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Low temperature condensation and scattering data

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We study a complex ϕ^4 field at finite temperature and finite density using a worldline representation. In particular we focus on the low temperature regime where the particle number shows condensation steps as a function of the chemical potential. The critical values of the chemical potential, i.e., the condensation thresholds, are related to the mass and higher multi-particle energies and can be determined within a simulation. We study the first three condensation thresholds, i.e, $\mu_c^{(i)}$, $i = 1, 2, 3$, which are linked to the 2- and 3-particle energies as a function of the spatial volume L^{d-1}. The L-dependence of the multi-particle energies is described by Lüscher's formula in the 2-particle sector and by its generalization in the 3-particle case. These finite size scaling functions carry the scattering information. Finally, we cross-check the results with conventional simulations at vanishing chemical potential where we extract the mass and the 2- and 3-particle energies from the 2-, 4- and 6-point correlation functions.

Primary authors: Prof. GATTRINGER, Christof (University of Graz); GIULIANI, Mario (University of Graz); ORASCH, Oliver (University of Graz)

Presenter: ORASCH, Oliver (University of Graz)

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