Consequently, the optical conductivity can be expressed in terms of local spectral functions (Dobrosavljević and Kotliar, 1993),

$$\sigma_{xx}(\omega) = \frac{\pi e^2 a^2 t^2}{\hbar^2} \frac{N}{V} \sum_{\sigma} \int_{-\infty}^{\infty} \mathrm{d}\omega' A_{A\sigma}(\omega') A_{B\sigma}(\omega'+\omega) \frac{n_{\mathrm{f}}(\omega') - n_{\mathrm{f}}(\omega'+\omega)}{\omega}, \qquad (4.132)$$

where $t^2 = \langle t^2_{\boldsymbol{r},\boldsymbol{r}+\boldsymbol{e}_x} \rangle$. Note that this expression essentially agrees with (4.120), but does not contain the factor L_x/L which scales to zero in the thermodynamic limit. We also observe that (4.132) is valid as long as the hopping terms in current direction are fully disordered in the sense defined above regardless if the bonds perpendicular to the current (i.e., within the hyperplanes) are ordered or disordered. This result can, therefore, be applied in connection with any underlying lattice and is, then, characteristic of the stacked disordered anisotropic model.

4.4.5 General Dispersion Method

In the preceding subsections, we have seen that all previous approaches of defining and computing an optical conductivity compatible with DMFT calculations for a semi-elliptic DOS had an inherently anisotropic character. Using the general formalism developed in Sec. 2.3 and applied to the Bethe DOS in Sec. 2.4, we can here for the first time consider the isotropic case. We remind the reader that in the general dispersion formalism hopping matrix elements only depend on taxi-cab distance D which, for $d \to \infty$, leads to the dispersion $\epsilon_{\boldsymbol{k}} = \sum_{D=1}^{\infty} \mathrm{He}_D(\epsilon^{\mathrm{hc}}_{\boldsymbol{k}})\, t^*_D/\sqrt{D!}$, where $\mathrm{He}_D(x)$ is the Hermite polynomial of order D and $\epsilon^{\mathrm{hc}}_{\boldsymbol{k}}$ is the dispersion of the hypercubic lattice with NN hopping [cf. (2.52)]. Due to the completeness of the Hermite polynomials, an arbitrary transformation function f with $\epsilon_{\boldsymbol{k}} = f(\epsilon^{\mathrm{hc}}_{\boldsymbol{k}})$ can be realized by an appropriate choice of scaled hopping matrix elements t^*_D. In particular, any bounded function f leads to corresponding band edges in the resulting DOS. Using (2.61), a suitable (monotonous) transformation function f may be determined for an arbitrary "target" DOS which then allows for the computation of transport properties, e.g., via (2.63). Furthermore, the hopping matrix elements defining the corresponding microscopic model can be computed according to (2.55).

For the "redefined Bethe lattice", a regular isotropic hc lattice with extended hopping along the diagonals and a semi-elliptic DOS, we have from (2.70),

$$\tilde{\rho}(\epsilon) = \frac{1}{2\sqrt{1-\epsilon^2/4}} \exp\left[-2\left(\mathrm{erf}^{-1}\left(\frac{\epsilon\sqrt{1-\epsilon^2/4} + 2\sin^{-1}(\epsilon/2)}{\pi}\right)\right)^2\right] \qquad (4.133)$$

which defines $\sigma_{xx}(\omega)$ in conjunction with the general expression (4.65) and is shown in Fig. 4.14. Also shown in the figure is the function $\tilde{\rho}'(\epsilon)/\rho(\epsilon)$ which determines the sum rule (4.95). It is a straightforward but lengthy exercise to derive the explicit analytic expression from the chain rule. Let us, instead, only point out that it approaches $-\pi\epsilon/2$ at $\epsilon \approx 0$, but clearly deviates from this asymptotic form near the band edges. Thus, the f-sum cannot be proportional to the kinetic energy in any limit. The