# Transport Processes in Tokamak-plasmas in Fully Collisional Regime

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The aim of this work is to derive the expression of the collisional operator for magnetically confined plasmas, which guarantees that the Thermodynamic Covariance Principle (TCP) is satisfied by the closure transport relations (i.e., the flux-force relations). Here, we deal with plasmas in the collisional-dominated transport regime, characterized by a time scale which is much longer than one involved in the so-called fluctuation-induced turbulence transport. Our purpose is to determine the simplest expression of the collisional operator such that the resulting closure equation satisfies the TCP (without, of course, violating the energy, mass, and momentum conservation laws).
In order to test the validity of the derived collisional operator, we have considered a concrete example and computed the heat loss in L-mode collisional plasmas, confined in the FTU (Frascati Tokamak Upgrade). More in particular, we have computed the electron heat loss in fully collisional FTU-plasmas vs the minor radius of the tokamak. We have compared the theoretical profile obtained by the nonlinear theory satisfying the TCP with the experimental data provided by the ENEA C.N.R. - EUROfusion in Frascati and with the theoretical prediction obtained by adopting the linear theory (i.e. Onsager's theory - the neoclassical theory). We found that there is a fairly good agreement between the theoretical prediction of the nonlinear theory and experiments. However, disagreements appear in the region where the dimensionless entropy production is of order 1 ($\sigma \sim 1$). In particular, we showed that the disagreement appears in the region of the tokamak where the plasma is in the turbulent regime. Incidentally, this corresponds also to the region where $\sigma \sim 1$.