凝縮系物理学ゼミナール
Condensed Matter Seminar

Location: Room 413, School of Science Bldg. 5 (理学 5 号館 413 号室)
Date: 13:30-15:00, Wednesday, 30 October 2013

"Vortices in Spin-2 spinor Bose-Einstein condensates"

Speaker: Dr. **Michikazu Kobayashi** (Dept. of Physics, Kyoto Univ.)

Abstract:
Quantized vortices in quantum fluids with internal degrees of freedom have various topological properties depending on underlying topology of quantum fluids. In the seminar, I talk about quantized vortices in spin-2 spinor Bose-Einstein condensates (BECs) as an example. In this system, there are characteristic topological behavior of vortices which is rarely seen in other quantum fluids, and I pick up three of them:

1: Non-Abelian vortices in the cyclic phase.
For spin-2 spinor BECs, there are four phases depending on the coupling constants. In the cyclic phase, vortices can be classified by the non-Abelian fundamental group, becoming, so called, non-Abelian vortices. Compared to conventional vortices, there is a big difference in the collision dynamics of vortices.

2: Quasi-Nambu-Goldstone (QNG) modes from vortices in the nematic phase.
In the nematic phase, the state has the larger symmetry than that of the Hamiltonian and there are QNG modes due to enlarged vacuum manifold. Several vortices are unstable under the enlarged manifold, and decay with emitting QNG modes. These vortices, however are stabilized by quantum and thermal fluctuations which make QNG modes massive.

3: Emergence of internal modes in the core and spontaneous breaking of the rotational symmetry.
Being different from scalar BECs, several symmetries are unbroken for spinor BECs, and several these unbroken symmetry are further broken in the vortex core, creating localized Nambu-Goldstone (LNG) modes. In spin-2 case, these LNG modes sometimes coupled to real space causing the spontaneous breaking of the rotational symmetry and coupling with the Kelvin mode which is original LNG modes.