Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Quantized vortices in interacting gauge theories[1] SALVATORE BUTERA, MANUEL VALIENTE, PATRIK OHBERG, SUPA, Institute of Photonics and Quantum Sciences, Heriot-Watt University — We consider a two-dimensional weakly interacting ultracold Bose gas whose constituents are two-level atoms. We study the effects of a synthetic density-dependent gauge field that arises from laser-matter coupling in the adiabatic limit with a laser configuration such that the single-particle vector potential corresponds to a constant synthetic magnetic field. We find a new type of current non-linearity in the Gross-Pitaevskii equation which affects the dynamics of the order parameter of the condensate. We investigate on the physical conditions that make the nucleation of a quantized vortex in the system energetically favourable with respect to the non rotating solution. Two different physical interpretations can be given to this new non linearity: firstly it can be seen as a local modification of the mean field coupling constant, whose value depends on the angular momentum of the condensate. Secondly, it can be interpreted as a density modulated angular velocity given to the cloud. We analyze the physical conditions that make a single vortex state energetically favourable. In the Thomas-Fermi limit, we show that the effect of the new nonlinearity is to induce a rotation to the condensate, where the transition from non-rotating to rotating depends on the density of the cloud.

[1]The authors acknowledge support from CM-DTC and EPSRC.

Salvatore Butera
SUPA, Institute of Photonics and Quantum Sciences, Heriot-Watt University

Date submitted: 29 Jan 2015 Electronic form version 1.4