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Sorting phenomena in a mathematical model for two mutually attracting/repelling species

Macroscopic models for systems involving diusion, short-range repulsion, and long-range attraction have been studied extensively in the last decades. In this paper we extend the analysis to a system for two species interacting with each other according to different inner- and intra-species attractions. Under suitable conditions on this self- and crosswise attraction an interesting effect can be observed, namely phase separation into neighboring regions, each of which contains only one of the species. We prove that the intersection of the support of the stationary solutions of the continuum model for the two species has zero Lebesgue measure, while the support of the sum of the two densities is simply connected. Preliminary results indicate the existence of phase separation, i.e. spatial sorting of the different species. A detailed analysis in one spatial dimension follows. The existence and shape of segregated stationary solutions is shown via the Krein-Rutman theorem. Moreover, for small repulsion/nonlinear diffusion, also uniqueness of these stationary states is proved.