Condensation thresholds and scattering data

Mario Giuliani
Christof Gattringer

Karl Franzens Universität Graz, Austria

- We study ϕ^4 theory in $4D$ with chemical potential (Relativistic Bose Gas):

$$S = \sum_x \left(\eta |\phi_x|^2 + \lambda |\phi_x|^4 - \sum_{\nu=1}^{4} \left[e^{\mu \delta_{\nu,4}} \phi_x^* \phi_{x+\hat{\nu}} + e^{-\mu \delta_{\nu,4}} \phi_x^* \phi_{x-\hat{\nu}} \right] \right)$$

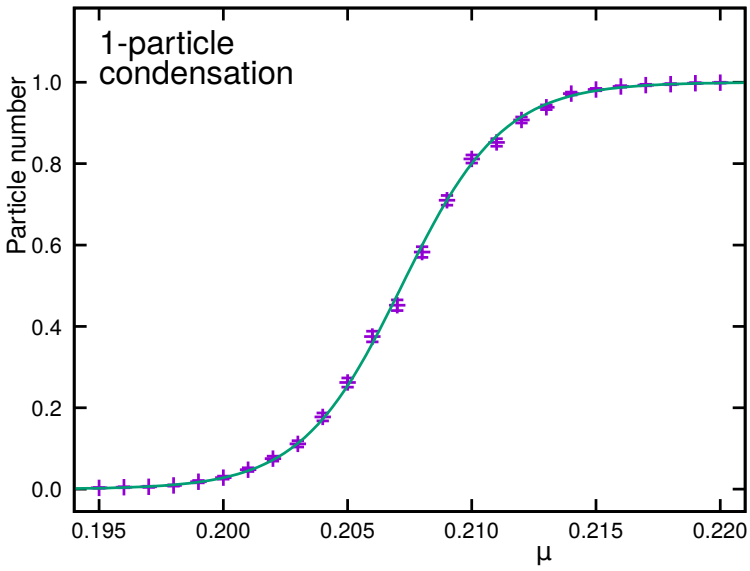
$\eta = 8 + m^2$

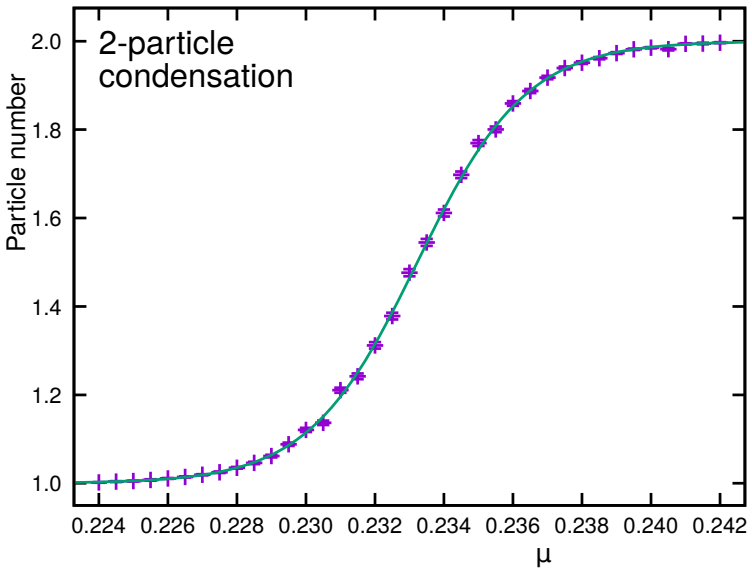
- The partition function can be rewritten exactly using world lines:

$$Z = \sum_k e^{\mu N_T \omega[k]} \; W[k] \; \prod_x \delta(\vec{\nabla} \vec{k_x}) \; ,$$

- Tuning the chemical potential it is possible to change the particle number

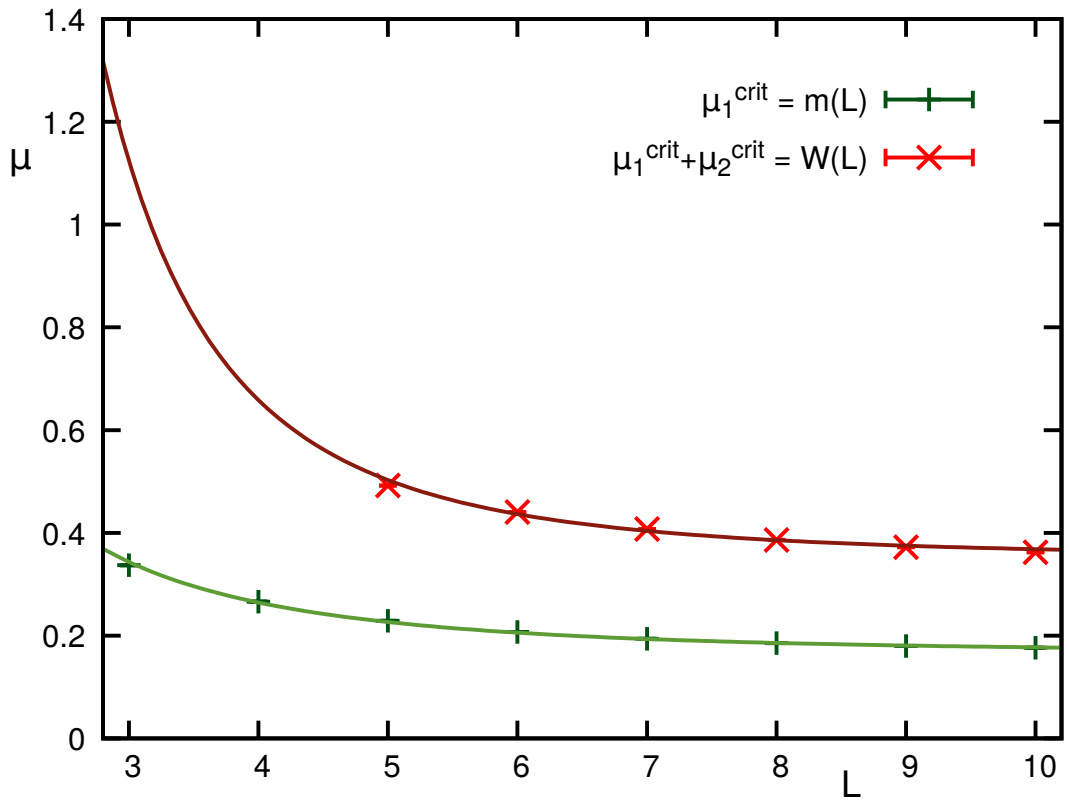
- In the limit $T \to 0$ ($N_T \to \infty$), it is possible to separate the particle sectors





- $\mu_1^{crit} = m$ particle mass
- $\mu_1^{crit} + \mu_2^{crit} = W$ 2-particle energy

- We simulate different spatial volumes L^3 and study $\mu_i^{crit}(L)$
- We use the Lüscher formula to extract scattering information from $W(L)$



- Scattering length a_0 related to particle condensation