

# Clarifications and corrections

## Chapter 1

- In Sec. 1.4.5 (Open quantum systems) the identity operators in Eq. (1.64) are interchanged. That equation should read

$$\hat{H} = \hat{H}_e \otimes \hat{1}_{ph} + \hat{1}_e \otimes \hat{H}_{ph} + \hat{H}_{e-ph}$$

- In Sec. 1.4.5 (Open quantum systems), when I refer to Eq. (1.74), and state “for an arbitrary  $\mathcal{L}$  Eq. (1.73) does not necessarily admit a stationary solution”, I am referring to  $\mathcal{L}$  operators that do depend on time. If this is the case, the corresponding equations of motion for the statistical operator are called *quantum master equations* (see Appendix C). If  $\mathcal{L}$  does not depend on time (and the Hilbert space is finite) then there is (at least) one stationary solution.

## Chapter 2

- In Eq. (2.147) there is no comma between  $H$  and  $[\rho, \ln \rho]$  in the second equality. That equation should read

$$\frac{dS[\hat{\rho}]}{dt} = \frac{i k_B}{\hbar} \text{Tr}\{[\hat{H}, \hat{\rho}] \ln \hat{\rho}\} = \frac{i k_B}{\hbar} \text{Tr}\{\hat{H}[\hat{\rho}, \ln \hat{\rho}]\} = 0.$$

- In Exercise 2.8, Eq. (E2.7), there should be no  $t'$ . That equation should read

$$\chi_{AB}(\omega) = \int dt e^{i\omega t} \chi_{AB}(t).$$

## Chapter 3

- In the sentence after Eq. (3.310)  $\mu_3$  of probe 3 is a function of  $\mu_1, \mu_2, \mathcal{T}_{31}$  and  $\mathcal{T}_{32}$  not  $\mu_3$  as it is currently written.
- In footnote 65 the definition of magnetoresistance should be

$$R = \frac{R_{\uparrow\downarrow} - R_{\uparrow\uparrow}}{R_{\uparrow\downarrow}}.$$

### Chapter 5

- After Eq. (5.14) the sentence “Before replacing 5.10 into” should be “Before replacing 5.13 into”.
- In Eq. (5.49) the sum is over  $m$  and should thus read as

$$G(k) = \sum_{m=0}^{\infty} \frac{(ik)^m S_m}{m! e^m},$$

- Same for Eq. (5.50)

$$\ln G(k) = \sum_{m=1}^{\infty} \frac{(ik)^m}{m!} \langle \langle n_m(t) \rangle \rangle,$$

### Chapter 6

- In Eq. (6.3)  $m$  should be  $M_i$ .
- In Eq. (6.75) the steady state condition has the wrong sign. It should read

$$P_v = I_{th}^{out} - I_{th}^{in} \implies \theta_{eff} = (\theta_0^4 + \theta_v^4)^{1/4}, \text{ finite background } \theta$$

### Chapter 7

In Sec. 7.5 after the *initial-state maximum entropy principle* when referring to *Prigogine’s principle* the terminology “close to equilibrium” really means “close to local (in space) thermodynamic equilibrium”. This implies that if  $n$  forces  $X_j$  ( $j = 1, \dots, n$ ) act on the system producing the  $n$  fluxes  $J_j$ , there exists a linear relation of the type

$$J_i = \sum_k L_{ik} X_k$$

where the linear-response coefficients  $L_{ik}$  satisfy the Onsager’s relations

$$L_{ik} = L_{ki},$$

a direct consequence of the *micro-reversibility* of the Hamilton equations of motion (2.127). In the same local thermodynamic equilibrium assumption, the local entropy production rate  $\sigma$  can be written as

$$\sigma = \sum_k X_k J_k = \sum_{ki} L_{ik} X_i X_k,$$

from which Prigogine’s principle can be proved.

Note, however, that Prigogine's principle has a meaning only when two or more forces act on the system. In the case of a two-terminal current device in the linear regime, the only force acting on the system is the bias. The only corresponding flux is the current, so that Prigogine's principle does not apply.

### Chapter 8

- In the discussion in Sec. 8.6.1 (Electron heat conduction), I have implicitly neglected a term  $(\mu_L + \mu_R) \mathcal{T}(E) [f_L(E, \theta_R) - f_R(E, \theta_L)]/2$  in the integral of Eq. (8.66). This term, which is directly related to the variation of number of particles, is negligible in the limit of zero bias and for  $\mathcal{T}(E)$  independent of energy, which is what I assume in that section.
- In Eq. (8.72) the entropy and velocity field in the first term on the left-hand side depend on time. That equation reads

$$\sigma_{ij}(\mathbf{r}, t) \partial_j v_i(\mathbf{r}, t) + \nabla \cdot [k(\mathbf{r}, t) \nabla \theta_e(\mathbf{r}, t)] = n_{cP} \left( \frac{\partial \theta_e}{\partial t} + \mathbf{v}(\mathbf{r}, t) \cdot \nabla \theta_e(\mathbf{r}, t) \right).$$

### Appendix C

Referring to Sec. C.3, note that for a time-independent Lindblad operator (namely a time-independent system Hamiltonian and bath operators) and for a finite Hilbert space there is (at least) one stationary solution to Eq. (C.30).