Problem Set 3 for Many-body Physics II. Fall 2018

1. (5 points) Prove that the expression we obtained during the derivation of the Matsubara/Wick theorem,

$$\frac{[\hat{\alpha}_a(\tau > 0), \hat{\alpha}_b(0)]_s}{1 - se^{\lambda_a \beta \xi_a}}$$

is equivalent to the pairing of the operators $\hat{\alpha}_a(\tau)$ and $\hat{\alpha}_b(0)$ in the thermal sense. Here, $\hat{\lambda}_a = -1$ if $\hat{\alpha}_a$ is an annihilation operator and $\lambda_a = 1$ if α_a is a creation operator, and $\xi_a = \epsilon_a - \mu$ is the energy of the annihilated/created state relative to the chemical potential.