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Modeling of the anisotropic magnetosheaths of Jupiter, Saturn, and Neptune

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In the magnetosheath plasmas of Jupiter, Saturn, and Neptune - as in the case of the Earth's magnetosheath - anisotropies of the plasma parameters are caused by strong magnetic fields. These anisotropies influence the dispersion relation of excited magnetohydrodynamic waves, and thus also diffusion processes in the plasmas of rather low particle densities, considerably. In the present work, based on the double-adiabatic Chew-Goldberger-Low approximation, the dispersion of magnetoacoustic and Alfvén waves in collision-free systems is studied. Further, the derivatives of the components of the velocity fluctuations parallel and perpendicular to the average magnetic field are analysed, and the variations of the polytropic coefficients of the plasma by the excited waves are calculated. It is shown that in the case of slow magnetoacoustic waves regions with effective polytropic coefficients smaller than unity are found in the magnetosheaths of the three considered planets. In these regions, in the average, compression of the plasma is accompanied by cooling. The dependence of the regions with effective polytropic coefficients smaller than unity on the mean plasma parameters is discussed.