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Collapse and stable self-trapping for Bose-Einstein condensates with $1/r^b$ type attractive interatomic interaction potential

We consider dynamics of Bose-Einstein condensates with long-range attractive interaction proportional to $1/r^b$ and arbitrary angular dependence. It is shown exactly that collapse of Bose-Einstein condensate without contact interactions is possible only for $b \geq 2$. Case $b = 2$ is critical and requires number of particles to exceed critical value to allow collapse. Critical collapse in that case is strong one trapping into collapsing region a finite number of particles. Case $b > 2$ is supercritical with expected weak collapse which traps rapidly decreasing number of particles during approach to collapse. For $b < 2$ singularity at $r = 0$ is not strong enough to allow collapse but attractive $1/r^b$ interaction admits stable self-trapping even in absence of external trapping potential.

26. Mai 2010, 10:00 Uhr

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