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Projective Representation of Non-Representable Matroids (of Biased Graphs)

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To each quasigroup Q there is a complete graph K_3 with multiple edges corresponding to the elements of Q , with a class \mathbf{B} of selected triangles such that every two non-parallel edges belong to exactly one selected triangle. This is called a “biased expansion” of K_3 , written $Q \cdot K_3$. There are two associated rank-3 matroids, the “full frame matroid” $G(Q \cdot K_3)$ and “extended lift matroid” $L_0(Q \cdot K_3)$.

When Q is a subgroup of the multiplicative or additive group of a skew field F , the full frame or extended lift matroid (respectively) is representable in the projective plane over F . Thomas Zaslavsky and I are generalizing this standard theorem to arbitrary quasigroups, the role of F being taken by a planar ternary ring associated with a projective plane. There are complications; for instance, although the skew field associated with a Desarguesian plane is unique, there is not a unique planar ternary ring for a non-Desarguesian plane.

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