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Evolution of solar accelerated electron beams as a function of distance from the Sun

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Solar electrons beams are accelerated in the corona, and can travel out into the solar wind and beyond. These beams of non-thermal electrons evolve as a function of distance from the Sun, interacting with the background plasma and growing Langmuir waves as they propagate. Subsequent radio emission is also seen in the form of type III bursts. Around 1 AU, we detect in-situ electrons up to 10-20 keV together with local Langmuir waves. However, previous studies suggest that higher energy electrons interact with Langmuir waves close to the Sun and so these electrons would not propagate scatter-free. Through beam-plasma structure simulations we study the interactions between these electron beams and the background plasma of the solar corona and the solar wind at different distances from the Sun, up to 130 solar radii. This allows us to determine what is the maximum electron velocity responsible for Langmuir wave production and growth, and consequently which electron energies are affected by wave-particle interactions as a function of distance from the Sun. We also vary the spectral index of the electron velocity distribution α and the electron beam density n_{beam} to identify what role they play in determining the relevant electron velocities at which wave-particle interactions occur. Understanding the mechanisms driving the change in the maximum electron velocity will permit more accurate predictions in electron onset as well as arrival times, relevant for space weather applications and the understanding of the subsequent emissions at radio and X-ray wavelength. Moreover, our radial predictions can be tested against in-situ electron and plasma measurements from the instruments on-board the Solar Orbiter and Parker Solar Probe spacecrafts.