops or at the CME-driven shock, could land on the front side of the Sun and produce gamma-rays there. We discuss the implications of these results for constraining particle acceleration mechanisms in solar eruptions.