

The Category $\mathcal{O}$ for Lie algebras of vector fields (II): Lie-Cartan modules and cohomology

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We study Lie-Cartan modules and their categorical and cohomology properties. The category $\mathcal{LC}$ is abelian, and a “highest weight category” with depths. What is surprising, the set of co-standard objects in the category $\mathcal{O}$ turns out to represent the isomorphism classes of simple objects of $\mathcal{LC}$. We then establish the cohomology for this category (called the “ $\mathcal{LC}$ cohomology”), extending Chevalley-Eilenberg cohomology theory. Another surprising result says that in the fundamental case $\mathfrak{g} = W(n)$ the extension ring $Ext_{u_{\mathcal{LC}}}^{\bullet}(\mathcal{R})$ for the polynomial algebra $\mathcal{R}$ in the “ $\mathcal{LC}$ -cohomology is isomorphic to the usual cohomology ring $H^*(\mathfrak{gl}(n))$ of the general linear Lie algebra $\mathfrak{gl}(n)$. This is a joint work with Bin Shu, Yufeng Yao and Priyanshu Chakraborty.

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