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Characters of the Nullcone Related to Vinberg Groups

Let G be a reductive linear algebraic group defined over an algebraically closed field k of characteristic 0, and let θ be an automorphism of G of order m. We consider the Vinberg pair $(G_0, \mathfrak{g}_1)$, where G_0 is the identity component of the subgroup G^θ of θ-fixed points in G and $\mathfrak{g}_1$ is the ω-eigenspace of $\mathrm{d}\theta$ in $\mathfrak{g} = \mathrm{Lie}(G)$, where ω is a primitive mth root of 1 in k. In particular, we derive a formula for the formal characters of the G_0-modules $k_n[\mathcal{N}]$, where $\mathcal{N}$ is the variety of nilpotent elements in $\mathfrak{g}_1$ and $k_n[\mathcal{N}]$ is the space of polynomials on $\mathcal{N}$ of homogeneous degree n. We use this formula to compute the multiplicities of the simple highest weight modules in $k_n[\mathcal{N}]$. This multiplicity formula is also shown to hold for all n up to a certain maximum when k has positive characteristic.

Keywords: Reductive groups, Vinberg pairs, nullcone, formal characters, good characteristic.

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