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Time evolution of a Bose-Einstein condensate of Na atoms under fast potential variation

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Traditionally Bose-Einstein condensate is an equilibrium state with a distribution of population between the ground state and the excited states of an external potential for particles. However, in some situations, modifications can take the system out of the traditional equilibrium. (1) Because the system can thermalize through interactions, returning to the equilibrium situation. The observation of such phenomena can be done through a sudden change in the potential. In this process an initial Hamiltonian defined as $H(a)$ has the system in an equilibrium state. Suddenly the Hamiltonian is changed to $H(b)$, and the system finds itself out of the situation of equilibrium of the new Hamiltonian. A time evolution that must occur promotes the system to a new state and the reaching of these new states corresponds to a transient regime. (2) Experimentally, this occurs when we produce abrupt changes in the potential that trap the atoms. In our laboratory, at the research center (CePOF) in São Carlos - Brazil, this quantum quench is performed for sodium atoms, by changing the frequency from 216 rad/sec to 700 rad/sec, followed by observing the system during different time intervals. The main result is that our system suffers a quench, producing evolution of the condensate fraction and also the temperature. Preliminary measurements indicate how fast the new equilibrium condition is reached.

Palavras-chave: Bose-Einstein condensate. Out of equilibrium.

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