太陽風のプラズマ熱力学的状態

九州大学　太陽地球系物理学研究分野　中溝　葵

Huang, C.Y., et al.,(1992)

Nonadiabatic heating of the central plasma sheet at substorm onset

$$\frac{d}{dt}\left(\frac{P}{n^{\gamma}}\right)=(\gamma-1)\frac{-\nabla\cdot\mathbf{q}+\mathbf{j}\cdot\mathbf{E}}{n^{\gamma}}$$

γ = 1+2/f =5/3 (for space plasma)

distribution function $f_s(\mathbf{x},\mathbf{v}_s,t)$

The Boltzmann Equation

$$\frac{\partial f_s}{\partial t}+\dot{\mathbf{x}}_s\cdot\nabla f_s+\dot{\mathbf{v}}\cdot\nabla_{\mathbf{v}_s}f_s=\frac{\delta f_s}{\delta t}$$

Macroscopic variables (n-th order velocity moment of f)

Macroscopic equations

(n-th order velocity moment of Boltzmann equation)

The prognostic equation for scalar pressure

Polytropic index : e

$$p=\alpha\rho^{e}$$

e=0	isobaric (constant pressure)
1	isothermal (constant temperature high heat conduction)
γ	isentropic
∞	isometric (constant density)

$\gamma\equiv 1+2/f$ (f : degree of freedom)

3	1	motion constrained parallel to B
2	2	motion constrained perpendicular to B
5/3	3	isotropic
7/5	5	air(Earth)
1	∞	many modes of thermal motion