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A Green's function method for local and non-local parallel transport in general magnetic fields DIEGO DEL-CASTILLO-NEGRETE, LUIS CHACÓN, Oak Ridge National Laboratory — The study of transport in magnetized plasmas is a problem of fundamental interest in controlled fusion and astrophysics research. Three issues make this problem particularly challenging: (i) The *extreme anisotropy* between the parallel (i.e., along the magnetic field), $\chi_{\|}$, and the perpendicular, $\chi_{\perp}$, conductivities ($\chi_{\|}/\chi_{\perp}$ may exceed 10^{10} in fusion plasmas); (ii) Magnetic *field lines chaos* which in general complicates (and may preclude) the construction of magnetic field line coordinates; and (iii) *Nonlocal parallel transport* in the limit of small collisionality. Motivated by these issues, we present a Lagrangian Green's function method to solve the local and non-local parallel transport equation applicable to integrable and chaotic magnetic fields. The numerical implementation employs a volume-preserving field-line integrator [Finn and Chacón, *Phys. Plasmas*, **12** (2005)] for an accurate representation of the magnetic field lines regardless of the level of stochasticity. The general formalism and its algorithmic properties are discussed along with illustrative analytical and numerical examples. Problems of particular interest include: the departures from the Rochester–Rosenbluth diffusive scaling in the weak magnetic chaos regime, the interplay between non-locality and chaos, and the robustness of transport barriers in reverse shear configurations.

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