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Dependence of the Walén test on the density estimate: A Cluster case study

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The experimental check of the tangential momentum balance (Walén test) at the magnetopause is often performed without exploiting the full density information collected along the satellite track. Instead, one uses the density, ρ, measured at a reference point in the magnetosheath, and the anisotropy factor, α, measured during the entire crossing, together with the relation $\rho(1-\alpha) = \mathrm{const.}$, which holds for a rotational discontinuity. This approach has often been used because, in the presence of heavier ions, ion instruments that do not resolve mass provide better estimates of the pressure anisotropy than of mass density.

The CIS ion spectrometers on the Cluster spacecraft allow for a continuous monitoring of the plasma composition, with an increased accuracy in the calculation of the ion moments. In this study we focus on a particular reconnection event, when both He^+ and O^+ ions were present. We investigate the possibility of processing the full information available from CIS during this traversal, in order to get accurate density estimates; particular attention is given to minimize the errors of instrumental origin. We explore the impact of using these mass density estimates on the Walén test, and discuss the consequences for a rotational discontinuity.