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Casimir operators and virtual copy method for generalized conformal pseudo-Galilean algebras

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Casimir operators have been used in various algebraic methods in physics and appear in context of dynamical symmetries, exactly solvable models and superintegrable systems. Various approaches have been developed for the case of non-semisimple Lie algebras and among them the virtual copy approach used by Quesne in 1988 in context of $wu(n)$ Lie algebras and developed further by Campoamor-Stursberg and Low in 2006. We will present recent work in which we develop the approach in regard of other non-semisimple Lie algebras. Conformal Galilei groups and their Lie algebras are a class of nonrelativistic algebra with applications in classical and quantum mechanics. A particular case, the (centrally extended) Schrödinger algebra $\widehat{\mathscr{S}}(n)$ corresponds to the maximal invariance group of the free Schrödinger equation. The study of this Lie algebras was also motivated by different applications such as the kinematical invariance of hierarchies of partial differential equations and representation theory. We present a generalization introduced recently $\mathfrak{Gal}_\ell(p,q)$ of the conformal Galilei algebra $\mathfrak{g}_\ell(d)$ with Levi subalgebra isomorphic to $\mathfrak{sl}(2,\mathbb{R})\oplus\mathfrak{so}(p,q)$ is introduced and a virtual copy of the latter in the enveloping algebra of the extension is constructed. Explicit expressions for the Casimir operators are obtained from the determinant of polynomial matrices. For the central factor $\overline{\mathfrak{Gal}}_\ell(p,q)$ we also present discussion of the Casimir operators.

[1] Rutwig Campoamor-Stursberg and Ian Marquette, Generalized conformal pseudo-Galilean algebras and their Casimir operators, arXiv:1904.10101

This is joint work with joint work with Rutwig Campoamor-Stursberg.

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