# Shortcuts to adiabaticity in the Feshbach engine

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In this work we focus on a trapped Bose-Einstein condensate (BEC) and use the framework of non-equilibrium thermodynamics to study compression and expansion strokes in a theoretical quantum heat engine. By taking advantage of Feshbach resonances to control the nonlinear interactions in the trapped BEC, compression of the gas can be achieved by increasing the attractive nonlinear interaction, while expansion can be implemented using the reverse process. Non-adiabatic ramps of the interaction strength can create excitations in the system which leads to the creation of irreversible work. This irreversible work is analogous to friction and thereby reduces the efficiency of the engine. I will show that by exploiting shortcuts to adiabaticity these out-of-equilibrium excitations can be reduced resulting in a more efficient process on short timescales, and that large nonlinear interactions can improve the robustness of the shortcut allowing for faster stroke times which improves the power output of the engine [1,2]. Finally, I show that these shortcuts cannot result in infinitesimally small stroke durations as the energetic cost associated with implementing the shortcuts results in growing inefficiencies, and that these are heavily dependent on the strength of the nonlinear interaction in this system.

[1] Jing Li, Kun Sun & Xi Chen, Scientific Reports 6, 38258 (2016)

[2] Obinna Abah and Eric Lutz, arXiv:1611.09045 (2016)