Abstract Submitted
for the DPP19 Meeting of
The American Physical Society

Particle-in-Cell Simulations of the Effects of the Electron Temperature Anisotropy on the Development of the Proton Firehose Instability in the Solar Wind ALFREDO MICERA, Royal Observatory of Belgium, KU Leuven, ELISABETTA BOELLA, Lancaster University, A. N. ZHUKOV, Royal Observatory of Belgium, S. M. SHAABAN, MARIAN LAZAR, GIOVANNI LAPENTA, KU Leuven — It is thought that kinetic instabilities in the solar wind act to limit the pressure anisotropies that would naturally develop if the plasma expanded adiabatically. First-principles simulations could provide a crucial insight on this open issue. However, these simulations are usually very challenging and out of the realm of traditional PIC codes, because of the multitude of spatial and temporal scales characterizing the processes of interest. Using our innovative semi-implicit PIC algorithm ECsim, we investigate the development and the non-linear evolution of the parallel firehose instability in the presence of anisotropic electron and ion distribution functions. The simulations are performed with a realistic electron-proton mass ratio and values of thermal velocities, magnetic fields and plasma densities characteristic of the solar wind around 0.5 AU. The effects of wave activities in scattering plasma protons and electrons and in reducing their anisotropies to marginally stable state is analyzed in detail. Our results show that the presence of an electron temperature anisotropy modifies the onset and the growth rate of the proton firehose instability, which develops earlier and grows faster, respect to the case where only ions are anisotropic.

Alfredo Micera
Royal Observatory of Belgium, KU Leuven

Date submitted: 03 Jul 2019 Electronic form version 1.4