Abstract

Minimal graded free resolutions are an important and central topic in algebra. They are a useful tool for studying modules over finitely generated graded K-algebras. Such a resolution determines the Hilbert series, the Castelnuovo-Mumford regularity and other invariants of the module.

This thesis is concerned with the structure of minimal graded free resolutions. We relate our results to several recent trends in commutative algebra.

The first of these trends deals with relations between properties of the Stanley-Reisner ring associated to a simplicial complex and the Stanley-Reisner ring of its Alexander dual.

Another development is the investigation of the linear part of a minimal graded free resolution as defined by Eisenbud and Schreyer.

Several authors were interested in the problem to give lower bounds for the Betti numbers of a module. In particular, Eisenbud-Koh, Green, Herzog and Reiner-Welker studied the graded Betti numbers which determine the linear strand of a minimal graded free resolution.

Bigraded algebras occur naturally in many research areas of commutative algebra. A typical example of a bigraded algebra is the Rees ring of a graded ideal. Herzog and Trung used this bigraded structure of the Rees ring to study the Castelnuovo-Mumford regularity of powers of graded ideals in a polynomial ring. Conca, Herzog, Trung and Valla dealt with diagonal subalgebras of bigraded algebras. Aramova, Crona and De Negri studied homological properties of bigraded K-algebras.

Keywords

Minimal graded free resolution, Alexander duality, Betti number, bigraded algebra, Koszul cycle.