Cameron-Liebler type sets of k-spaces

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A Cameron-Liebler line class in $\mathrm{PG}(n,q)$ can be defined as a set $\mathcal{L}$ of lines whose characteristic vector lies in $\mathrm{row}(A)$, where A is the point-line incidence matrix of $\mathrm{PG}(n,q)$. These objects are connected to collineation groups of $\mathrm{PG}(n,q)$ having the same number of orbits on points and lines, as well as to symmetric tactical decompositions of the point-line design $\mathrm{PG}(n,q)$. When n is odd, an equivalent characterization is that $\mathcal{L}$ shares a constant number of lines with every line-spread of the projective space. The main focus on Cameron-Liebler line classes has been in $\mathrm{PG}(3,q)$, where line spreads are particularly important due to their relation with translation planes.

In this talk we will look at a generalization of Cameron-Liebler line classes to sets of k-spaces, focusing on results in $\mathrm{PG}(2k+1,q)$. Here we obtain a connection to k-spreads which parallels the situation for line classes in $\mathrm{PG}(3,q)$. After looking at various characterizations of these sets and explaining some of the difficulties that arise in contrast to the known results for line classes, we will give some connections to various other geometric objects including k-covers and Erdős-Ko-Rado sets, and prove some preliminary results concerning the existence of these objects.