

Appendix A

Reference distribution

The reference distribution $\sigma_{\{f\}}^{(0)}$ of Eq. (3.9) is parameterized through its expectation values in Eq. (3.11). From the structure of this quantum Gaussian operator, it follows that

$$\sigma_{\{\mathcal{K}(t,t_0) f \mathcal{K}^\dagger(t,t_0)\}}^{(0)} = \hat{U}^\dagger(t, t_0) \sigma_{\{f\}}^{(0)} \hat{U}(t, t_0). \quad (\text{A.1})$$

In the above, \hat{U} represents the single particle propagator of Eq. (3.16) acting in many-particle Fock-space and \mathcal{K} is the corresponding single particle Hilbert-space propagator of Eq. (3.23). This condition implies that

$$\partial_{\gamma_k} \sigma^{(0)} \text{Tr}\{[\hat{\text{H}}^{(0)}, \hat{\gamma}_k]\} = -[\hat{\text{H}}^{(0)}, \sigma^{(0)}] \quad (\text{A.2})$$

and was used to obtain Eq. (3.17).