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An automated approach to link solar flares and energetic particle events measured with Solar Orbiter

Nils Janitzek[1], **Henrik Jentgens**[2], Fabian Kistler[3], Louis Bischof[3], Muriel Stiefel[4], Krzysztof Barczynski[5], Yingjie Zhu[3,5], Louise Harra[3,5], Raul Gomez-Herrero[6], Alexander Warmuth[7], Alexis Rouillard[8], Robert Wimmer-Schweingruber[9], Javier Rodriguez-Pacheco[6], and Sam Krucker[4]

[1]ESAC, ESA, Madrid, Spain (nils.janitzek@esa.int)
[2]Eastern Switzerland University of Applied Sciences, IQT, KMN, Switzerland
[3]Institute for Particle and Astrophysics, ETH Zurich, Zurich, Switzerland
[4]University of Applied Sciences and Arts Northwestern Switzerland, Windisch, Switzerland
[5]Physical Meteorological Observatory Davos, Davos Dorf, Switzerland
[6]Space Research Group, University of Alcala, Alcala de Henares, Spain
[7]Leibniz Institute for Astrophysics Potsdam, Potsdam, Germany
[8]Institute of Research in Astrophysics and Planetology, Toulouse, France
[9]Institute of Experimental and Applied Physics, University of Kiel, Kiel, Germany

Solar flares and associated eruptions are a known source of solar energetic particles (SEPs), but it is often challenging to establish a precise link between individual flares and SEP events measured in-situ throughout the heliosphere. The Solar Orbiter mission, with its Spectrometer/Telescope for Imaging X-rays (STIX) and Energetic Particle Detector (EPD), provides excellent measurements for systematic studies of these phenomena. Based on these data, we developed an algorithm that automatically links solar flares to SEP electron events using a STIX flare list, SEP electron measurements from EPD, and considering model predictions of magnetic connectivity between the Sun and the spacecraft. As a result, the method identifies several hundred flares to be connected to SEP events - out of more than 25000 flares detected with STIX between 2021 and 2025. The precise linkage criteria can be set by the user - including the accepted distance between flare and modelled magnetic footpoint and the length of the accepted time window for SEP arrival. A first comparison of the automatic method with the CoSEE-Cat electron event catalogue for the time period 2021 - 2022 shows, that about 50% of the links found by the algorithm are actual physical links. The method is already available as quick-look online tool for flare-SEP linkage.