IV. The Weakly Interacting Bose Gas in the Critical Regime

One-Body Density Matrix

$$n(s) = \langle \Psi^\dagger(\vec{r})\Psi(\vec{r}')\rangle$$

In the Presence of a Condensate

$$n(\vec{p}) = N_0\delta(\vec{p}) + \tilde{n}(\vec{p})$$

$$n(s) = \frac{1}{V}\int \mathrm{d}\vec{p}\, n(\vec{p})e^{i\vec{p}\cdot s\vec{e}/\hbar} \xrightarrow{s\to\infty} \frac{N_0}{V}$$

For a homogeneous Bose Gas

$$\langle \Psi^\dagger(\vec{r})\Psi(\vec{r}')\rangle \propto \frac{1}{s}\exp(-\frac{s}{\xi})|_{s=|\vec{r}-\vec{r}'|}$$

Divergence of the Correlation Length

$$\xi \propto |\frac{T_C}{T - T_C}|^\nu$$

Measurement

$$\nu = 0.67 \pm 0.13$$

2-Vector Model

$$\mathcal{H}(\phi) = \int \left(\frac{1}{2}(\partial_\mu \phi)^2 + \frac{1}{2}(r_C + t)\phi^2 + \frac{1}{4!} g \Lambda^\varepsilon (\phi^2)^2\right) \mathrm{d}^d x$$

ε-Expansion

$$\nu = 0.671 \pm 0.005$$