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Pair Covering Designs with Block Size 6

A t-(v,k,λ) *covering design*, denoted $(\mathcal{V},\mathcal{B})$, where $v=|\mathcal{V}|$, is a finite family $\mathcal{B}$ of k-subsets of $\mathcal{V}$, called *blocks*, such that each t-subset of $\mathcal{V}$ occurs in at least λ blocks. The *covering number* $C_\lambda(v,k,t)$ is $\min|\mathcal{B}|$, where the minimum is taken over all t-(v,k,λ) covering designs. My talk is based on a recent joint work (with Abel, Greig and de Heer) on the covering number $C_1(v,6,2)$. This number meets the Schönheim bound:

$$C_1(v,k,2)\geq\left\lceil\frac{v}{k}\left\lceil\frac{v-1}{k-1}\right\rceil\right\rceil.$$

We show that $C_1(v,6,2)$ attains the Schönheim bound for all $v\equiv 2 \pmod 5$. I will discuss direct combinatorial constructions and computer assisted searches related to this result.