Cesium solitons

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When a non-interacting Bose-Einstein condensate is confined to a quasi one-dimensional channel it will spread due to dispersion as dictated by the Schrödinger equation. The spreading rate can be affected by changing the interaction between the atoms via the Feshbach resonance. If the interaction is set to just the right value, the attraction between atoms exactly compensates the dispersion. In this case the BEC doesn't spread and we get a bright matter-wave soliton [1]. The maximum number of atoms in a soliton is limited by the frequency of the channel and the interaction between atoms. By setting the inter-atom interaction to different attractive values we are able to create soliton trains with different number of solitons from a single BEC [2, 3]. Soliton trains form due to modulational instability, meaning that a small variation in density, caused by some broadband perturbation, is exponentially amplified and causes the BEC to split into several solitons [4, 5].
Collisions between two solitons can have an interesting outcome depending on the relative phase and velocity between the solitons. Fast solitons always pass through each other, while slow ones can merge into one, "jump over" each other or even "annihilate" depending on their relative phase [6].

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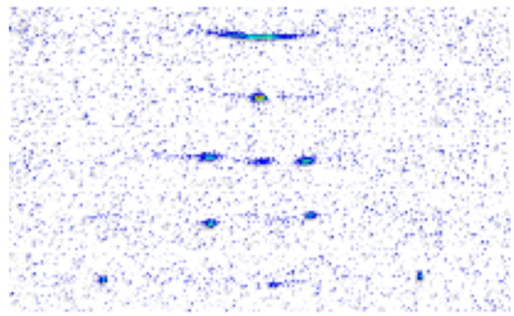

Figure 1: Atoms after 160 ms of evolution in the channel. Interaction goes from slightly repulsive to more and more attractive as we move from top to bottom. The atom cloud goes from dispersed to a single soliton to soliton trains with ever smaller solitons.

Keywords: COLD ATOMS, CESIUM, SOLITONS, SOLITON TRAINS

References

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