



The magnetopause as a rotational discontinuity: open issues on MHD reconnection tests

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When magnetic reconnection is ongoing, the magnetopause (MP) behaves like a rotational discontinuity (RD) outside the reconnection region. With *in-situ* satellite data, the RD character of the MP is usually checked by carrying out the Walén test, based on the MHD conservation laws. According to the theory, the plasma velocity in the deHoffmann-Teller frame should be equal to the Alfvén velocity. However, in experimental context the plasma velocity is typically just 0.6 – 0.8 of the Alfvén velocity. This discrepancy might originate in a number of simplifying assumptions, two of which are examined in the presentation.

Tests of the Walén relation have commonly been based on the ion velocities, although the magnetic field is more closely tied to the electron velocities, which differ from the ion velocities whenever electric currents are flowing. For a Cluster event on March 14, 2002, we have inferred the electron velocities from the measured currents and ion velocities, and performed the Walén test with the electron velocities, but found no substantial improvement. Another assumption adopted by the standard Walén test is to consider all the ions as protons, an approximation commonly justified by the large prevalence of the protons in the MP environment. A Cluster event from January 26, 2001, very rich in O^+ , is used to check the influence of this minor ion species. By using the center-of-mass moments instead of the proton moments, the plasma flow velocity increases by 12–15%, with one interval of analysis showing an increase of even 22.5%, from 0.6 to 0.74 of the Alfvén velocity.

Another important open issue related to the RD identification refers to the experimental cross-check of the relation $\rho(1 - \alpha) = \text{const}$ across the RD, where ρ is the plasma density and α the plasma pressure anisotropy factor. This relation relies on the same conservation laws as the Walén test, and is expected to hold to the same degree as the Walén test. The reconnection event from March 14, 2002, is almost ideally suited to test the relation experimentally, with strong evidence that the MP behaves like a thick, planar, and stationary RD. Contrary to the expectations, we find that $\rho(1 - \alpha)$ is far from constant across the discontinuity.