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## Local Criteria and Dimensions of $u$ -S-flat Modules

### Communication Info

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### Abstract

This work investigates the homological behavior of modules relative to a multiplicative subset of a commutative ring  $R$ . Building on the theory of uniformly  $S$ -torsion and uniformly  $S$ -flat modules introduced by Zhang, we develop new local criteria and structural characterizations for  $u$ - $S$ -flat modules. We first establish practical local conditions showing that  $u$ - $S$ -flatness can be verified via localization at finitely many elements whose generated ideal intersects  $S$ . We then provide characterizations in terms of finitely generated ideals and prime ideals disjoint from  $S$ , yielding a prime ideal criterion that parallels classical flatness theory.

These results show that the uniform  $S$ -flat framework preserves many features of classical homological algebra while capturing refined local–global phenomena governed by the multiplicative set  $S$ .

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