“Explicit derivation and stability of coherent patterns of motion in kinetic swarming models”

In my talk I will first review some modeling concepts describing the behavior of individuals in an animal swarm of e.g. fish or birds, and focus on a model of self-propelled interacting particles. It is a well-known fact that even minimalistic interactions rules allow for the emergence of coherent macroscopic patterns observed in nature, when applied to all members of a swarm. In the mean-field limit approach, a kinetic PDE is used to model the evolution of a particle density rather than tracing individuals separately. Its macroscopic closure allows for a compact description of some coherent patterns, such as flocks or mills.
I will then discuss the possibility to explicitly compute the stationary density profile of such states using a particular type of interaction potential called Quasi-Morse. Flock and mill profiles can be predicted with a cheap numerical procedure that does not necessitate particle simulations.
Finally, I will present a result on the stability of flock solutions, where we are able to show that under mild assumptions the stability of the interaction potential (in a first-order aggregation model) inherits to the family of flock solutions in our second-order model.