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Exploring the cohomology ring of generalized Springer varieties.

The Springer variety is the set of flags stabilized by a nilpotent operator. Its cohomology ring is a long-studied object. In 1976, Springer introduced a famed symmetric group action on this ring, and he offered a deep geometric construction. Fourteen years later, Garsia, Procesi, Tanisaki, and others succeeded in giving a more tangible combinatorial description of this ring. We begin to generalize their results and extend it to a family of varieties called Hessenbergs, a two-parameter generalization of Springer varieties. Little is known about their cohomology. For the class of regular nilpotent Hessenbergs, we conjecture a quotient presentation for this ring and exhibit an explicit basis. Tantalizing new evidence supports our conjecture for a subclass of regular nilpotent varieties called Peterson varieties. (Received February 14, 2010)