



## **Hybrid-Vlasov simulations of the Earth's bow shock/magnetosheath compared to Cluster observations**

Dimitry Pokhotelov (1,2), Jan Soucek (3), Yann Kempf (1,2), Sebastian von Alfthan (1), Minna Palmroth (1), Hannu E. J. Koskinen (1,2)

(1) Finnish Meteorological Institute, Earth Observation Unit, Helsinki, Finland (dimitry.pokhotelov@fmi.fi), (2) Department of Physics, University of Helsinki, Helsinki, Finland, (3) Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic

The new hybrid-Vlasov simulation code, Vlasiator, is applied to model the Earth's collisionless bow shock in two spatial dimensions and three dimensions in velocity space retrieving ion distribution functions over the foreshock and magnetosheath regions with unprecedented details. The code is engineered to run in a massively parallel setup on modern supercomputers using hybrid MPI-OpenMP parallelisation. The hybrid-Vlasov approach produces noise-free uniformly discretized ion distribution functions comparable to those measured in-situ by spacecraft. Vlasiator can reproduce features of the magnetosheath known previously from multi-spacecraft observations, such as large-scale mirror mode structures in the magnetosheath. Features of the magnetosheath mirror modes and associated highly-anisotropic ion distributions are compared with observations of mirror modes with a constellation of Cluster spacecraft.