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Transport Optimization in Stellarators

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Stellarators have much in common with tokamaks, and some attractive features relative to them – disruption-free performance, and no requirement for current drive to produce a rotational transform. However, a major drawback has been elevated transport levels due to their non-axisymmetry. Since the early 1980s, stellarator research has addressed this deficiency, developing a range of approaches for mitigating transport, both neoclassical and, more recently, also anomalous. Several of these are now being implemented in a new generation of experiments in the US and abroad. This talk will present the fundamental physics of transport reduction:

(1) Basic stellarator neoclassical theory, including
  (a) the various transport "branches" contributing in a 3D toroidal system,
  (b) multiple roots of the ambipolarity constraint,
  (c) constraints on plasma flows, and
  (d) confinement of energetic versus thermal particles.

(2) The various transport reduction concepts, including
  (a) quasi-symmetric,
  (b) quasi-omnigenous/quasi-isodynamic,
  (c) use of the multiple ambipolarity roots.

(3) The reduction of transport in the presence of microturbulence.

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