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Powersum Bases in Quasisymmetric Functions and Quasisymmetric Functions in Non-commuting Variables

We introduce a new P basis for the Hopf algebra of quasisymmetric functions that refine the symmetric powersum basis. Unlike the quasisymmetric power sums of types 1 and 2, our basis is defined combinatorially: its expansion in quasisymmetric monomial functions is given by fillings of matrices. This basis has a shuffle product, a deconcatenate coproduct, and has a change of basis rule to the quasisymmetric fundamental basis by using tuples of ribbons. We lift our quasisymmetric powersum P basis to the Hopf algebra of quasisymmetric functions in non-commuting variables by introducing fillings with disjoint sets. This new basis has a shifted shuffle product and a standard deconcatenate coproduct, and certain basis elements agree with the fundamental basis of the Malvenuto-Reutenauer Hopf algebra of permutations.