Possibility of Alfven wave reflection in a curvilinear magnetic field and formation of Alfvenic resonators on open field lines

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Though shear Alfven waves have no reflection points, these waves can be partially reflected from sharp variations in Alfven velocity. Such a reflection can lead to the formation of quasi-resonators, such as the ionospheric Alfven resonator, in which the wave energy could be accumulated. We show that a similar partial reflection of Alfven waves can occur in regions with steep variations of geomagnetic field line geometry. For that, the propagation of Alfven waves in a plasma immersed in a 2D curvilinear magnetic field has been investigated. The waves are described by a 1D equation that formally coincides with the equation for the quasi-uniform straight magnetic field with a modified Alfven velocity that takes into account the longitudinal dependence of the Lame coefficients. It is shown that toroidal and poloidal Alfven modes depend differently on the magnetic field geometry. In the case of a 2D configuration of the magnetic field, poloidal modes are efficiently reflected from regions where the magnetic field lines sharply converge or diverge. This effect can result in the formation of Alfven quasi-resonators with open field lines. This mechanism can be used to interpret the occurrence of specific polar cap Pi3 pulsations with periods ~15-20 min observed at the AGO magnetometer array in Antarctica. Also, such a reflection can limit the influx of the Alfvenic wave energy along the reconnected field lines from the solar wind into the magnetosphere at certain wavelengths.