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Mode-Locking of Passive Scaler Transport to Chaotic Flows in a Disk GUY METCALFE, DANIEL LESTER, MURRAY RUDMAN, CSIRO Australia — We study transport of a passive scaler in a bounded 2-dimensional, chaotic flow, specifically a disk with flow generated by tangential boundary motion over finite arcs of the disk, the RAM flow.[1] We calculate a spectral solution to the advection-diffusion equation, such that for a fixed Peclét number the full spectrum of eigensolutions—the so-called "strange" eigenmodes for the spatial distribution of the scaler[2] and their decay rates—can be obtained for the entire space of controlling flow parameters with just a few additional matrix multiplies. Over this parameter space the dominant strange eigenmode symmetry locks to the wavenumber of the chaotic flow. For low values of stretching the eigenmode is symmetric. As stretching increases, the locked intervals grow, showing Arnol'd tongues and a transition to asymmetry of the scaler distribution. Preliminary experiments using an infrared camera to image temperature in a thin fluid layer show similar patterns and decay rates.

[1]Metcalfe et al, to appear AIChE J (2005).
[2]Pierrehumbert Chaos **10** 61 (2000).

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