Can "hysteresis in flux" be reproduced by broadened power deposition profiles?

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Old and recent experiments show that there is a direct response to a change in heating power of the electron thermal transport in modulated ECH experiments both in tokamaks and stellarators [1, 2], which is also known as non-local transport. This is most apparent for modulated experiments in stellarators such as LHD and W7-AS. In this contribution we show that this power dependence and its corresponding experimental observations such as the so-called hysteresis in flux [2] can be reproduced by linearized transport equations based on broadened deposition profiles. Moreover, linearized non-local transport equations depending directly on the heating power can be shown to be mathematically equivalent to a broadened deposition profile making them indistinguishable from each other in its linearized form [4]. These relationships can be further studied by separating the transport in a slow (diffusive) and a fast (heating/non-local) time-scale, which can only be done in the presence of perturbations [3].

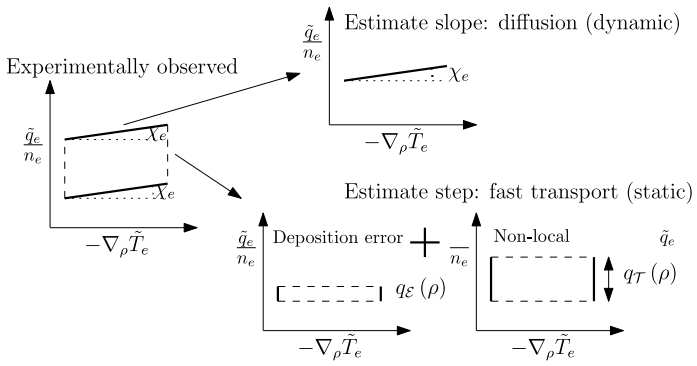

Figure 1: Overview of how to discern slow from fast transport, i.e., the combination from deposition profile errors $\mathscr{E}$ and non-local components $\mathscr{T}$ in terms of their heat flux contributions $q_\mathscr{E}$ and $q_\mathscr{T}$ and the diffusive component χ_e. The combination of $q_\mathscr{E}$ and $q_\mathscr{T}$ cannot be distinguished from each other based on the Lissajous curve ("hysteresis in flux") only.

References

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