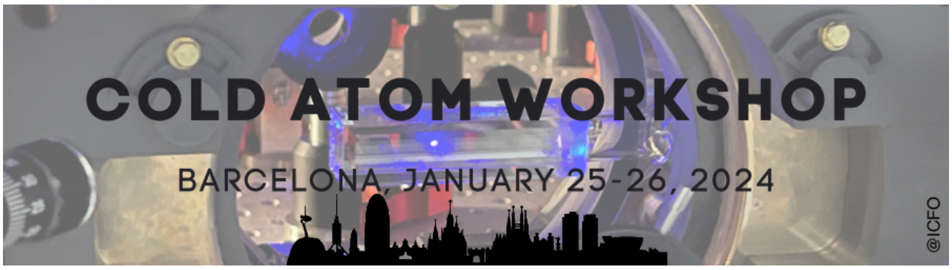

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Exploring the supersolid stripe phase in a spin-orbit coupled BEC

Thursday 25 January 2024 15:00 (20 minutes)

Supersolids are an exotic phase of matter that combines seemingly opposing characteristics of solids and superfluids. They display spontaneous translational symmetry breaking manifesting in crystalline order, while also possessing superfluid properties like frictionless flow. Supersolids were originally predicted over fifty years ago in the context of solid Helium, but were first observed only few years ago in ultracold atomic systems. Cavity-mediated interactions, dipolar interactions, or optically induced spin-orbit coupling can spontaneously break translational symmetry in a Bose-Einstein condensate. Here, we characterize supersolidity in a spin-orbit coupled Bose-Einstein condensate of potassium. We optically dress the system to engineer a single-particle dispersion relation with two minima at distinct momenta. Matter-wave interference between the condensates in the two minima gives rise to a density modulation, which constitutes the spontaneous breaking of translational symmetry and thus realizes the so-called supersolid stripe phase. We are able to observe this spontaneous density modulation in-situ, by employing a matter-wave lensing technique to magnify the density stripes. We achieve a spatial period larger than our optical imaging resolution, which allows us to characterize the crystalline structure of the stripe phase.

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