Title: Evolution of electron distributions inside the mirror mode structures from bow shock to the magnetopause using MMS observations

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Abstract:

The mirror instability occurs in planetary magnetosheaths, where an ion temperature anisotropy develops due to ion heating at the quasi-perpendicular bow shock. Mirror mode structures form magnetic peaks and holes in their linear regime. These structures get convected toward the magnetopause and as they grow nonlinear, magnetic peaks collapse and magnetic holes deepen. Using high resolution data from the Magnetospheric Multiscale (MMS) mission, we study the evolution of these structures and their interactions with electron distributions. We investigate two burst intervals of mirror mode structures in one magnetosheath crossing. One interval is in the middle of the magnetosheath while the other interval is close to the magnetopause. By comparing skewness between the two intervals, the event closer to the magnetopause is dominated by magnetic holes, while the interval in the middle of the magnetosheath is prevailed by magnetic peaks. We compare the electron pitch angle distributions and the structure morphology between the intervals. Closer to the magnetopause, structures are wider and deeper. Populations of trapped electrons have been observed within the mirror mode structures, giving rise to a temperature anisotropy and promoting the generation of electron whistler instability. By studying the electron pitch angle distribution within the holes, we find electrons isotropize at higher energies closer to the magnetopause due to the generation of whistler waves. The movement of energy from mirror mode instabilities to whistler mode instabilities demonstrates an important cross-scale energy transport between ion– and electron- scales. This process helps regulate the magnetosheath temperature and protect the Earth from the solar wind.