applicable. For NN hopping in current direction, the conductivity is thus given by

$$\mathrm{Re}\,\sigma_{xx}(\omega) = \frac{2\pi e^2 a^2 t^2}{\hbar^2}\frac{N}{V}\int\limits_{-\infty}^{\infty}\mathrm{d}\epsilon\rho(\epsilon)\int\limits_{-\infty}^{\infty}\mathrm{d}\omega' A_\epsilon(\omega')A_\epsilon(\omega'+\omega)\frac{n_\mathrm{f}(\omega')-n_\mathrm{f}(\omega+\omega')}{\omega}\,, \tag{4.125}$$

which agrees with (4.73) for a uniform hopping amplitude $t = t^*/\sqrt{d}$. For the particular case of the stacked Bethe lattice, this fact was observed and used by Uhrig and Vlaming (1993). Longer-range hopping in stacking direction as illustrated in Fig. 4.12 b only leads to a modified constant prefactor. For this general case, an expression for $\sigma_{xx}(\omega)$ is found from (4.65) in conjunction with (4.75).

As verified by Uhrig and Vlaming (1993) within their locator formalism, the resulting sum rule for NN hopping in current direction is indeed of the form characteristic for the hypercubic lattice [with $\sigma_0 = 2\pi e^2 N/(V\hbar^2)$ as defined in (4.67)],

$$\int\limits_0^{\infty}\mathrm{d}\omega\,\sigma_{xx}(\omega) = -\frac{\sigma_0 t^2 a^2}{4}\langle\hat{T}_x\rangle\,. \tag{4.126}$$

This observation is, however, not very useful in the DMFT context since the applicability of (4.125) depended on the fact that $\langle\hat{T}_x\rangle$ is negligible with respect to the full kinetic energy. Thus, (4.126) alone gives no relation between the frequency sum and any expectation value surviving the DMFT limit. Using instead the general DMFT f-sum rule (4.87), we obtain for the general stacked case,

$$\int\limits_0^{\infty}\mathrm{d}\omega\,\sigma_{xx}(\omega) = \frac{\sigma_0}{4}\langle\frac{\frac{\mathrm{d}}{\mathrm{d}\epsilon}\rho(\epsilon)}{\rho(\epsilon)}\rangle\int\limits_0^{2\pi/a_x}\mathrm{d}k_x v_{k_x}^2\,, \tag{4.127}$$

where the integral equals t^2a^2 for NN hopping in current direction. Thus, we have not only identified a form of the f-sum rule which is generally applicable for anisotropic lattices in high dimensions, but also found an expression for the expectation value of the kinetic energy in the stacking direction. For the particular case of the stacked Bethe lattice with NN hopping, the sum rule reads [cf. (4.97)]

$$\int\limits_0^{\infty}\mathrm{d}\omega\,\sigma_{xx}(\omega) = \frac{t^2a^2\sigma_0}{4}\langle\frac{-\epsilon}{4-\epsilon^2}\rangle\,. \tag{4.128}$$

4.4.4 Offdiagonal Disorder

In the DMFT limit, diagrammatic expressions for directional transport are always dominated by diagrams with minimal extent in current direction. Specifically, for lattices where all lattice sites are arranged in planes perpendicular to the current and where the interplane contribution to the kinetic energy has zero weight for $Z \to \infty$, the surviving diagrams are confined to two neighboring planes with only two connections, the current vertices, between the planes as illustrated in Fig. 4.13: here