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Using finite field cyclotomy to identify constructions of disjoint and external partial difference families

A disjoint (respectively, external) partial difference family, $S = \{D_1, \ldots, D_m\}$, is a collection of subsets of a group G such that each element $g \in \mathrm{G}\backslash\{0\}$ occurs λ times as a pairwise difference between elements of the same (respectively, distinct) subsets if $g \in \cup_{i=1}^{m} D_i$ and μ times if $g \notin \cup_{i=1}^{m} D_i$. In this talk, I will motivate the study of these objects and will also explore cyclotomic constructions of these structures.

Finite field cyclotomy concerns the study of cyclotomic classes and cyclotomic numbers in finite fields. Cyclotomic classes may be regarded as cosets of multiplicative subgroups of the non-zero elements of a finite field, while cyclotomic numbers provide information about the additive interactions between these multiplicative cosets.

As well as exploring cyclotomic constructions of disjoint and external partial difference families, I will present my contributions toward the explicit evaluation of cyclotomic numbers. I will also discuss future directions for developing new techniques to extend what is known about the evaluation of cyclotomic numbers in finite fields, with a view to using these techniques to identify new constructions of partial difference families.