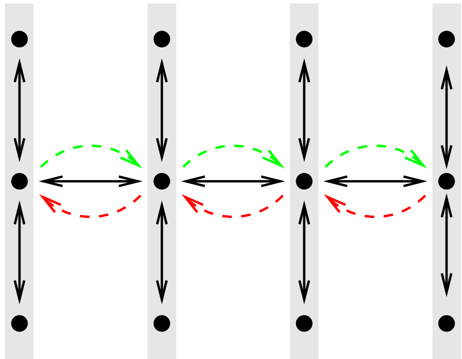

**Figure 4.7:** Schematic representation of hopping processes for a lattice consisting of stacked hyperplanes connected by a single chain of bonds in current direction (e.g., Stumpf's view on the Bethe lattice). Contributions to the current operator are restricted to this chain (dashed lines) while contributions to the kinetic energy (full lines) arise both from hopping along the chain and within the hyperplanes.

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main characteristics are that it describes only incoherent transport and that the total current is not extensive.[34] The lack of coherence is clearly a shortcoming with respect to a realistic description of Fermi liquids, but very much in line with properties of the unperturbed Bethe lattice (i.e., with $\boldsymbol{A} = 0$). In fact, we have pointed out already in subsection 2.2.2 that all lattices with Bethe DOS have an effective mean free path of one lattice spacing. As we will see in this section, the same statement can be made about all lattices to which the expression for $\sigma(\omega)$ resulting from Stumpf's treatment applies. Specifically, the optical conductivity of periodically stacked lattices where the bonds in current direction are fully disordered agrees with Stumpf's result except that it is extensive.

Let us consider a model as depicted in Fig. 4.7, where a current can flow in $x$ direction along a single chain of bonds which connect central sites of equivalent sublattices. The remaining hopping bonds of each sublattice are confined in stacked hyperplanes orthogonal to the current direction. For full correspondence to Fig. 4.6, each sublattice would have to consist of a Bethe lattice with two bonds removed at the central site (since these are assumed to connect neighboring planes); for $Z = \infty$, however, the removal of a finite number of bonds per site is irrelevant so that each hyperplane can be regarded as a full Bethe lattice. More generally, any DMFT lattice type can be assumed to be replicated on each hyperplane with the same resulting expressions for the conductivity $\sigma_{xx}(\omega)$ in stacking direction.

Labeling sites by the linear coordinate $x$ and some intraplanar coordinate $\alpha$, where $\alpha = 0$ denotes the central sites, the paramagnetic current operator (4.47) takes the form

$$\hat{\jmath}_x = \frac{ieta}{\hbar} \sum_{i,\sigma} \left( \hat{c}^{0\dagger}_{i+1,\sigma} \hat{c}^{0}_{i,\sigma} - \hat{c}^{0\dagger}_{i,\sigma} \hat{c}^{0}_{i+1,\sigma} \right) . \tag{4.117}$$

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[34] The latter directly follows from the restriction of the current to the single chain of bonds lying along the current direction.