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Hypergraph Hajnal-Szemerédi

A seminal result of Hajnal and Szemerédi from 1970 asserts that every graph on n vertices with $q \mid n$ and minimum degree at least $\left(1-\frac{1}{q}\right)n$ admits a K_q-factor (a collection of vertex-disjoint copies of K_q spanning all vertices). There has been sustained interest in extending this result to hypergraph K_q^r-factors. For general q and r, Lu and Székely in 2007 showed that every large enough, r-graph G with $q \mid v(G)$ and $\delta_{r-1}(G) \geq \left(1-\frac{c}{q^{r-1}}\right)v(G)$ admits a K_q^r-factor (where c is a constant depending on r but not q), and there have been various subsequent improvements to the constant (but not the order) of this bound over the ensuing decades. Meanwhile, results from codegree Turán theory show that $\delta_{r-1}(G) \geq \left(1-\frac{c\cdot\log q}{q^{r-1}}\right)v(G)$ is necessary. Surprisingly, our main result shows that the order of this upper bound is not correct and, in fact, the codegree K_q^r-factor threshold is much closer to this codegree Turán theory bound. In particular, we show that $\delta_{r-1}(G) \geq \left(1-c\cdot\frac{\log^{1-1/(r-1)} q}{q^{r-1}}\right)v(G)$ suffices for the existence of a K_q^r-factor. Joint work with Michelle Delcourt, Thomas Lesgourgues, and Luke Postle.