Lebesgue spectrum for area preserving flows on the two torus

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How much "chaotic" can area preserving surface flows be? It is widely known (from the works of Kolmogorov, Katok and others) that starting from very low regularity these flows, if they do not have singularities, cannot be mixing. Via Poincare sections, the latter phenomenon is due to a Denjoy type rigidity of discrete time one dimensional dynamics. However, Kochergin and then Khanin and Sinai showed that these flows can be mixing when they have singularities. Nothing however was know about their spectral type. We will explain why Kochergin flows with one (sufficiently strong) power like singularity typically have a maximal spectral type equivalent to Lebesgue measure on the circle. So, these quasi-minimal flows on the two torus, that have almost the same phase portrait as that of a minimal translation flow, share the same maximal spectral type as Anosov flows! In fact, the Lebesgue spectrum is rather reminiscent of the parabolic paradigm (of horocyclic flows for example) to which the Kochergin flows are related due to the shear along their orbits. We will discuss this relation and its consequences as well as several questions around mixing area preserving flows.

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