

Exercises for Space Plasma Physics:

X. Magnetosphere

1. How can the full MHD-equations be simplified to describe the quiet loading phase before a magnetic storm occurs?
2. Explain the physical processes which occur, when the slow quasistatic evolution of the magnetotail ends and a very dynamic eruptive phase starts.
3. Resistivity is a kind of friction in a plasma. How can it be that such kind of friction plays a key-role for the initiation of dynamic processes? For comparison: in classical mechanics friction slows down the motion of say a pendulum, but does not initiate the motion. How can it be that an ideal plasma remains calm, but erupts when resistivity occurs?
4. In the lecture we derived the Grad-Shafranov equation from magneto-hydro-statics. How can one find corresponding distribution functions which fulfill the stationary Vlasov-equation?
5. Scientists apply both MHD-models and kinetic models to study magnetospheric physics. Is this necessary? If MHD is not sufficient to understand some physical processes, why not study the whole magnetosphere with a kinetic model?
6. How could one in principle model planetary magnetospheres, like, e.g., the Jovian magnetosphere where fast planetary rotation and mass loading from the moon Io is assumed to play an important role?