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Mean-field Stationary State of a Bose Gas at a Feshbach Resonance ANDREW CARMICHAEL, JUHA JAVANAINEN, University of Connecticut — We study the steady state behaviour of a zero-temperature Bose gas close to a Feshbach resonance using a simple mean field model which allows for atomic and molecular condensates as well as correlated zero-momentum "BCS" pairs whose provenance would be dissociated zero momentum molecules. Beginning with a second quantized Hamiltonian and equations conserving total (free and bound) atom number and enforcing an assumption that atoms only appear either in the condensates or pairs and the usual Bogoliubov approximation, the system is numerically (and in certain limits, analytically) soluble in the steady state and exhibits a first order phase transition to a pure atomic condensate when the controllable parameters of the coupling and detuning are varied across an (analytically determined) transition line. Analysis of the thermodynamics of the zero-entropy system shows a negative pressure and hence mechanical instability on both sides of the resonance. A mathematical difficulty arising from an ultra-violet divergence due to the assumption of a zero range interaction is resolved with the help of a simpler, exactly analytically soluble two atom version of the problem.

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