EGU21-10023
https://doi.org/10.5194/egusphere-egu21-10023
EGU General Assembly 2021

Large amplitude ion-acoustic waves observed in the solar wind by the Solar Orbiter

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Electric field observations of the Time Domain Sampler (TDS) receiver, a part of the Radio and Plasma Waves (RPW) instrument onboard Solar Orbiter, often exhibit very intense broadband emissions at frequencies below 10 kHz in the spacecraft frame. The RPW instrument has been operating almost continuously during the commissioning phase of the mission from March to May, the first perihelion in June, and through the first flyby of Venus in late December 2020. Nearly a year of observations allow us to perform a statistical study of ion-acoustic waves in the solar wind covering an interval of heliocentric distances between 0.5 AU to 1 AU. The occurrence of low-frequency waves peaks around perihelion in June at distances of 0.5 AU and decreases with increasing distances, with only a few waves detected per day in late September at ~1 AU. A more detailed analysis of triggered waveform snapshots shows the typical wave frequency at about 3 kHz and wave power about 5e-2 mV^2/m^2. The distribution of the relative phase between two components of the projected E-field in the Spacecraft Reference Frame (SRF) shows a mostly linear wave polarization. These waves are interpreted as strongly Doppler-shifted ion-acoustic waves, generated by solar wind ion beams and often accompany large-scale solar wind structures. A detailed analysis of the Doppler-shift using solar wind data from a Proton and Alpha particle Sensor (PAS), a part of Solar Wind Analyzer (SWA), is done for several examples.

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