Lectures:
Monday, 1.7.:   Cooper Pairs
Thursday, 4.7.:   BCS Theory

Exercises:
All solutions must be handed in by **Tue. 9.7.** noon in box on 5th floor of Building 46 or electronically to laschwar@rptu.de

18.) Fermionic Transformations
Consider the following models in terms of fermionic creation and annhilation operators

i) Bogoliubov: $H = \varepsilon(c^{\dagger}c + d^{\dagger}d) + \gamma(cd + d^{\dagger}c^{\dagger})$

ii) Bi-linear: $H = \varepsilon(c^{\dagger}c + d^{\dagger}d) + \gamma(c^{\dagger}d + d^{\dagger}c)$

For each case, make an Ansatz for a transformation (linear combination) to define new fermionic creation and annihilation operators, which can be used to solve the models. What conditions on the coefficients must be met, so that the fermionic anti-commutation relations are preserved and the Hamiltonian becomes diagonal? What are the eigenenergies?

19.) Bosonic Transformations
Consider the following models in terms of bosonic creation and annhilation operators

i) Bogoliubov: $H = \varepsilon(a^{\dagger}a + b^{\dagger}b) + \gamma(ab + b^{\dagger}a^{\dagger})$

ii) Bi-linear: $H = \varepsilon(a^{\dagger}a + b^{\dagger}b) + \gamma(a^{\dagger}b + b^{\dagger}a)$

For each case, make an Ansatz for a transformation (linear combination) to define new bosonic creation and annihilation operators, which can be used to solve the models. What conditions on the coefficients must be met, so that the bosonic commutation relations are preserved and the Hamiltonian becomes diagonal? What are the eigenenergies?