Collective Excitation of Dipolar Rotating Trapped Bose Atoms

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Collective excitation of strongly correlated fractional quantum Hall (FQH) liquids is an exciting field of research in a two-dimensional electron system. FQH effect can be explained with the concept of quasi-particles known as composite fermions. Rapidly rotating Bose-Einstein Condensates (BEC), trapped in a a two-dimensional harmonic potential [1] creates a fictitious magnetic field, perpendicular to the 2D-plane that resembles like two-dimensional electron system in the plane perpendicular to the magnetic field. In such a system there is formation of Landau levels due to the perpendicular magnetic field. The correlated FQH-state produced in rotating trapped BEC can be explained theoretically using composite fermions for the Bose atoms [2]. The composite Fermions, bound state of Bose atoms and the odd number of quantized vortices experience a reduced magnetic field $B^* = B - p\rho\phi_0$, where, B represents the fictitious magnetic field, ϕ_0 is the magnetic flux quantum, while the number density of the Bose atoms is ρ, and $p = 1, 3, 5$, is the odd number of flux quanta. The LL filling fraction of the Bose atoms (ν) can be related with the LL filling fraction of composite Fermions by $\nu = \frac{n}{np+1}$.

In this talk, we will present our numerical study to analyze the collective spin-conserving and spin-reversed excitation spectra in dipolar rotating trapped Bose gas considering the pseudo-spin $1/2$ state [3]. We consider each of the Bose atoms with a dipole moment oriented perpendicular to the trapping potential and they interact with each other via long-ranged dipole-dipole interaction. We have taken into account the lowest possible excitations in our study and calculated the excitation spectra for the three fractions of the first Jain series $\nu = 1/2, 1/4, 1/6$. The lowest-order fundamental mode and the next higher-energy mode of excitation spectra are found for each of the three fractions. In both the spin-reversed and spin conserving excitation we find that the gap between the low lying spectrum decreases significantly with the decrease in the filling fraction. Further we compute the spectral weight for the fundamental mode of excitation, that shows a significant increment in the spectral intensity with decrease with the filling fraction. At the end we provide a possible connection of our observation with the experimental realization.

References

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