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Speed up of Traveling Fronts by Large Advection

Pulsating traveling fronts are solutions of a reaction-advection-diffusion equation in an unbounded heterogeneous periodic framework. Having a KPP reaction (after Kolmogorov, Petrovsky, Piskunov), it is well known by now that traveling fronts exist with a minimal speed c^*. The models describe population dynamics in a periodic framework. In the homogeneous case, where the reaction is $f(u) = u(1-u)$, the minimal KPP speed is exactly equal to 2. In the generalized framework, the minimal speed has a variational formulation involving elliptic eigenvalue problems which was proved by Berestycki, Hamel, Nadirashvilli, and earlier by Weinberger in a slightly more particular framework. In this talk, I will describe the asymptotic behavior of the KPP minimal speed within a large drift. These problems have been widely investigated in the last 10 years (L. Ryzhik, A. Novikov, A. Zlatoš, F. Hamel, H. Berestycki, N. Nadirashvilli and many others). After showing the asymptotic regime in any space dimension N via a variational quantity involving first integrals of the advection field, I will give a Sharp Criterion for the linear speed up of the fronts by the drift term in the 2D case. This talk is based on joint work with Stephane Kirsch.