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On the Classification of 2-Solvable Frobenius Lie Algebras

We prove that every 2-solvable Frobenius Lie algebra splits as a semidirect sum of an n -dimensional vector space V and an n -dimensional maximal Abelian subalgebra (MASA) of the full space of endomorphisms of V . We supply a complete classification of 2-solvable Frobenius Lie algebras corresponding to nonderogatory endomorphisms, as well as those given by maximal Abelian nilpotent subalgebras (MANS) of class 2, hence of Kravchuk signature $(n-1, 0, 1)$. In low dimensions, we classify all 2-solvable Frobenius Lie algebras in general up to dimension 8. We correct and complete the classification list of MASAs of $\mathfrak{sl}(4, \mathbb{R})$ by Winternitz and Zassenhaus. As a biproduct, we give a simple proof that every nonderogatory endomorphism of a real vector space admits a Jordan form and also provide a new characterization of Cartan subalgebras of $\mathfrak{sl}(n, \mathbb{R})$.

Keywords: Frobenius Lie algebra, 2-step solvable exact symplectic Lie algebra, symplectic Lie group, maximal Abelian subalgebra, nonderogatory endomorphism, cyclic matrix, companion matrix, Kravchuk signature, Cartan subalgebra, Jordan form.

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