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Minute-scale period oscillations of the magnetosphere

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Oscillations with periods on the order of 5–10 min have been observed by instrumented spacecrafts in the Earth's magnetosphere. These oscillations often follow sudden impacts related to coronal mass ejections. It is demonstrated that a simple model is capable of explaining the basic properties of these oscillations and give scaling laws for their basic characteristics in terms of the basic parameters of the problem. The period of the oscillations and their anharmonic nature, in particular, are accounted for. The model has no free adjustable numerical parameters. We use measurable quantities as inputs (such as Solar wind momentum density), and our results can be seen as an effort to predict some dynamic properties of magnetospheres on the basis of measurable steady state characteristics. A simple test of the model is found by comparing its prediction of the Earth-Magnetopause distance with observed values. The general results agree with observations. The analysis is supported by numerical simulations solving the Magneto-Hydro-Dynamic (MHD) equations in two spatial dimensions, where we let a solar wind interact with a magnetic dipole representing a magnetized Earth. Two tilt-angles of the magnetic dipole axis were considered. We observed the formation of a magnetosheath, with the magnetopause at a distance corresponding well to the analytical results. Sudden pulses in the model solar wind set the model magnetosphere into damped oscillatory motions and quantitatively good agreement with the analytical results is found. The models seem to be robust, and give good qualitative agreement with the numerical simulations for a range of parameters.