Electrodynamics of Solids: Errata

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- p. 2: The 4th equation should read:
$\bar{\bar{\epsilon}}_{ij}(\mathbf{q},\omega) = \bar{\bar{\epsilon}}^*_{ij}(\mathbf{q},\omega)$
- p. 27: In Equation (2.3.24) a factor of $\frac{1}{2}$ is missing in the second line. It now reads

$$\mathbf{J}_{\rm cond} \cdot \mathbf{E} = \hat{\sigma}\mathbf{E}\cdot\mathbf{E} \approx \frac{-{\rm i}\omega}{4\pi\mu_1}\hat{N}^2\mathbf{E}\cdot\mathbf{E} \approx \frac{1}{2}\left[\frac{2nk\omega}{4\pi\mu_1} - {\rm i}\frac{\omega}{4\pi\mu_1}\left(n^2-k^2\right)\right]E_0^2 \qquad (2.3.24)$$

- p. 27: There is also a factor $\frac{1}{2}$ missing in the equation two lines under Equation (2.3.24):

$$P = \frac{1}{2}\sigma_1 E_0^2$$

- p. 33: 7th line from the bottom, it should read $\psi_{\rm t}$ instead of $\phi_{\rm t}$
- p. 37: Equations (2.4.17) and (2.4.18) are incorrect; σ_2 should be replaced by $\left(\frac{\omega}{4\pi} - \sigma_2\right)$. The correct formula (2.4.17) for the reflectivity then reads:

$$R = \frac{1 + \frac{4\pi}{\omega}\left[\sigma_1^2 + \left(\frac{\omega}{4\pi}-\sigma_2\right)^2\right]^{1/2} - \left(\frac{8\pi}{\omega}\right)^{1/2}\left\{\left[\sigma_1^2 + \left(\frac{\omega}{4\pi}-\sigma_2\right)^2\right]^{1/2} + \left(\frac{\omega}{4\pi}-\sigma_2\right)\right\}^{1/2}}{1 + \frac{4\pi}{\omega}\left[\sigma_1^2 + \left(\frac{\omega}{4\pi}-\sigma_2\right)^2\right]^{1/2} + \left(\frac{8\pi}{\omega}\right)^{1/2}\left\{\left[\sigma_1^2 + \left(\frac{\omega}{4\pi}-\sigma_2\right)^2\right]^{1/2} + \left(\frac{\omega}{4\pi}-\sigma_2\right)\right\}^{1/2}}$$

The correct formula (2.4.18) for the phase shift is

$$\tan\phi_r = -\frac{\left(\frac{8\pi}{\omega}\right)^{1/2}\left\{\left[\sigma_1^2 + \left(\frac{\omega}{4\pi}-\sigma_2\right)^2\right]^{1/2} - \left(\frac{\omega}{4\pi}-\sigma_2\right)\right\}^{1/2}}{1 - \frac{4\pi}{\omega}\left[\sigma_1^2 + \left(\frac{\omega}{4\pi}-\sigma_2\right)^2\right]^{1/2}}$$

The derivation starts fraom Equation (2.4.15):

$$R = \frac{(1-n)^2+k^2}{(1+n)^2+k^2} = \frac{1+n^2+k^2-2n}{1+n^2+k^2+2n}$$

and uses $n(\sigma_1,\sigma_2)$, $k(\sigma_1,\sigma_2)$ from Table 2.1 ($\mu_1 = 1$):

$$R = \frac{1 + \left[\left(1-\frac{4\pi}{\omega}\sigma_2\right)^2 + \left(\frac{4\pi}{\omega}\sigma_1\right)^2\right]^{1/2} - 2\left\{\frac{1}{2}\left[\left(1-\frac{4\pi}{\omega}\sigma_2\right)^2 + \left(\frac{4\pi}{\omega}\sigma_1\right)^2\right]^{1/2} + \frac{1}{2}\left(1-\frac{4\pi}{\omega}\sigma_2\right)\right\}^{1/2}}{1 + \left[\left(1-\frac{4\pi}{\omega}\sigma_2\right)^2 + \left(\frac{4\pi}{\omega}\sigma_1\right)^2\right]^{1/2} + 2\left\{\frac{1}{2}\left[\left(1-\frac{4\pi}{\omega}\sigma_2\right)^2 + \left(\frac{4\pi}{\omega}\sigma_1\right)^2\right]^{1/2} + \frac{1}{2}\left(1-\frac{4\pi}{\omega}\sigma_2\right)\right\}^{1/2}}.$$

If we put the factor of 2 inside the square root given by the curled brackets { } and arranging the prefactors as in the Book, this equation becomes

$$R = \frac{1 + \frac{4\pi}{\omega}\left[\left(\frac{\omega}{4\pi} - \sigma_2\right)^2 + \sigma_1^2\right]^{1/2} - \left(\frac{8\pi}{\omega}\right)^{1/2}\left\{\left[\left(\frac{\omega}{4\pi} - \sigma_2\right)^2 + \sigma_1^2\right]^{1/2} + \left(\frac{\omega}{4\pi} - \sigma_2\right)\right\}^{1/2}}{1 + \frac{4\pi}{\omega}\left[\left(\frac{\omega}{4\pi} - \sigma_2\right)^2 + \sigma_1^2\right]^{1/2} + \left(\frac{8\pi}{\omega}\right)^{1/2}\left\{\left[\left(\frac{\omega}{4\pi} - \sigma_2\right)^2 + \sigma_1^2\right]^{1/2} + \left(\frac{\omega}{4\pi} - \sigma_2\right)\right\}^{1/2}}.$$

Similar transformation have to be done for $\tan\phi_r$.

- p. 42, before Equation (2.4.23): The electric field is not normal but parallel to the surface. Thus the sentence should read:
  $\hat{Z}_{\mathrm{S}}$ was defined as the ratio of the electric field $\mathbf{E}$ parallel to the surface of a metal to the total current density $\mathbf{J}$ induced in the material

- p. 44: In Equation (2.4.28) the sign of the imaginary part has to be negative:

$$\hat{Z}_{\mathrm{S}} = \frac{(2\pi)^2\,\mu_1}{c}\frac{\delta_0}{\lambda_0}\,(1 - \mathrm{i})$$

- p. 50, Equation (3.1.10) - (3.1.12)
  The derivation of Equation (3.1.12) is not straight forward, since the previous Equation (3.1.10) is not fully correct. The displacement field $\mathbf{D}$ used in this equation has to be redefined, but eventually cancels in Equation (3.1.11).
  We start with Maxwell's equations (2.2.7)

$$\begin{aligned}
\nabla \times \mathbf{E} + \frac{1}{c}\frac{\partial \mathbf{B}}{\partial t} &= 0 \\
\nabla \cdot \mathbf{B} &= 0 \\
\nabla \times \mathbf{H} - \frac{1}{c}\frac{\partial \mathbf{D}}{\partial t} &= \frac{4\pi}{c}\mathbf{J} \\
\nabla \cdot \mathbf{D} &= 4\pi\rho
\end{aligned}$$

and the material parameters (2.2.5)

$$\mathbf{D} = \epsilon_1\mathbf{E} = (1 + 4\pi\chi_e)\,\mathbf{E} = \mathbf{E} + 4\pi\mathbf{P},$$

and (2.26)

$$\mathbf{B} = \mu_1\mathbf{H} = (1 + 4\pi\chi_m)\,\mathbf{H} = \mathbf{H} + 4\pi\mathbf{M}.$$

Now let us introduce a dielectric displacement $\mathbf{D}'$ which also includes the change of the magnetization:

$$\frac{\partial \mathbf{D}'(\mathbf{r},t)}{\partial t} = \frac{\partial \mathbf{E}(\mathbf{r},t)}{\partial t} + 4\pi\frac{\partial \mathbf{P}(\mathbf{r},t)}{\partial t} + 4\pi\nabla \times \mathbf{M}$$

The Maxwell's equations then become

$$
\begin{aligned}
\nabla\times\mathbf{E}+\frac{1}{c}\frac{\partial\mathbf{B}}{\partial t} &= 0\\
\nabla\cdot\mathbf{B} &= 0\\
\nabla\times\mathbf{B}-\frac{1}{c}\frac{\partial\mathbf{D}'}{\partial t} &= \frac{4\pi}{c}\mathbf{J}\\
\nabla\cdot\mathbf{D}' &= 4\pi\rho
\end{aligned}
$$

Let us now transform Maxwell's equations to Fourier space

$$
\begin{aligned}
\mathbf{q}\times\mathbf{E}(\mathbf{q},\omega)-\frac{\omega}{c}\mathbf{B}(\mathbf{q},\omega) &= 0\\
\mathbf{q}\cdot\mathbf{B}(\mathbf{q},\omega) &= 0\\
\frac{\mathrm{i}}{\mu_1(\mathbf{q},\omega)}\mathbf{q}\times\mathbf{B}(\mathbf{q},\omega)+\mathrm{i}\frac{\omega}{c}\epsilon_1(\mathbf{q},\omega)\mathbf{E}(\mathbf{q},\omega) &= \frac{4\pi}{c}\mathbf{J}(\mathbf{q},\omega)\\
\mathrm{i}\epsilon_1(\mathbf{q},\omega)\,\mathbf{q}\cdot\mathbf{E}(\mathbf{q},\omega) &= 4\pi\rho(\mathbf{q},\omega)
\end{aligned}
\tag{1}
$$

Let us start in a different way. We can split the tensor of the dielectric constant in longitudinal and transverse components as done in (3.1.5)

$$
(\epsilon_1)_{ij}(\mathbf{q},\omega)=\epsilon_1^L(\mathbf{q},\omega)\frac{\mathbf{q}_i\circ\mathbf{q}_j}{q^2}+\epsilon_1^T(\mathbf{q},\omega)\left[\delta_{ij}-\frac{\mathbf{q}_i\circ\mathbf{q}_j}{q^2}\right],
$$

and similarly all other dielectric vectors (3.1.6). This procedure is interesting for the dielectric displacement

$$
\mathbf{D}'(\mathbf{q},\omega)=\frac{\mathbf{q}\cdot\mathbf{D}'(\mathbf{q},\omega)}{q^2}\mathbf{q}+\frac{\mathbf{q}\times\mathbf{D}'(\mathbf{q},\omega)}{q^2}\times\mathbf{q}.
$$

With the help of the material equations we obtain

$$
\mathbf{D}'(\mathbf{q},\omega)=\epsilon_1^L(\mathbf{q},\omega)\frac{\mathbf{q}\cdot\mathbf{E}(\mathbf{q},\omega)}{q^2}\mathbf{q}+\epsilon_1^T(\mathbf{q},\omega)\frac{\mathbf{q}\times\mathbf{E}(\mathbf{q},\omega)}{q^2}\times\mathbf{q}.
$$

This allows to simplify some of Maxwell's equations, for example (3.1.9d):

$$
\mathrm{i}\epsilon_1^L(\mathbf{q},\omega)\,\mathbf{q}\cdot\mathbf{E}(\mathbf{q},\omega)=4\pi\rho(\mathbf{q},\omega)
$$

since we can immediately calculate the scalar product which is only the longitudinal component:

$$
\mathbf{q}\cdot\mathbf{D}'(\mathbf{q},\omega)=\epsilon_1^L(\mathbf{q},\omega)\,\mathbf{q}\cdot\mathbf{E}(\mathbf{q},\omega).
$$

The other equations are given in (3.1.9):

$$\begin{aligned}\mathbf{q}\times\mathbf{E}(\mathbf{q},\omega)-\frac{\omega}{c}\mathbf{B}(\mathbf{q},\omega)=&0\\ \mathbf{q}\cdot\mathbf{B}(\mathbf{q},\omega)=&0\\ \mathrm{i}\mathbf{q}\times\mathbf{B}(\mathbf{q},\omega)+\mathrm{i}\frac{\omega}{c}\mathbf{D}'(\mathbf{q},\omega)=&\frac{4\pi}{c}\mathbf{J}(\mathbf{q},\omega)\end{aligned} \tag{2}$$

Let us subtract Equations (1) from (2)

$$\mathrm{i}\left(1-\frac{1}{\mu_1(\mathbf{q},\omega)}\right)\mathbf{q}\times\mathbf{B}(\mathbf{q},\omega)+\mathrm{i}\frac{\omega}{c}\mathbf{D}'(\mathbf{q},\omega)-\mathbf{i}\frac{\omega}{c}\epsilon_1(\mathbf{q},\omega)\mathbf{E}(\mathbf{q},\omega)=0$$

In the case of harmonic waves, the magnetic and electric fields are related by (2.2.17)

$$\mathbf{B}(\mathbf{q},\omega)=\frac{c}{\omega}\mathbf{q}\times\mathbf{E}(\mathbf{q},\omega)$$

which we use for substitution of $\mathbf{B}$

$$\left(1-\frac{1}{\mu_1(\mathbf{q},\omega)}\right)\mathbf{q}\times[\mathbf{q}\times\mathbf{E}(\mathbf{q},\omega)]=-\frac{\omega^2}{c^2}\epsilon_1(\mathbf{q},\omega)\mathbf{E}(\mathbf{q},\omega)-\frac{\omega^2}{c^2}\mathbf{D}'(\mathbf{q},\omega)$$

If we eventually split this equation in the longitudinal and the transverse components of the vector and tensor, we arrive at (3.1.11)

$$\begin{aligned}\left[\frac{q^2c^2}{\omega^2}\left(1-\frac{1}{\mu_1}\right)+\epsilon_1(\mathbf{q},\omega)\right]\mathbf{q}\times[\mathbf{q}\times\mathbf{E}(\mathbf{q},\omega)]-\epsilon_1(\mathbf{q},\omega)[\mathbf{q}\cdot\mathbf{E}(\mathbf{q},\omega)]\mathbf{q}=\\ =\epsilon_1^T(\mathbf{q},\omega)\mathbf{q}\times[\mathbf{q}\times\mathbf{E}(\mathbf{q},\omega)]-\epsilon_1^L(\mathbf{q},\omega)[\mathbf{q}\cdot\mathbf{E}(\mathbf{q},\omega)]\mathbf{q},\end{aligned}$$

which finally leads to (3.1.12)

$$q^2\left(1-\frac{1}{\mu_1}\right)=\frac{\omega^2}{c^2}\left[\epsilon_1^T(\mathbf{q},\omega)-\epsilon_1^L(\mathbf{q},\omega)\right].$$

- p. 72:
  The Hamiltonian operator of Equation (4.1.1) describes the energy density per unit volume. Thus it should be called Hamiltonian density.

- p. 74, Equation (4.1.10) should read:

$$\mathbf{A}(\mathbf{q})=\frac{1}{\Omega}\int\mathbf{A}(\mathbf{r})\exp\{-\mathrm{i}\mathbf{q}\cdot\mathbf{r}\}\mathrm{d}\mathbf{r}$$

- p. 88, line 3:
  The Coulomb gauge should read $\nabla\mathbf{A}=0$, as correctly given in Equation (2.1.6)

- p. 95: In Equation (5.1.9) the sign of the denominator is incorrect. The formula should read:

$$\hat{\epsilon}(\omega) = \epsilon_1(\omega) + \mathrm{i}\epsilon_2(\omega) = 1 - \frac{\omega_\mathrm{p}^2}{\omega^2 + \mathrm{i}\omega/\tau}$$

- p. 99, last line of the Figure caption:
  The approximation shows deviations from the Drude model for frequencies above the scattering rate γ.

- p. 110: The $\mathbf{q} = 0$ limit calculation is wrong, but the result is correct. The complete calculation reads:

$$\begin{aligned}
\sigma_\mathrm{dc} &= \frac{e^2}{4\pi^3\hbar} \int \frac{\tau\,(\mathbf{n_E}\cdot\mathbf{v_k})\,v_\mathbf{k}}{v_\mathbf{k}} \mathrm{d}S_\mathrm{F} \\
&= \frac{e^2}{4\pi^3\hbar} \underbrace{2\pi}_{\phi\text{ - integration}} \tau \int_0^\pi \mathrm{d}\theta \underbrace{\frac{1}{3}v_\mathrm{F}}_{\text{averaging}} \underbrace{k_\mathrm{F}^2 \sin\theta}_{\text{surface element}} \\
&= \frac{e^2\tau}{2\pi^2\hbar}\frac{1}{3} \underbrace{v_\mathrm{F}}_{\frac{\hbar k_\mathrm{F}}{m}} k_\mathrm{F}^2 \cdot 2 \\
&= \frac{e^2\tau}{\pi^2}\frac{1}{3}\frac{\overbrace{k_\mathrm{F}^3}^{3\pi^2 N}}{m} = \frac{Ne^2}{m}\tau
\end{aligned}$$

- p. 111: The derivation of formula (5.2.19) is given here. Footnote 2 on p. 111 gives the wrong integrals that are needed to obtain the result. So we give here the full derivation. Starting from Equation (5.2.16):

$$\hat{\sigma}(\mathbf{q},\omega) = \frac{2e^2}{(2\pi)^3} \int\int \frac{\tau\,(\mathbf{n_E}\cdot\mathbf{v_k})\,v_\mathbf{k}}{1 - \mathrm{i}\omega\tau + \mathrm{i}\mathbf{v_k}\cdot\mathbf{q}\tau} \left(-\frac{\partial f^0}{\partial\varepsilon}\right) \frac{\mathrm{d}S}{\hbar v_\mathbf{k}} \mathrm{d}\varepsilon$$

We align the **E**-field in x-direction. Thus the conductivity in the x direction is of interest. We put $\mathbf{q}$ in the z-direction. Multiplying the nominator and denominator with i/τ simplifies the equation. Besides, the integration is changed to an integration over k via $\frac{\mathrm{d}\varepsilon}{\hbar v_\mathbf{k}} = \mathrm{d}k$.

$$\hat{\sigma}_\mathrm{xx}(q,\omega) = -\frac{\mathrm{i}e^2}{4\pi^3} \int_0^{k_\mathrm{F}} \int_0^\pi \int_0^{2\pi} \mathrm{d}k\,\mathrm{d}\theta\,\mathrm{d}\phi\,k^2 \sin\theta \frac{\overbrace{(\mathbf{e}_\mathrm{x}\cdot\mathbf{v}_{k,\theta,\phi})v_k}^{v_k^2 \sin^2\theta\cos^2\phi}}{\underbrace{\frac{\mathrm{i}}{\tau} + \omega}_{:=\tilde{\omega}} - v_\mathbf{k} q\cos\theta} \left(\frac{\partial f^0}{\partial\varepsilon}\right)$$

$$\hat{\sigma}_\mathrm{xx}(q,\omega) = -\frac{\mathrm{i}e^2 v_k^2}{4\pi^3} \int_0^{k_\mathrm{F}} \int_0^\pi \int_0^{2\pi} \mathrm{d}k\,\mathrm{d}\theta\,\mathrm{d}\phi\,k^2 \cos^2\phi \frac{\sin^3\theta}{\tilde{\omega} - v_\mathbf{k} q\cos\theta} \left(\frac{\partial f^0}{\partial\varepsilon}\right)$$

The ϕ - integration $\int_0^{2\pi} \mathrm{d}\phi\cos^2\phi = \pi$ and the θ- integration $\int_0^\pi \frac{\sin^3\theta}{a + b\cos\theta} = \frac{a^2-b^2}{b^3}\ln\left(\frac{a-b}{a+b}\right) +$

$\frac{2a}{b}$ yields:

$$\hat{\sigma}_{\mathrm{xx}}(q,\omega) = -\frac{\mathrm{i}e^2 v_k^2}{4\pi^2}\int_0^{k_\mathrm{F}} \mathrm{d}k\, k^2 \left[\frac{\tilde{\omega}^2 - v_\mathbf{k}^2 q^2}{-v_\mathbf{k}^3 q^3}\mathrm{Ln}\left\{\frac{\tilde{\omega}+v_\mathbf{k}q}{\tilde{\omega}-v_\mathbf{k}q}\right\} + \frac{2\tilde{\omega}}{v_\mathbf{k}^2 q^2}\right]\left(\frac{\partial f^0}{\partial \varepsilon}\right).$$

Transforming back to an integral over ε, we can make use of the δ-function behavior of the Fermi-Dirac distribution f^0 at zero temperature.

$$\hat{\sigma}_{\mathrm{xx}}(q,\omega) = -\frac{\mathrm{i}e^2 v_k^2}{4\pi^2}\int_0^{\varepsilon_\mathrm{F}} \frac{\mathrm{d}\varepsilon}{\hbar v_\mathrm{k}}\, k^2 \left[\frac{2\tilde{\omega}}{v_\mathbf{k}^2 q^2} - \frac{\tilde{\omega}^2 - v_\mathbf{k}^2 q^2}{v_\mathbf{k}^3 q^3}\mathrm{Ln}\left\{\frac{\tilde{\omega}+v_\mathbf{k}q}{\tilde{\omega}-v_\mathbf{k}q}\right\}\right]\underbrace{\left(\frac{\partial f^0}{\partial \varepsilon}\right)}_{-\delta(\varepsilon-\varepsilon_\mathrm{F})}$$

$$\hat{\sigma}_{\mathrm{xx}}(q,\omega) = \frac{\mathrm{i}e^2 \overbrace{v_\mathrm{F}}^{\frac{\hbar k_\mathrm{F}}{m}} k_\mathrm{F}^2}{4\pi^2\hbar}\left[\frac{2\tilde{\omega}}{v_\mathrm{F}^2 q^2} - \frac{\tilde{\omega}^2 - v_\mathrm{F}^2 q^2}{v_\mathrm{F}^3 q^3}\mathrm{Ln}\left\{\frac{\tilde{\omega}+v_\mathrm{F}q}{\tilde{\omega}-v_\mathrm{F}q}\right\}\right]$$

We can change the nominator and denominator in the logarithm argument according to $\mathrm{Ln}\,(z) = -\mathrm{Ln}\,(z^{-1})$, to:

$$\hat{\sigma}_{\mathrm{xx}}(q,\omega) = \frac{\mathrm{i}e^2 \overbrace{k_\mathrm{F}^3}^{3\pi^2 N}}{4\pi^2 m}\left[\frac{2\tilde{\omega}}{v_\mathrm{F}^2 q^2} + \frac{\tilde{\omega}^2 - v_\mathrm{F}^2 q^2}{v_\mathrm{F}^3 q^3}\mathrm{Ln}\left\{\frac{\tilde{\omega}-v_\mathrm{F}q}{\tilde{\omega}+v_\mathrm{F}q}\right\}\right].$$

$$\hat{\sigma}_{\mathrm{xx}}(q,\omega) = \frac{3\mathrm{i}Ne^2\tau}{4m\tau}\left[\frac{2\tilde{\omega}}{v_\mathrm{F}^2 q^2} + \frac{\tilde{\omega}^2 - v_\mathrm{F}^2 q^2}{v_\mathrm{F}^3 q^3}\mathrm{Ln}\left\{\frac{\tilde{\omega}-v_\mathrm{F}q}{\tilde{\omega}+v_\mathrm{F}q}\right\}\right].$$

$$\hat{\sigma}_{\mathrm{xx}}(q,\omega) = \frac{3\sigma_\mathrm{dc}}{4}\frac{\mathrm{i}}{\tau}\left[\frac{2\tilde{\omega}}{v_\mathrm{F}^2 q^2} - \frac{v_\mathrm{F}^2 q^2 - \tilde{\omega}^2}{v_\mathrm{F}^3 q^3}\mathrm{Ln}\left\{\frac{\tilde{\omega}-v_\mathrm{F}q}{\tilde{\omega}+v_\mathrm{F}q}\right\}\right].$$

Re-substituting $\tilde{\omega} = \omega + \frac{\mathrm{i}}{\tau}$ and naming the transversal conductivity $\hat{\sigma}_{\mathrm{xx}}$ generally $\hat{\sigma}$, we obtain the result given in Equation (5.2.19):

$$\hat{\sigma}(\mathbf{q},\omega) = \frac{3\sigma_\mathrm{dc}}{4}\frac{\mathrm{i}}{\tau}\left[2\frac{\omega+\mathrm{i}/\tau}{v_\mathrm{F}^2 q^2} - \left(\frac{1-(\omega+\mathrm{i}/\tau)^2/(qv_\mathrm{F})^2}{qv_\mathrm{F}}\right)\mathrm{Ln}\left\{\frac{\tilde{\omega}-v_\mathrm{F}q}{\tilde{\omega}+v_\mathrm{F}q}\right\}\right].$$

- p. 111: The expansion between Equation (5.2.20) and (5.2.21) contains a wrong exponent. It should read:

$$\mathrm{Ln}\left\{\frac{\hat{z}+1}{\hat{z}-1}\right\} = 2\left(\frac{1}{\hat{z}} + \frac{1}{3\hat{z}^3} + \frac{1}{5\hat{z}^5}\right)$$

- p. 111: In footnote 2, the sine is missing in the numerator. It should read:

$$\int_0^\pi \frac{\sin x}{a+b\cos x}\mathrm{d}x = \frac{1}{b}\ln\frac{a+b}{a-b}$$

- p. 111, Equation (5.2.22): A factor of $\frac{1}{\tau}$ is too much. It should read:

$$\hat{\sigma}(\mathbf{q},\omega) \approx \frac{3\pi N e^2}{4 q v_{\mathrm{F}} m}\left[1 - \frac{\omega^2}{q^2 v_{\mathrm{F}}^2} + \mathrm{i}\frac{4\omega}{\pi q v_{\mathrm{F}}}\right]$$

- p. 117: In Figure 5.11, the equations in the two parabolas are incorrect, since $\hbar$ has to be replaced with $\hbar^2$. Hence they should read:

$$\hbar\omega = \frac{\hbar^2}{2m}\left(q^2 + 2qk_{\mathrm{F}}\right)$$

$$\hbar\omega = \frac{\hbar^2}{2m}\left(q^2 - 2qk_{\mathrm{F}}\right)$$

- p. 123, footnote 3 should read:

$$\int \mathrm{d}\mathbf{k} \frac{\Theta(\mathbf{k}-\mathbf{k}_{\mathrm{F}})}{\omega - q^2\frac{v_{\mathrm{F}}}{2k_{\mathrm{F}}} - \frac{v_{\mathrm{F}}}{k_{\mathrm{F}}}(\mathbf{k}\cdot\mathbf{q}) + \frac{\mathrm{i}}{\tau}}$$

$$= \int_0^{2\pi} \mathrm{d}\phi \int_0^{\pi} \mathrm{d}\theta \int_0^{k_{\mathrm{F}}} \mathrm{d}k k^2 \sin\theta \frac{1}{\omega - q^2\frac{v_{\mathrm{F}}}{2k_{\mathrm{F}}} - \frac{v_{\mathrm{F}}}{k_{\mathrm{F}}}(kq\cos\theta) + \frac{\mathrm{i}}{\tau}}$$

$$\overset{\text{p. 111 footnote 2}}{=} 2\pi \int_0^{k_{\mathrm{F}}} \mathrm{d}k k^2 \frac{1}{-\frac{v_{\mathrm{F}}}{k_{\mathrm{F}}}kq} \mathrm{Ln}\left(\frac{\omega - q^2\frac{v_{\mathrm{F}}}{2k_{\mathrm{F}}} + \frac{\mathrm{i}}{\tau} - \frac{v_{\mathrm{F}}}{k_{\mathrm{F}}}kq}{\omega - q^2\frac{v_{\mathrm{F}}}{2k_{\mathrm{F}}} + \frac{\mathrm{i}}{\tau} + \frac{v_{\mathrm{F}}}{k_{\mathrm{F}}}kq}\right)$$

$$= -\frac{2\pi}{v_{\mathrm{F}}q}k_{\mathrm{F}} \int_0^{k_{\mathrm{F}}} \mathrm{d}k k \mathrm{Ln}\left(\frac{\omega + \frac{\mathrm{i}}{\tau} - \frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}} - \frac{q v_{\mathrm{F}}}{k_{\mathrm{F}}}k}{\omega + \frac{\mathrm{i}}{\tau} - \frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}} + \frac{q v_{\mathrm{F}}}{k_{\mathrm{F}}}k}\right)$$

$$= -\frac{2\pi}{v_{\mathrm{F}}q}k_{\mathrm{F}} \int_0^{k_{\mathrm{F}}} k\mathrm{Ln}\left(\underbrace{\omega + \frac{\mathrm{i}}{\tau} - \frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}}}_{b} \underbrace{- \frac{q v_{\mathrm{F}}}{k_{\mathrm{F}}}}_{a} k\right) - k\mathrm{Ln}\left(\underbrace{\omega + \frac{\mathrm{i}}{\tau} - \frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}}}_{b} + \underbrace{\frac{q v_{\mathrm{F}}}{k_{\mathrm{F}}}}_{-a} k\right) \mathrm{d}k$$

$$= -\frac{2\pi}{v_{\mathrm{F}}q}k_{\mathrm{F}} \int_0^{k_{\mathrm{F}}} k\mathrm{Ln}\left(b + ak\right) - k\mathrm{Ln}\left(b - ak\right)\mathrm{d}k$$

$$= -\frac{2\pi}{v_{\mathrm{F}}q}k_{\mathrm{F}}\left[\frac{b}{2a}k_{\mathrm{F}} \cancel{-\frac{1}{4}k_{\mathrm{F}}^2} + \frac{1}{2}\left(k_{\mathrm{F}}^2 - \frac{b^2}{a^2}\right)\mathrm{Ln}\left(b + ak_{\mathrm{F}}\right) + \cancel{\frac{1}{2}\frac{b^2}{a^2}\mathrm{Ln}(b)} + \right.$$
$$\left. + \frac{b}{2a}k_{\mathrm{F}} \cancel{+\frac{1}{4}k_{\mathrm{F}}^2} - \frac{1}{2}\left(k_{\mathrm{F}}^2 - \frac{b^2}{a^2}\right)\mathrm{Ln}\left(b - ak_{\mathrm{F}}\right) \cancel{-\frac{1}{2}\frac{b^2}{a^2}\mathrm{Ln}(b)}\right]$$

$$= -\frac{2\pi}{v_{\mathrm{F}} q} k_{\mathrm{F}} \left[\frac{b}{a} k_{\mathrm{F}} + \frac{1}{2} \left(k_{\mathrm{F}}^2 - \frac{b^2}{a^2} \right) \mathrm{Ln} \left(\frac{b + a k_{\mathrm{F}}}{b - a k_{\mathrm{F}}} \right) \right]$$

$$= \frac{2\pi}{v_{\mathrm{F}} q} k_{\mathrm{F}}^3 \left[\left(\frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - \frac{q}{2k_{\mathrm{F}}} \right) + \frac{1}{2} \left(\left(\frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - \frac{q}{2k_{\mathrm{F}}} \right)^2 - 1 \right) \mathrm{Ln} \left(\frac{\frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}} - \left(\omega + \frac{\mathrm{i}}{\tau}\right) + q v_{\mathrm{F}}}{\frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}} - \left(\omega + \frac{\mathrm{i}}{\tau}\right) - q v_{\mathrm{F}}} \right) \right]$$

Using $D(\varepsilon_{\mathrm{F}}) = \frac{m k_{\mathrm{F}}}{\pi^2 \hbar^2}$, and $v_{\mathrm{F}} = \frac{\hbar k_{\mathrm{F}}}{m}$ results:

$$= 2\pi^3 D(\varepsilon_{\mathrm{F}}) \hbar \frac{k_{\mathrm{F}}}{q} \left[\left(\frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - \frac{q}{2k_{\mathrm{F}}} \right) + \frac{1}{2} \left(\left(\frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - \frac{q}{2k_{\mathrm{F}}} \right)^2 - 1 \right) \mathrm{Ln} \left(\frac{\frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}} - \left(\omega + \frac{\mathrm{i}}{\tau}\right) + q v_{\mathrm{F}}}{\frac{q^2 v_{\mathrm{F}}}{2k_{\mathrm{F}}} - \left(\omega + \frac{\mathrm{i}}{\tau}\right) - q v_{\mathrm{F}}} \right) \right]$$

- p. 123, Equation (5.4.16): two i are missing. It should read:

$$\hat{\chi}(\mathbf{q}, \omega) = -\frac{e^2 D(\varepsilon_{\mathrm{F}})}{2} \left(1 + \frac{k_{\mathrm{F}}}{2q} \left[1 - \left(\frac{q}{2k_{\mathrm{F}}} - \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} \right)^2 \right] \mathrm{Ln} \left\{ \frac{\frac{q}{2k_{\mathrm{F}}} - \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} + 1}{\frac{q}{2k_{\mathrm{F}}} - \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - 1} \right\} \right.$$
$$\left. + \frac{k_{\mathrm{F}}}{2q} \left[1 - \left(\frac{q}{2k_{\mathrm{F}}} + \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} \right)^2 \right] \mathrm{Ln} \left\{ \frac{\frac{q}{2k_{\mathrm{F}}} + \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} + 1}{\frac{q}{2k_{\mathrm{F}}} + \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - 1} \right\} \right)$$

- p. 127, Equation (5.4.21): Two i are missing. It should read:

$$\hat{\epsilon}(\mathbf{q}, \omega) = 1 + \frac{3\omega_{\mathrm{p}}^2}{q^2 v_{\mathrm{F}}^2} \left(\frac{1}{2} + \frac{k_{\mathrm{F}}}{4q} \left[1 - \left(\frac{q}{2k_{\mathrm{F}}} - \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} \right)^2 \right] \mathrm{Ln} \left\{ \frac{\frac{q}{2k_{\mathrm{F}}} - \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} + 1}{\frac{q}{2k_{\mathrm{F}}} - \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - 1} \right\} \right.$$
$$\left. + \frac{k_{\mathrm{F}}}{4q} \left[1 - \left(\frac{q}{2k_{\mathrm{F}}} + \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} \right)^2 \right] \mathrm{Ln} \left\{ \frac{\frac{q}{2k_{\mathrm{F}}} + \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} + 1}{\frac{q}{2k_{\mathrm{F}}} + \frac{\omega + \frac{\mathrm{i}}{\tau}}{q v_{\mathrm{F}}} - 1} \right\} \right)$$

- p. 133: The much smaller signs should be vice-versa. The text should say:
  ... quasi-static, limit for $q v_{\mathrm{F}} \gg \omega$ screening becomes...
  ...but still $q v_{\mathrm{F}} \gg \omega$ ...

- p. 167: In line 5, the sentence should read:
  ..., and thus delocalization occurs if the impurity concentration exceeds a certain critical concentration.

- p. 246: In section 10.1.1, the Hagen-Rubens relation quoted in the text is incorrect. It should read:

$$1 - R(\omega) \propto \sqrt{\omega}$$

- p. 305: In Equation (12.1.8), there is a square root missing in the middle part. It should read:

$$\omega_{\mathrm{p}}^{+} = \left(\frac{4\pi N e^2}{m_{\mathrm{b}} \epsilon_\infty} \right)^{\frac{1}{2}} = \frac{\omega_{\mathrm{p}}}{\sqrt{\epsilon_\infty}} \qquad (12.1.8)$$

- p. 319, line 6 from the bottom the sentence should read:
  In this case the (originally) localized orbitals at energy position ε_d (or ε_f) away from the Fermi level are broadened, due to interaction with the conduction band; ...

- p. 323, after Equation (12.2.7):
  It should read Fermi gas instead of Fermi glass

- p. 355, the chemical formula of cuprous oxide is Cu_2O
  This should be corrected in Fig. 13.11 and its caption as well as in the text below.

- p. 374, Figure 14.1 (a):
  The x-axis should be labeled T_C/T

- p. 383, line 15:
  The equation referred to should read (12.2.14)

- p. 385, line 3 from the bottom, the sentence should read:
  First, because the **nodes** in the gap extend to zero energy, ...

- p. 416: the second Equation in (B.24) contains an incorrect index; it should read:

$$\hat{t}_{12} = \frac{2\hat{N}_1}{\hat{N}_1 + \hat{N}_2}$$

- p. 444: Wrong reference:
  [Mat58] is Phys. Rev. **111**, 412 (1958)

- p. 459, Figure F.6: the equations in the two parabolas are incorrect, since $\hbar$ has to be replaced with $\hbar^2$. Hence they should read:

$$\hbar\omega = \frac{\hbar^2}{2m}\left(q^2 + 2qk_\mathrm{F}\right)$$

$$\hbar\omega = \frac{\hbar^2}{2m}\left(q^2 - 2qk_\mathrm{F}\right)$$