the local moment (with $\langle (n_\uparrow - n_\downarrow)^2 \rangle = 1 - 2D$ for half filling) is larger; consequently, the ordering temperature should be higher in this phase which favors Fig. 3.56 f over Fig. 3.56 e. In both cases, the first-order MIT line becomes part of the boundary of the AF phase in the intermediate temperature range.

Still, the assumption implicit in Fig. 3.56 f (and Fig. 3.56 g) that the MIT line remains unchanged from the fully frustrated case even when one of the adjacent phases is antiferromagnetic is clearly wrong. Considering that the free energy decreases in the AF phase with increasing order parameter, i.e., decreasing T, the phase with the higher Néel temperature must widen so that the MIT line shifts as illustrated in Fig. 3.56 g. We stress that the continuity of D and E within the metallic phase along this line and across the second-order Néel curve within the insulating phase implies a continuous first derivative of the MIT curve $U_c(T)$. In principle, a second-order end point of the first-order MIT line at the lower Néel temperature appears possible; however, at least a discontinuity of the order parameter would have to continue towards lower T or to evolve into a crossover region analogous to the case discussed above in connection with Fig. 3.56 c; furthermore, such a coincidence appears nongeneric. Generically, one has to expect a continuation of the first-order line within the AF phase as shown in Fig. 3.56 h. This diagram contains five different phase transitions; among these, all metal-insulator transitions are of first order (i.e., PM-PI, PM-AFI, and AFM-AFI) while the remaining transitions (PM-AFM and PI-AFI) are of second order. The first-order line is continuously differentiable. The topology of this diagram agrees with the phase diagram proposed by Rozenberg, Kotliar, and Zhang [Fig. 43 in Georges et al. (1996)]; however, the details of the latter, in particular the ending of the first-order MIT in the paramagnetic phase on a (roughly perpendicular) Néel curve, are thermodynamically inconsistent.

The slope of the MIT line $U_c(T)$ at low T depends on the sign of the ratio $\Delta E/\Delta D$ of differences in energy and double occupation between the AFM and AFI phases (cf. Sec. 3.6). In contrast to the PM-PI transition, both signs appear possible for the AFM-AFI transition (possibly depending on the degree of frustration); the positive slope shown in Fig. 3.56 h for $T \to 0$ reflects an arbitrary choice rather than a prediction. Note that our scenario is consistent with ground state ED calculations performed for a frustrated model with semi-elliptic DOS (Chitra and Kotliar, 1999). For increasing frustration, both Néel temperatures along the MIT line are reduced. Then, the AFM phase might disappear before the AFI phase is completely suppressed. In any case, the full paramagnetic MIT line calculated in the previous section is recovered as soon as AF order is destroyed for all $U < U_{c2b}^0$.

Frustration by longer-range hopping

In generic cases, longer-range hopping suitable for causing magnetic frustration also leads to an asymmetric DOS, at least in absence of disorder (cf. subsection 2.1.3 and subsection 2.2.2). In the following, let us assume that t'^* parameterizes such type of hopping and, consequently, the degree of frustration and the modification of the DOS. Several scenarios come to mind:

1. The Mott transition disappears (even in a computation for the homogeneous