PAP301 Abstract
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06.02.2024

The Earth’s Magnetospheric Convection in Vlasiator

The Earth's magnetic field is formed by the interaction of the Earth's intrinsic magnetic field and the solar wind that is constantly emitted by the sun. This interaction prompts convection in the Earth's magnetosphere, driven by the opening and closing of magnetic field lines through magnetic reconnection on both dayside and nightside. The thesis aims at quantifying the intensity of this convection.

This process is known as the Dungey Cycle, a concept first introduced in 1961. It describes how plasma flux is transported within the magnetosphere, leading to a distinctive twin-cell convection pattern in the ionosphere. When the southward Interplanetary Magnetic Field (IMF) encounters the Earth's magnetopause on the dayside, it initiates magnetic reconnection. This process opens Earth's magnetic field lines, which are then carried away by the solar wind, forming an elongated magnetotail. As pressure builds in the tail's lobe region, plasma is pushed towards lower latitudes, where reconnection happens again and closing the open flux. This nightside reconnection allows the plasma to circulate back to the dayside and completing the cycle.

By utilizing Vlasiator, a 3D hybrid-Vlasov simulation code, we can study this convection pattern quantitatively. In this code, the evolution of the phase-space density of kinetic ions is solved with Vlasov’s equation while electrons are taken as a charge-neutralising fluid. Given the challenges of directly measuring the reconnection rate with empirical equations, an indirect method is applied. This method calculates the reconnection rate by using the closed flux change rate and magnetic flux convection rate in the magnetosphere. The Dungey cycle convection rate can then be quantified as the difference between dayside and nightside reconnection rate.

Future research will include comparing the current findings with results from observations and refining the measurement of the ionospheric flux change rate.