

Sphere packing in the Hamming space: Cavity approach

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We use the cavity method in replica symmetric (RS) and one-step replica symmetry breaking (1RSB) frameworks to study the hard sphere packing problem in the Hamming space. Both the approximations give a maximum rate of packing that is asymptotically the same as the lower bound of Gilbert and Varshamov. We use a message passing algorithm based on the cavity equations in the RS approximation to find dense packings of hard spheres in small dimensions. Replica symmetric equations also suggest a crystalline solution, where for even diameters the spheres are more likely to be found in the even subspace of the Hamming space. These crystalline packings can be generated by an iterative algorithm devised to find maximum packings in an ultrametric space.