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## Ferromagnetism in coherently coupled atomic mixtures

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In the present talk we review the properties of a spin-1/2 Bose-Einstein condensate (BEC) in presence of both longitudinal and transverse external fields. The system has very peculiar properties not only with respect to the single component BEC, but also with respect to BEC mixtures (where the atom number of each species is conserved). In particular the system can exhibit a para- to ferro-magnetic transition, has a gapped spin spectrum, and can sustain peculiar magnetic defects. Most of the peculiar properties are due to the system being an analog of a (non-dissipative) ferromagnetic material well described by the so-called Landau-Lifshitz equation. We then present some of the system's properties that have very recently been tested experimentally in our lab using  $^{23}\text{Na}$  atomic gases. In particular we measured the excitation spectrum by modulating the trapping potential and generating Faraday patterns, we started characterising the ferromagnetic transition and obtain the first results on magnetic bubble generation from out-of-equilibrium initial states.

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