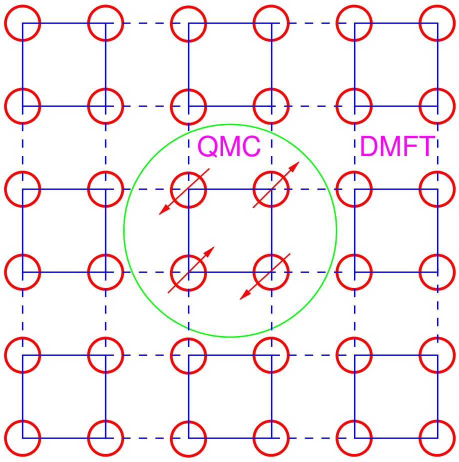

Figure A.4: CDMFT: the lattice is broken up in clusters (here with 2x2 sites); one of these is treated explicitly (e.g., using QMC) while the influence of the others is captured in a cavity picture analogous to the DMFT (scheme adapted from Lichtenstein and Katsnelson (2000)).

is the direct formulation in real (not momentum) space. Here, the lattice is divided up into free finite-size clusters, one of which is treated explicitly and embedded into a medium which gives a mean-field estimate of the effect of the surrounding clusters as illustrated in Fig. A.4. In contrast to the DCA, the cluster is here free, i.e., does not have periodic boundary conditions. Consequently, the analogue of (1.35) cannot be formulated in momentum space, but involves explicit matrix inversions in the cluster indices. Again, one can show causality and the interpolating character towards finite dimensions.

At least conceptionally, one should expect the CDMFT methods to yield a better description for short-range correlations within the first few nearest-neighbor shells than the DCA since here the cluster Hamiltonian is in direct correspondence to the lattice Hamiltonian. On the other hand, CDMFT breaks the lattice translational symmetry[6] which is preserved in DCA so that the DCA should give a better overall momentum resolution for the same number of cluster sites (and $L > 2$). First results for the $d = 2$ Hubbard model show that the nonlocal extensions of the DMFT indeed introduce d-wave type superconducting correlations (Lichtenstein and Katsnelson, 2000; Maier, Jarrell, Pruschke, and Keller, 2000). Very recently, finite-size effects were found to be smaller for the DCA treatment in a comparative study (Maier and Jarrell, 2002). For a detailed pedagogical review of the DCA method, see Jarrell, Maier, Hettler, and Tahvildarzadeh (2001).

The random-dispersion approximation (RDA) is not an extension, but an alternative to the DMFT approach. It avoids the self-consistency cycle inherent in all

[6]Since edge sites of the CDMFT cluster have a reduced number of direct hopping bonds, they are relatively stronger coupled to the effective medium and can, thus, be expected to be *more* mean-field like than inner sites. This is opposite to a direct calculation on a finite cluster with open boundary conditions where edge sites have *less* mean-field character.