Packings of Partial Difference Sets

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As the underlying configuration behind many elegant finite structures, partial difference sets have been intensively studied in design theory, finite geometry, coding theory, and graph theory. Over the past three decades, there have been numerous constructions of partial difference sets in abelian groups with high exponent, accompanied by numerous very different and delicate techniques. Surprisingly, we manage to unify and extend a great many previous constructions in a common framework, using only elementary methods. The key insight is that, instead of focusing on one single partial difference set, we consider a packing of partial difference sets, namely, a collection of disjoint partial difference sets in a finite abelian group. Although the packing of partial difference sets has been implicitly studied in various contexts, we recognize that a particular subgroup reveals crucial structural information about the packing. Identifying this subgroup allows us to formulate a recursive lifting construction of packings in abelian groups of increasing exponent.

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