

Lectures on Boson Systems: Condensation and Dynamics

by

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Contents

Lecture 1. *Conventional Bose-Einstein Condensation (BEC): Ideal Bose-gas*

The conventional one-mode BEC in the ideal boson gas is the key example for this series of lectures. The physical motivation (Einstein, 1925) and the later theoretical and mathematical controversy (G.E.Uhlenbeck, 1927, F.London, 1938) will be presented in details as well as remark on equivalence of ensembles and M.Kac distribution (1973).

Lecture 2. *Generalised BEC and the second critical point I*

H.B.G.Casimir observation (1968) and generalised BEC à la van den Berg-Lewis-Pulé (1986) of non-interacting Bose-gas in Casimir boxes. Anisotropic thermodynamical limit may produce three different type of (generalised) BEC. The second critical point predicted by van den Berg (1983) for exponentially anisotropic thermodynamical limit (SLAB) and coexistence of different type of generalised BEC.

Lecture 3. *Generalised BEC and the second critical point II*

Generalised BEC and the second critical point for non-interacting Bose-gas in anisotropic harmonic traps (Beau-Zagrebnov, 2009). Examples of generalised BEC due to repulsive boson interaction (Michoel-Verbeure, 1999, Bru-Zagrebnov, 1999).

Lecture 4. *One-Mode Open Photon Cavity*

Dynamics of open systems: Markovian master equation, complete positivity. The Kossakowski-Lindblad dynamical semigroup for a model of one-mode leaky/pumping photon cavity. Schrödinger picture.

Lecture 5. *W^* -Dynamics, Return to Equilibrium, NESS*

Dual dynamical map (Heisenberg picture). Open photon cavity and return to equilibrium. Completely positive quasi-free dynamics on the CCR algebra. Quasi-free states. Open cavity and atomic beam pumping (one-atom maser). Limiting Non-Equilibrium Steady States (NESS). (Nachtergaele, Vershynina, Zagrebnov, 2012)

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