

## **Bounding the Castelnuovo-Mumford regularity**

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The Castelnuovo-Mumford regularity measures the complexity of a given graded module (or sheaf), and is studied by both commutative algebraists and algebraic geometers. In the most general setting, regularity behaves wildly. For this reason, the focus shifted to specific families, where better bounds were obtained. We will mainly look at square-free monomial ideals with Green-Lazarsfeld property  $N_p$  (i.e. quadratic ideals with  $p - 1$  linear steps in the minimal graded free resolution). We show that, if such ideals are Gorenstein, then their regularity is at most 4. Under some mild assumptions we find a doubly logarithmic bound in terms of the number of variables. Most importantly, for every  $r$  and  $p$  we construct a monomial ideal with  $N_p$  and regularity  $r$ . Previously, the highest known example had  $p = 2$  and  $r = 5$ . To this aim we introduce a surprising connection with hyperbolic Coxeter groups.