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Poincaré Polynomials of Combinatorially Smooth Toric Varieties

Let M be a \mathcal{J} -irreducible monoid associated with a integral polytope P over an algebraically closed field K . Let T be its maximal torus. Then $\overline{T} \setminus \{0\}/K^*$ can be identified as the toric variety X_P constructed from the polytope P . The toric variety X_P is called combinatorially smooth if the polytope P is simple. In this talk, we describe a very powerful theorem by Renner to determine when the toric variety X_P is combinatorially smooth. Then we try to find the Poincaré polynomials of such toric varieties (or equivalently f -vectors or h -vectors of the polytopes, or Hilbert series of the face rings of the polytopes). It turns out that the Renner monoids hold all the information to calculate the Poincaré polynomials.