Study of Thermal Clouds Near the Bose-Einstein Transition When Excited by External Fields

S Sab[1] and V S Bagnato[1]

[1] *São Carlos Institute of Physics, Av. Trabalhador Sancarlense, 400, São Carlos, Brazil*
Contact Email: sarahsab@usp.br

In this work we wanted to study the effect of quantum turbulence on the density profile of freely expanding thermal atoms. Bose-Einstein Condensate was produced in a magnetic trap composed of quadrupole and Ioffe coils. After the evaporative cooling process, the cloud reaches temperatures below the critical temperature, causing condensation and the appearance of the cloud's bimodal profile: Gaussian plus Thomas-Fermi. The condensed fraction is determined by its temperature, so that the critical temperature represents the transition point from purely thermal behavior to quantum behavior. Trying to reproduce the same behavior obtained in previous works for the state $|F = 2, m_F = 2\rangle$ [1], a condensate of fraction around 90% was excited in the hyperfine state $|1, -1\rangle$. However, it was observed that in the current experiment configuration the natural oscillation frequency of the cloud changes according to the excitation amplitude. Thus, by keeping the number of oscillation cycles constant, it was not possible to couple enough energy from a certain amplitude and observe the deviation from the Gaussian to an exponential.

Finally, the classical gas was excited at a temperature close to the critical temperature, without a condensed fraction, in order to observe whether the density profile deviated. No change in profile was observed, since the atoms occupy many states and the density behavior always tends to be Gaussian.

References

[1] A D G Orozco. Efeito da turbulência quântica na expansão livre de um superfluido atômico. PhD thesis, Universidade de São Paulo, 2018