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2-Partially Intersecting Partitions

An ℓ-partition of a set of size $n = k\ell$ can be expressed as a set of ℓ disjoint sets, $P = \{P_1, P_2, \ldots, P_\ell\}$. Further, an ℓ-partition is uniform if $|P_i| = k$ for all $i = 1, \ldots, \ell$. Two uniform ℓ-partitions $P = \{P_1, P_2, \ldots, P_\ell\}$ and $Q = \{Q_1, Q_2, \ldots, Q_\ell\}$ are said to be 2-partially intersecting if there exist an i and j such that $|P_i \cap Q_j| \geq 2$. There are many different notions of intersection for partitions, and this particular type of intersection is connected to several different problems in design theory. In this talk I will show how an algebraic approach can be used to determine the size of the largest collection of uniform ℓ-partitions of a $k\ell$-set in which any two partitions are 2-partially intersecting.