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The low-energy ion event on 2020 June 19 measured by Solar Orbiter

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Shortly after reaching the first perihelion, the Energetic Particle Detector (EPD) onboard Solar Orbiter measured a low-energy (<1 MeV/nuc) ion event whose duration varied with the energy of the particles. The increase above pre-event intensity levels was detected early on June 19 for ions in the energy range from ~50 keV to ~1 MeV and lasted up to ~12:00 UT on June 20. In the energy range from ~10 keV to < 40 keV, the ion event spanned from June 18 to 21. This latter low-energy ion intensity enhancement coincided with a two-step Forbush decrease (FD) as displayed in the EPD > 17 MeV/nuc ion measurements. On the other hand, no electron increases were detected. As seen from 1 au, there is no clear evidence of solar activity from the visible disk that could be associated with the origin of this ion event. We hypothesize about the origin of this event as due to either a possible solar eruption occurring behind the visible part of the Sun or to an interplanetary spatial structure. We use interplanetary magnetic field data from the Solar Orbiter Magnetometer (MAG), solar wind electron density derived from measurements of the Solar Orbiter Radio and Plasma Waves (RPW) instrument to specify the in-situ solar wind conditions where the ion event was observed. In addition, we use solar wind plasma measurements from the Solar Orbiter Solar Wind Analyser (SWA) suite gathered during the following solar rotation, for comparison purposes. In order to seek for possible associated solar sources, we use images from the Extreme Ultraviolet Imager (EUI) instrument onboard Solar Orbiter. Together with the lack of electron observations and Type III radio bursts, the simultaneous response of the ion intensity-time profiles at various energies indicates an interplanetary source for the particles. The two-step FD shape observed during this event suggests that the first step early on June 18 was due to a transient structure, whereas the second step on June 19, together with the ~50 –1000 keV/nuc ion enhancement, was due to a solar wind stream interaction region. The observation of a similar FD in the next solar rotation favours this interpretation, although a more complex structure cannot be discarded due to the lack of concurrent solar wind temperature and velocity observations.

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