Condensates Breaking Up Under Rotation

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Rotating condensates have amply been studied when the emergence of quantum vortex states and their condensed properties are put up front [1,2]. Here, we examine the impact of rotation on the ground state of weakly interacting bosons in anharmonic potentials computed both at the mean-field level [3] and particularly at the many-body level of theory [4]. For the computations, we employ the well-known many-body method called the multiconfigurational time-dependent Hartree for bosons [5-8]. We find that different degrees of fragmentation of the reduced one-particle density matrix emerge following the breakup of the densities, without ramping up a potential barrier for strong rotations. The breakup of the densities follows the acquisition of angular momentum in the condensate. In addition to fragmentation, the presence of correlations is established by examining the variances of many-particle observables, such as the position and momentum operators, where opposite anisotropy of the variances, despite having the same mean-field and many-body densities per particles, is found in elongated traps. For anharmonic traps possessing n-fold rotation symmetry, the breaking up into n sub-clouds and emergence of n-fold fragmentation are found. Our work provides a thorough investigation of how and which correlations build up when a trapped condensate breaks up under rotation.

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