



Cold ions in magnetotail reconnection and waves in the ion diffusion region: Particle-in-Cell simulations

Ivan Zaytsev, Andrey Divin, Vladimir Semenov, Yuri Khotyaintsev, Andris Vaivads, Mats André, Sergio Toledo-Redondo, Giovanni Lapenta, Stefano Markidis, Pierre Henri

► To cite this version:

Ivan Zaytsev, Andrey Divin, Vladimir Semenov, Yuri Khotyaintsev, Andris Vaivads, et al.. Cold ions in magnetotail reconnection and waves in the ion diffusion region: Particle-in-Cell simulations. 20th EGU General Assembly, Apr 2018, Vienne, Austria. pp.17768. insu-03566319

HAL Id: insu-03566319

<https://insu.hal.science/insu-03566319>

Submitted on 11 Feb 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License



Cold ions in magnetotail reconnection and waves in the ion diffusion region: Particle-in-Cell simulations

Ivan Zaytsev (1), Andrey Divin (1), Vladimir Semenov (1), Yuri Khotyaintsev (2), Andris Vaivads (2), Mats André (2), Sergio Toledo-Redondo (3), Giovanni Lapenta (4), Stefano Markidis (5), and Pierre Henri (6)

(1) Saint Petersburg State University, St. Petersburg, Russian Federation (andrey.div@gmail.com), (2) Swedish Institute of Space Physics, Uppsala, Sweden, (3) European Space Agency, ESA/ESAC, Madrid, Spain, (4) CmPA, Department of Mathematics, KU Leuven, Belgium, (5) KTH Royal Institute of Technology, Stockholm, Sweden, (6) LPC2E, CNRS, Orleans 45071, France

Magnetic reconnection is an explosive plasma process which is responsible for conversion of magnetic energy into heat and bulk plasma flows. In collisionless environments (in particular, in the Earth's magnetotail), the process develops a multi-scale structure with the electron diffusion region (EDR) embedded into that of heavier species (protons, heavy ions). Recent observational and simulation studies reveal a substantial population of very cold ions (10 eV) of ionospheric origin which spreads in the Earth's magnetosphere without significant heating. Such a population co-exists with hot magnetospheric ion component (5-10 KeV), thus influencing kinetic properties of magnetic reconnection at the magnetopause and in the tail. Motivated by these observational findings, we present results of 2D Particle-in-cell (PIC) simulations of collisionless reconnection in a plasma composed of hot electrons, hot and cold ions. We vary density of hot component from 0 to 100% in different runs to investigate in detail the effect of cold component. We report a new instability, which is excited inside the IDR due to unmagnetized cold ion beams accelerated by polarization electric field perpendicular to the B field. The sub-ion scale instability is of lower hybrid range (unmagnetized ions, magnetized electrons). The mode partially relaxes electron nongyrotropies existing in the EDR, leading to shortening of the unmagnetized electron jet. In a simulation where cold ion component is the only population (no hot ions), the diffusion region and separatrices appear to be turbulent with no electron jet emanating from the EDR, which is of potential importance for detection of EDR crossings in data. We suggest that the presence of cold ion component can slightly increase the reconnection rate.