# Abstract

**Project Code:** MRG6180032
**Project Title:** On generalized Heisenberg groups and their modules with Lie bracket
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**Project Period:** 2 May 2018–1 May 2020

**Abstract:** A classical Heisenberg group is defined to be a group of matrices or, more abstractly, can be constructed from a symplectic vector space. Via an algebraic approach, we construct a generalized Heisenberg group from an $R$-module $M$, endowed with an $R$-bilinear form $\beta$, where $R$ is a ring with identity. The resulting group is nilpotent of class two and corresponds to a module with Lie bracket. We then investigate the structure of the generalized Heisenberg group and its automorphism group. In particular, we show that the generalized Heisenberg group generated by $(M, \beta)$ decomposes into a semidirect product and admits decomposition similar to polar decomposition in linear algebra if $\beta$ is symmetric or skew-symmetric. The latter case leads to another realization of the generalized Heisenberg group.

**Keywords:** Heisenberg group, decomposition of group, involutive automorphism, Lie bracket, module