LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

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9th Exercise Sheet Many-Body Physics

Will be discussed in the week of June 24-28.

Exercise 1: Dyson equation and bosons

a. Derive an explicit expression for G_{11}, G_{20} and G_{02} in terms of the selfenergies by solving the Dyson equation. The final result can be found in the notes.

b. Find the first order selfenergies by applying the Feyman rules, and plug them into the formula's found above. You wll find the Bogoliubov dispersion relation $E(p)$. Assume that the potential has a Fourier transform which is constant as a function of momentum (and frequency).

c. Split the poles into $+E(p)$ and $-E(p)$, and obtain explicit expressions for the coherence factors u_p and v_p (as in the notes). Plot $E(p), u_p$ and v_p as a function of momentum and discuss the asymptotics.

Exercise 2: Hugenholtz-Pines theorem

Show explicitly that the Hugenholtz-Pines relation $\mu = \Sigma_{11}(0,0) - \Sigma_{02}(0,0)$ holds in second order. Use an expansion in bare propagators and condensate lines (no skeleton diagrams).