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A matroid-friendly basis for quasisymmetric functions.

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Matroid base polytope decompositions arise in the work of certain algebraic geometers. In 2006, Billera, Jia, and Reiner invented a new invariant $F(M)$ for matroids in the form of a quasisymmetric function. One motivating application of this invariant is to the study of matroid base polytope decompositions. The mapping of matroids to the algebra of quasisymmetric functions (QSym) behaves as a valuation on matroid base polytopes, and leads to a necessary algebraic condition on their decompositions. Billera, Jia, and Reiner pose a number of questions regarding this relationship. We address some of these questions, obtaining a full characterization for the rank two case.

Along the way, we obtain a novel Z -basis for QSym that has especially nice properties. For instance this basis has nonnegative integer structure constants and reflects, in addition to the usual grading of QSym by degree, a second grading of QSym that on (the images of) loopless matroids coincides with their matroidal rank.

No familiarity with quasisymmetric functions or matroids is assumed for this talk.

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