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Neutral vector bosons in a constant magnetic field

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The thermodynamical potential as well as all thermodynamical quantities of a neutral boson gas bearing a magnetic moment in presence of a constant magnetic field are calculated in the low temperature limit. The Bose Einstein Condensation (BEC) is studied. For the weak field regime the gas shows a usual BEC whereas for the strong field regime a diffuse BEC appears. This diffuse BEC is characterized for the nonexistence of a definite critical temperature below which the population of the ground state starts to grow. We have also found that the gas magnetization is positive, increases with the field and diverges when B reaches certain critical field. For particle densities under a critical value Nc the self-magnetization condition is fulfilled and the gas can self-generate a magnetic field and the system shows a ferromagnetic behavior. The above describe phenomenology is manifested for magnetic fields and particle densities in the order of those typical of compacts objects. Thus, this work could be useful to model the mechanisms that sustain the strong magnetic fields showed by astrophysical objects. In this regard, a discussion of the presence of magnetic neutral vector bosons as a part of the structure of jets or boson stars is presented.

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