Research

Colloquium

Ground States of Spin-1 Bose-Einstein Condensates

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摘　要：

The ultra-cold dilute boson gases have apparent macroscopic quantum ground state, called Bose-Einstein condensates (BECs). In this talk, I will report analytical results on such ground state patterns and their phase transitions of spin-1 BECs confined in a harmonic or box potential under the influence of a homogeneous magnetic field, based on a mean field model–a generalized Gross-Pitaevskii equation.

First, we show necessary and sufficient condition for the existence of ground states in arbitrary dimensions. Second, we have developed a Γ-convergence theory in the semi-classical regime for antiferromagnetic systems on the whole parameter plane. In the first part, we define an effective interaction parameter and show that the ground state can exist if and only if this effective interaction is repulsive in 3D, weakly attractive or repulsive in 2D, and no condition in 1D. For the second part, the ground states and bifurcation curves are given explicitly in the Thomas-Fermi regime. Further, the limiting ground state patterns are determined by the constant mean curvature interfaces with contact angle determined by Young's relation, a generalization of classical wetting theory to the quantum cases.

This is a joint work with Drs. Liren Lin and Tien-Tsan Shieh.