

## Generalized Toda Mechanics Associated with Classical Lie Algebras and Their Reductions

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Abstract: For any classical Lie algebra  $\mathfrak{g}$ , we construct a family of integrable generalizations of Toda mechanics labeled a pair of ordered integers  $(m, n)$ . The universal form of the Lax pair, equations of motion, Hamiltonian as well as Poisson brackets are provided, and explicit examples for  $\mathfrak{g} = \mathfrak{B}_r, \mathfrak{C}_r, \mathfrak{D}_r$  with  $m, n \leq 3$  are also given. For all  $m, n$ , it is shown that the dynamics of the  $(m, n-1)$ - and the  $(m-1, n)$ -Toda chains are natural reductions of that of the  $(m, n)$ -chain, and for  $m=n$ , there is also a family of symmetrically reduced Toda systems, the  $(m, m)$ - $\mathrm{Sym}$ -Toda systems, which are also integrable. In the quantum case, all  $(m, n)$ -Toda systems with  $m > 1$  or  $n > 1$  describe the dynamics of standard Toda variables coupled to noncommutative variables. Except for the symmetrically reduced cases, the integrability for all  $(m, n)$ -Toda systems survive after quantization.

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Key words: Lax pair, Poisson brackets, Toda chains

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