1154-68-786 **Sarah Cannon*** (scannon@cmc.edu) and **Will Perkins** (math@willperkins.org). *Counting independent sets in unbalanced bipartite graphs.*

We study the hard-core model (independent sets) on bipartite graphs using the cluster expansion from statistical physics. When there is a sufficient imbalance in the degrees or fugacities between the sides (L, R) of the bipartition, we can rewrite the hard-core partition function in terms of deviations from independent sets that are empty on one side of the bipartition and show this expression has a convergent cluster expansion. This has interesting algorithmic and probabilistic consequences. On the algorithmic side, we address an open problem in approximate counting and give a polynomial-time algorithm for approximating the partition function for a large class of bounded degree bipartite graphs; this includes, among others, the unweighted biregular case where the degrees satisfy $d_R \geq 7d_L \log d_L$. Our approximation algorithm is based on truncating the cluster expansion. On the probabilistic side, we also prove that the hard-core model on such graphs exhibits exponential decay of correlations by utilizing connections between the cluster expansion and joint cumulants. (Received September 10, 2019)