Workshop

Physics and Mathematics of cold atoms

LPMMC, Université Grenoble 1/CNRS

October 11th and 12th, 2012

Meeting of the PEPS-PTI project *Many-body quantum mechanics and cold atoms*

The talks will last approximately 45 minutes with 10 minutes for questions and discussion.

Thursday 11th

Venue: Maison des magistères, salle MAG 2.

- 14h : **Valentin Zagrebnov**, Centre de physique théorique, Marseille.

  Bogoliubov Approximation for Random Boson Systems.

  Validity of the Bogoliubov c-number approximation is discussed for the case of interacting boson gas in a homogeneous random media.

- 15h : **Alice Sinatra**, Laboratoire Kastler Brossel, Paris.

  Limits of spin squeezing in Bose-Einstein condensates

  Spin squeezing in an ensemble of atoms is about creating quantum correlations that can be useful for metrology. In a bimodal condensate, thanks to atomic interactions squeezing is created dynamically starting from a factorized state. After introducing the subject, I will concentrate on this squeezing scheme to explore its ultimate limits.
  An important point is the scaling of the entanglement and of the metrology gain as the system size and the atom number become large, and how the decoherence and the finite temperature affect this scaling.
  I will start from a simple two-mode hamltonian picture, with a stochastic ingredient, and show that in some conditions it can effectively describe the decoherence and also the more complicated multi-mode case at finite temperature that I will treat in the end.

- 16h : **Markus Holzmann**, LPMMC, Grenoble.

  Superfluid properties of trapped Bosons in quasi-two dimensions

  I will review experimental and theoretical results on thermodynamic properties of mesoscopic systems of Bosons in quasi-two dimensional traps at finite temperature.
  In particular, I will focus on coherence properties characterizing superfluidity in the system and the influence of correlated disorder around the critical temperature.

Friday 12th

Venue: Maison des magistères, AMPHI.

- 9h : **Michele Correggi**, Università degli Studi Roma Tre.

  On the stability of fermionic systems with zero-range interactions

  We review the phenomenon known under the name of Thomas effect for a few body quantum system with zero-range interactions, namely an instability due to the occurrence of a sequence of eigenvalues going to $-\infty$. We then focus on a specific model given by N fermions interacting with a different particle and discuss the condition on the mass of the test particle which guarantees boundedness from below of the energy operator and thus stability of the model.

- 10h : **Anna Minguzzi**, LPMMC, Grenoble.

  Universal contact for a Tonks-Girardeau gas at finite temperature

  We determine the finite-temperature momentum distribution of a strongly interacting 1D Bose gas in the Tonks-Girardeau (impenetrable-boson) limit under harmonic confinement, and explore its universal properties associated to the scale invariance of the model. We show that, at difference from the unitary Fermi gas in three dimensions, the weight of its large-momentum tails – given by the Tan's contact – increase with temperature, and calculate the high-temperature universal second contact coefficient using a virial expansion.

- 11h-12h : **Séminaire Philippe Nozières**.
  (Organized by the "Centre de Physique Théorique de Grenoble").
  Pablo Cornaglia, Bariloche Atomic Center, Argentina
  Tunable spin and charge Seebeck effects in magnetic molecular junctions

  Details and abstract : http://lpmmc.grenoble.cnrs.fr/spip.php?article168

- 14h : **Paolo Pedri**, LPL, Paris 13.

  TBA

- 15h : **Krzysztof Pawlowski**, Laboratoire Kastler Brossel, Paris.

  Effect of particle losses on superpositions of phase states in Bose Josephson junctions

  We analyze the effect of particle losses on macroscopic superpositions of phase states in a two-mode Bose-Josephson junction. The superpositions are produced by the dynamics of the junction after a sudden quench of the tunnelling amplitude. We use the quantum trajectory method and an exact diagonalization of the master equation to study the state of the system under two- and three-body losses. We determine the amount of quantum correlations useful for high-precision atom interferometry by calculating the quantum Fisher information. We analyze separately the contributions to the Fisher information of the restrictions of the atom density matrix to subspaces with a fixed number of atoms. For mesoscopic samples with an initial atom number N_0 and weak loss rates we find that the quantum correlations persist in the subspaces with $N_0 - j$ atoms for $j = 0, j = 2$ for two-body losses and $j = 3$ for three-body losses. Due to the interplay of losses and interaction effects, we find that in the case of two-body losses the quantum correlations in the subspace with $N_0 - 2$ atoms increases with the loss rates when the losses are small, and they are better preserved for asymmetric loss rates or interaction strengths in the two modes of the junction than for symmetric ones.