Objective

"Bose-Einstein condensation, the macroscopic ground state occupation of a system of bosonic particles below a critical temperature, has in the last two decades been observed in cold atomic gases and in solid-state physics quasiparticles. The perhaps most widely known example of a bosonic gas, photons in blackbody radiation, however exhibits no Bose-Einstein condensation, because the particle number is not conserved and at low temperatures the photons disappear in the system’s walls instead of massively occupying the cavity ground mode. This is not the case in a small optical cavity, with a low-frequency cutoff imprinting a spectrum of photon energies restricted to well above the thermal energy. Using a microscopic cavity filled with dye solution at room temperature, my group has recently observed the first Bose-Einstein condensate of photons.

Building upon this work, the grant applicant here proposes to study the physics of interacting photon Bose-Einstein condensates in variable potentials. We will study
the flow of the light condensate around external perturbations, and exploit signatures for superfluidity of the two-dimensional photon gas. Moreover, the condensate will be loaded into variable potentials induced by optical index changes, forming a periodic array of nanocavities. We plan to investigate the Mott insulating regime, and study thermal equilibrium population of more complex entangled manybody states for the photon gas. Other than in an ultracold atomic gas system, loading and cooling can proceed throughout the lattice manipulation time in our system. We expect to be able to directly condense into a macroscopic occupation of highly entangled quantum states. This is an issue not achievable in present atomic physics Bose-Einstein condensation experiments. In the course of the project, quantum manybody states, when constituting the system ground state, will be macroscopically populated in a thermal equilibrium process."

Field of science

/field of science/engineering and technology/environmental engineering/energy and fuels/fossil energy/gas

/natural sciences/physical sciences/atomic physics

/natural sciences/physical sciences/theoretical physics/particles

/natural sciences/physical sciences/condensed matter physics/solid-state physics

/natural sciences/physical sciences/condensed matter physics/bose-einstein condensates

/natural sciences/physical sciences/theoretical physics/particles/photons

Programme(s)

Topic(s)

Call for proposal

ERC-2012-ADG_20120216

Funding Scheme

ERC-AG - ERC Advanced Grant

Host institution

RHEINISCHE FRIEDRICH-WILHELMIS-UNIVERSITAT BONN

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Education Establishments

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