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Local and nonlocal parallel heat transport in general magnetic fields DIEGO DEL-CASTILLO-NEGRETE, LUIS CHACON, Oak Ridge National Laboratory — A novel approach that enables the study of purely parallel transport in magnetized plasmas is proposed. The approach is based on a Lagrangian Green's function method applicable to general magnetic fields (2-D and 3-D from integrable to completely chaotic), and with local or nonlocal parallel heat-flux closures. The approach is free from numerical pollution, and preserves temperature positivity by construction. The method is used to study: (i) local and nonlocal temperature flattening in magnetic islands; (ii) the fractal structure of the devil staircase temperature profile in weakly chaotic fields; and (iii) effective radial transport in fully chaotic 3D fields. For (iii), self-similar evolution of the form $T = (\chi_{\|} t)^{-\gamma/2} f(\eta)$ is observed with similarity variable $\eta = (\psi - < \psi >)/(\chi_{\|} t^{\gamma/2})$ where ψ is a radial flux function. Different to the well-know local transport case (Rechester-Rosenbluth), it is shown that in the case of non-local parallel transport f is an algebraic decaying, $f \sim \eta^{-3}$, non-Gaussian function, and $\gamma = 1$. Recent work on the extension of the method to include perpendicular transport and heat sources is presented. The approach is algorithmically scalable, and second-order accurate in time on the slow-perpendicular-time scale. Numerical examples of relevance to magnetic fusion geometries will be presented.

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