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Probing Quantum Phase Changes in Nuclear Reactions¹

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Strong indications of a phase change analogous to the classical liquid gas phase transition have been observed in nuclear collisions. However the analogy should not be overstressed as nuclear matter is a strongly interacting quantum system. In the nuclear case the difference between the neutron and proton concentrations acts as an additional order parameter for which the symmetry potential is the conjugate variable. We present experimental data revealing the N/Z dependence of the nuclear phase transition and discuss possible implications in terms of the Landau Free Energy description of critical phenomena.² At very low densities the clustered state is more stable than uniform matter and theoretical calculations indicate the existence of Bose Condensates and possibly self-bound boselets or fermilets owing their existence to three-body bound states, the Efimov effect. Evidence for such behavior is also being sought in collision studies.

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²A. Bonasera et al, submitted to Phys. Rev. Lett, 2008