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*Buchsbaum-Rim multiplicity and Hilbert-Samuel multiplicities.*

Let  $R$  be a regular local ring of dimension 2 with maximal ideal  $\mathfrak{m}$ . We study the Buchsbaum-Rim multiplicity  $e_{BR}(M)$  of a finitely generated module  $M$  of finite colength in a free module  $F$ .

Let  $\mathfrak{a}$  be an  $\mathfrak{m}$ -primary ideal in  $R$ . We first investigate the colength  $\ell(R/\mathfrak{a})$  of  $\mathfrak{a}$  and its Hilbert-Samuel multiplicity  $e(\mathfrak{a})$  using linkage theory. As applications, we establish several multiplicity formulas that express  $e_{BR}(M)$  in terms of the Hilbert multiplicities of ideals related to an arbitrary minimal reduction  $U$  of  $M$ . In the special case where the maximal Fitting ideal of  $F/U$  is integrally closed,  $e_{BR}(M)$  is directly related to all Fitting ideals of  $F/U$ .

There exists  $\mathfrak{m}$ -primary Bourbaki ideals  $I$  and  $J$  of the modules  $F$  and  $M$  respectively such that  $F/M \cong I/J$ . We also have a formula for  $e_{BR}(M)$  in terms of  $e(I)$  and  $e(J)$ . This is related to a graphical interpretation of the multiplicities in the case of monomial ideals. (Received February 14, 2006)