

# A Vector Space Analogue of Kneser's Theorem and Its Applications

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**Abstract:** Let  $G$  be an abelian group (written additively), and let  $A$  and  $B$  be finite, nonempty subsets of  $G$ . Define

$$A + B := \{a + b \mid a \in A, b \in B\},$$

and

$$H(A + B) := \{g \in G \mid g + (A + B) = A + B\}.$$

M. Kneser in 1953 proved that

$$|A + B| \geq |A| + |B| - |H(A + B)|.$$

Kneser's theorem has many applications in additive number theory and combinatorics.

Motivated by a problem in constructions of strongly regular graphs (SRG) with a regular automorphism group using Galois rings, we prove a vector space analogue of Kneser's theorem. This vector space analogue (so far) has two applications. First, it helped us solve our motivating problem in the construction of SRGs. Second, it implies Kneser's original theorem, and our proof of this vector space analogue provides a new proof of Kneser's theorem. This is a joint work with X. D. Hou (Wright State University) and K. H. Leung (National University of Singapore).