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

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#### Abstract for the Combinatorics Seminar 2011 May 23

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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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