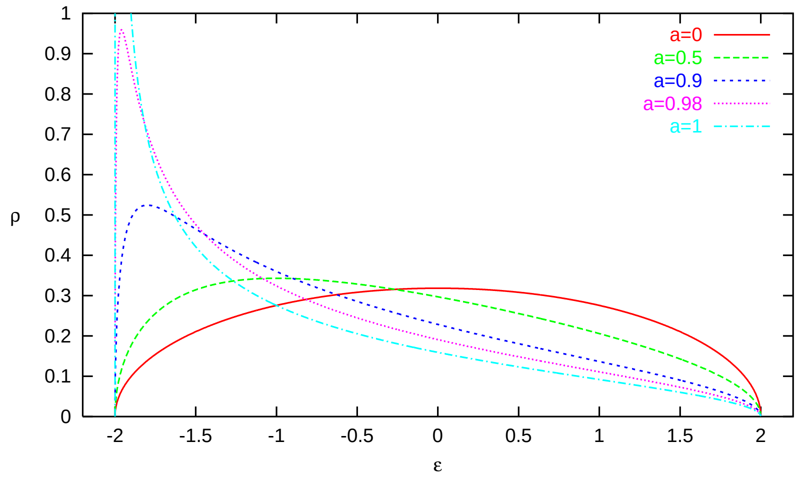

Figure 2.13: Asymmetric model DOS (2.27). For $a = 0$, the semi-elliptic DOS of the Bethe lattice (for $Z = \infty$) is recovered. As shown below, the extremely asymmetric case $a = 1$ corresponds to a Bethe lattice with only NNN hopping (also for $Z = \infty$).

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where $z(\omega) = \omega + \mu - \Sigma(\omega)$.

Giving up the strict connection to a (somewhat unphysical) model, one may break the particle-hole symmetry and concentrate spectral weight near one of the band edges by introducing an asymmetry parameter a (Wahle, Blümer, Schlipf, Held, and Vollhardt, 1998)

$$\rho^{\mathrm{a}}(\epsilon) = \frac{1+\sqrt{1-a^2}}{2\pi}\,\frac{\sqrt{1-(\epsilon/2)^2}}{1+a\epsilon/2}\,. \tag{2.27}$$

Here, $-1 \leq a \leq 1$; $a = 0$ corresponds to the semi-elliptic DOS. As apparent in Fig. 2.13, the asymmetry develops into a square-root divergence at one of the band edges for $|a| \to 1$. The particular advantage of (2.27) is that the analytic solution and inversion of the corresponding lattice Dyson equation is still possible.

2.2.2 Renormalized Perturbation Expansion

We will now derive very general relationships between weights of self-avoiding loops in lattices and moments of the corresponding DOS. Interesting general consequences for lattices with semi-elliptic DOS will follow in subsection 2.2.2.

We assume a finite total bandwidth, i.e., that all energy levels are in the range $[\epsilon_a, \epsilon_b]$. Even when the assumption is not always fulfilled for $Z = \infty$ it can be relaxed in the relevant cases by defining a suitable limiting process for $Z \to \infty$.[16] We use the spectral representation of the noninteracting Green function to write for

[16] One exception is the fully connected model, for which $\langle e \rangle \neq 0$ (van Dongen and Vollhardt, 1989); here no limiting form of the DOS exists for $Z \to \infty$ (and all moments $\langle \epsilon^i \rangle$ for $i > 1$ are infinite).