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Article / Book Information

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種別(和文)	論文要旨
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論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	物理学 系 物理学 コース	申請学位（専攻分野）： Academic Degree Requested	博士 (理学) Doctor of
学生氏名： Student's Name	ZHU MINGSHUO	審査員主査： Chief Examiner	伊藤 克司

要旨（英文 300 語程度）
Thesis Summary（approx.300 English Words ）

Integrable models represent a class of mathematical and physical systems characterized by their exact solvability due to a large number of conserved quantities, known as integrals of motion (IoMs). These models can be precisely analyzed using the Quantum Inverse Scattering Method (QISM), with the Yang-Baxter equation governing the R-matrix forming the foundation of this approach. Integrable models play a pivotal role in quantum mechanics, statistical physics, and quantum field theory, offering profound insights into the dynamics of strongly interacting quantum systems. In particular, integrability in quantum field theory enables exact solutions for energy spectra and scattering data, providing essential tools for understanding these systems. The Sine-Gordon model and its generalization, the Toda field theories, are key examples of such models and form the central focus of this thesis.

This research investigates quantum integrable models through a classical lens, leveraging the ODE/IM correspondence. Initially discovered as a connection between the spectral analysis of ordinary differential equations (ODEs) and the functional relations of integrable models, this correspondence has since been extended to continuous systems. In field theory, the most notable instance is the relationship between the Schrodinger equation on the complex plane and the Sine-Gordon model. Further developments revealed that the Schrodinger equation arises naturally from the classical Sine-Gordon equation, and this framework has been generalized to affine Toda field theories with broader Lie algebraic structures. The correspondence is established through $¥psi$-systems and Bethe ansatz equations, with solutions to the linear problem of the Sine-Gordon equation shown to be proportional to the IoMs of quantum Liouville theory in its ground state.

Building on this foundation, the thesis presents two main research projects. First, we establish a connection between the classical Toda field equations and certain (pseudo) ordinary differential equations. Second, we explore the correspondence between the IoMs of quantum Toda field theories and the WKB integrals derived from the aforementioned ODEs. By synthesizing these findings, we extend the known ODE/IM correspondence into a broader framework, unifying classical and quantum correspondences for Toda field theories and KdV hierarchies.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).