太陽風プラズマ中の見かけの温度の熱力学的性質: ポリトロープモデル

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Thermodynamic property of the apparent temperature in the solar wind plasma: A polytropic model

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It is well known that large amplitude fluctuations exist in the solar wind plasma. The fluctuations have the broadband spectra and often have time period longer than several hours. Magnetohydrodynamic (MHD) systems are widely used to describe the global phenomena in the solar wind plasma. There is no doubt that MHD systems play an important role in solar wind plasma physics, while the systems usually need the cut-off scale (coarse-graining scale) larger than typical ion scales such as the ion inertial length and the ion gyro-radius. It is noteworthy that finite amplitude fluctuations with the wave length smaller than coarse-graining scales often exist. It is believed that these fluctuations heat plasmas and produce thermally non-equilibrium components. In other words, it is not trivial whether energy of the fluctuations is negligible at the coarse-graining scale or not.

In this presentation, a thermodynamic property of the energy of coarse-graining scale fluctuations (apparent temperature) is discussed. We firstly discuss the specific heat ratio of the apparent temperature and the specific heat of systems using the Wentzel-Kramers-Brillouin (WKB) approximation. Then, a physical interpretation of the polytropic indices, which are often used in the solar wind MHD model, is presented.