

# General talk: Simple modules and tilting modules for reductive algebraic groups.

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Let  $G$  denote a reductive algebraic group over a field  $k$  of characteristic  $p > 0$ . For instance,  $G$  could be the general linear group  $G = GL(V)$  where  $V$  is a finite dimensional vector space. Over many decades the question of how to find characters of the simple modules for  $G$  has been one of the main open problems in modular representation theory. In 1979 G. Lusztig proposed a conjecture which gave an algorithm involving the Kazhdan-Lusztig polynomials for affine Weyl groups for how they could be determined. This conjecture was proved to hold for very large  $p$  in 1994 but in 2013 counterexamples were found for large families of smaller  $p$ . In this talk I will survey some of the highlights in the work (due to many authors) on this problem ending up with describing the breakthroughs during the last two years containing a complete solution for  $G = GL(V)$  and "almost complete" solutions for all other  $G$ . This developments involve tilting modules, Hecke categories, diagrammatics and  $p$ -canonical bases.