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Magnetosheath high-speed jet properties and evolution as deduced by Vlasiator: First results

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We use the novel global hybrid-Vlasov simulation for the magnetosphere, Vlasiator, to investigate magnetosheath high speed jets. Vlasiator includes an unscaled dipole strength as a boundary condition, and therefore the spatial and temporal scales can be, for the first time, presented without scaling, allowing to investigate the jet properties and compare them directly with the observed jets within the Earth's magnetosheath. In the run shown in this paper, the interplanetary magnetic field (IMF) cone angle is 30°, and a foreshock develops in front of the quasi-parallel magnetosheath. We visually detect a structure with a high dynamic pressure, penetrating from the bow shock edge towards the magnetopause. The structure is confirmed as a high speed jet using three different criteria, which have been adopted in previous observational studies. We find that the jet is an elongated structure of $\sim$2.3 R_E in length, while its size perpendicular to the direction of propagation is $\sim$0.5 R_E. The duration of the simulated jet agrees with observations. We also investigate the jet evolution, and find that the jet originates by the interaction of the foreshock Ultra Low Frequency (ULF) waves with the bow shock surface. The simulation shows that magnetosheath jets can develop at the quasi-parallel shock also under steady IMF, as inferred by observational studies.