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Pattern formation in the presence of space-dependent parameters

In first part of the talk, we consider a standard reaction-diffusion system (the Schnakenberg model) that generates localized spike patterns. Our goal is to characterize the distribution of spikes and their heights in the limit of many spikes, in the presence of spatially-dependent feed rate A(x). This leads to an unusual nonlocal problem for spike locations and their heights. A key ingredient in the solution of the reduced problem is the Euler-Maclaurin formula. In the second part of the talk, we look distribution of vortices in Bose-Einstein Condensates with a parabolic trap. We find novel equation of motion for vortex centers, and use these equations to derive vortex density as well as the theoretical maximum number of vortices that can fit within the vortex lattice for a given rotation rate. Our results improve on known results in the literature.