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KINETIC SIMULATION OF TYPE II RADIO BURSTS IN CME

The emission of solar radio bursts is closely related to coronal mass ejections. While the phenomenology of the bursts is rather well studied, the detailed mechanism of the emission is not yet fully understood [1]. Our approach to understand radio bursts - here the type II radio bursts - differs from previous approaches: Rather than trying to find the correct evolution of the CME using methods of fluid dynamics [2,3] or combined fluid/kinetic methods, we are using a fully kinetic approach to model the movement of electrons and protons in a shock environment, therefore neglecting the large scale evolution of the shock, while correctly modelling
the kinetic microphysics. The kinetic simulation itself is based on fully-relativistic Particle-in-Cell methods [4].
This technique allows for observation of plasma wave excitation in the shock region and gives a deep insight into the mechanisms of emission and transformation of different wave modes. We were using Fourier- and Laplace-transform based analysis to identify wave modes and electromagnetic emission, especially focused on their evolution in time.
In the setup of the simulation we were using a predefined shock environment in a computational box with periodic boundaries perpendicular to the shock direction and inflow boundaries along the shock direction. Our simulations were able to reproduce the phenomenological features of type II radio bursts and also additional information about fundamental processes taking place, with a focus on production of waves through three-wave interaction [5]. We present results of these simulations and compare them to previous models of radio burst modeling.