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Title: Segregation, interaction of species and related free boundary problems

Abstract: Partial differential equations are often used to describe physical laws governing a complicated system in a confined space with relatively simpler behavior on the boundary. Thus, reaction-diffusion systems with strong interaction terms appear in many multi-species physical problems as well as in population dynamics. A prototypical example appears when looking for solitary wave solutions for Bose-Einstein condensates of two (or more) different hyperfine states which overlap in space. Typically the forces between particles in the same state are attractive while those between particles in different states can be either attractive or repulsive. If the condensates repel, they eventually separate spatially giving rise to a free boundary. This phenomenon is called phase separation and has been described in recent literature, both physical and mathematical. The classification of entire solutions and the geometric aspects of phase separation are of fundamental importance as well. We intend to focus on the most recent development of the theory in connection with problems featuring anomalous diffusions, long-range and non symmetric interactions.
