

1073-14-130

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Patch ideals encode neighbourhoods of a variety in GL_n/B . For Peterson varieties we determine generators for these ideals and show they are complete intersections, and thus Cohen-Macaulay and Gorenstein. Consequently, we

- combinatorially describe the singular locus of the Peterson variety;
- give an explicit equivariant K -theory localization formula; and
- extend some results of [B. Kostant '96] and of D. Peterson to intersections of Peterson varieties with Schubert varieties.

We conjecture that the tangent cones are Cohen-Macaulay, and that their h -polynomials are nonnegative and upper-semicontinuous. (Received July 30, 2011)