Turbulent transport in magnetised plasmas

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Turbulent transport is ubiquitous in magnetised plasmas. Several fascinating features have attracted the attention in the past, some of them yet unexplained. One striking property is turbulence self-organisation via mesoscale structure formation. Zonal flows are a well-known example of self-regulation thanks to energy transfer from large to small scales. Large-scale transport events are another instance of turbulence retroaction via profile relaxation. Near threshold, self-organisation sometimes bears the form of a stratification known as “staircase”. The latter consists of shear flow layers interspaced with avalanching areas where transport is large. Its puzzling dynamics is still an open subject. Another amazing property of turbulence is its ability to spread. Spreading bears some importance as to the origin of turbulence in plasma regions where profiles are stable with respect to most known instabilities. The birthplace, dynamics and range of turbulence spreading is still subject to debate. Finally, the interplay of turbulent with collisional transport processes opens a wealth of synergetic processes. Consequences are enhanced up-gradient fluxes that materialise as particle, momentum and heat pinches. Moreover, large-scale flows result from a competition between turbulent momentum transport and collisional viscous damping. The resulting sheared flows control the plasma confinement properties. Thermodynamics then appears as a powerful tool to understand the various competing/cooperative processes. These various facets of turbulent transport will be discussed in view of recent simulations, observations, and theoretical developments.