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Entropy and relaxation processes

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Plasma relaxation towards thermodynamical equilibrium is intimately connected with the issue of entropy production [1]. Near equilibrium, fluxes are commonly related to thermodynamical forces via a matrix of transport coefficients. A pending question is whether Onsager symmetry applies, i.e. whether the transport matrix is symmetric or not. This subject is tricky in collisionless magnetized plasmas. A related issue is the relaxation of mean fields, say density and temperature, towards canonical profiles via turbulence equipartition [2]. The answers to these questions have deep consequences on confinement in magnetised plasmas, most notoriously in laboratory devices and astrophysics. Far from equilibrium and for long range interactions, the situation is even more complex. One successful approach, though not unique, is the Lynden-Bell theory, originally developed for stellar systems [3]. Here violent relaxation processes may lead to the emergence Quasi-Stationary States, which maximise the Lynden-Bell entropy. This path shed a new light on the beam-plasma instability far from threshold, a paradigmatic situation in plasma physics. Investigating relaxation near and far from thermodynamical equilibrium offers an opportunity to discuss principles of minimum and/or maximum entropy production, in particular the relevance and range of application. The discussion will be illustrated with recent developments in the theory of instabilities and turbulent transport in various plasma systems.

References

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