

The algebraic-geometric AKNS potentials

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Abstract. We characterize the algebraic-geometric potentials for the Schrödinger and AKNS operators using the Weyl m -functions and the Floquet exponent for these operators. The characterization is this: among random ergodic Schrödinger operators, the algebraic-geometric potentials are those for which (i) the spectrum is a union of finitely many intervals (or bands); (ii) the Lyapunov exponent vanishes on the spectrum.

1. Introduction

Our goal in this paper is to give a simple and rather surprising characterization of the finite-band potentials for the Schrödinger and AKNS (after Ablowitz, Kaup, Newell, and Segur [2], see also [35]) operators. Our characterization is based on properties of the Weyl m -functions m_\pm of these operators, together with certain ideas from the theory of algebraic curves and from ergodic theory and dynamical systems.

Although we are primarily interested in the AKNS operator, we begin the discussion by considering the one-dimensional Schrödinger equation

$$L\phi = \left(-\frac{d^2}{dx^2} + y(x) \right) \phi = \lambda\phi$$

with a real bounded measurable potential $y(x)$. In recent years, L has been intensively studied from two points of view. The first is algebraic-geometric; one considers certain quasi-periodic potentials $y(x)$ for which L has finite-band spectrum. Such a potential y can be calculated by evaluating a meromorphic function (abelian function), defined on the Jacobi variety $J(C)$ of a certain hyperelliptic curve C , along a rectilinear winding in $J(C)$ [8], [23], [26]. Thus $y(x)$ can be expressed in terms of the θ -function of C .

The second point of view is ergodic-theoretic. One begins with a family $\mathcal{V} = \{y\}$ of potentials which form a stationary ergodic process with ergodic measure ν (see §3 for our definitions of these terms). One introduces a Floquet exponent $\omega(\lambda) = \theta(\lambda) + i\alpha(\lambda)$ [20], [14], where $\theta(\lambda)$ is the Lyapunov exponent and $\alpha(\lambda)$ the rotation number-integrated density of states [20], [3]. We delay definitions to §3, and note only that $\theta(\lambda)$ determines the exponential growth rate of vectors $\begin{pmatrix} \phi(x) \\ \phi'(x) \end{pmatrix}$, where $L\phi = \lambda\phi$.

Neumann Systems For The Algebraic Akns Problem

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Neumann Systems For The Algebraic AKNS Problem:

Neumann Systems for the Algebraic AKNS Problem Randolph James Schilling, 1992 This work is concerned with an algebraically completely integrable Hamiltonian system whose solutions may be used to describe the finite gap solutions of the AKNS spectral problem a first order two by two matrix linear system Trace formulas constraints Lax pairs and constants of motion are obtained using Krichever's algebraic inverse spectral transform Computations are carried out explicitly over the class of spectral problems with square matrix coefficients

Enright-Shelton Theory and Vogan's Problem for Generalized Principal Series Brian D. Boe, David H. Collingwood, 1993 This book investigates the composition series of generalized principal series representations induced from a maximal cuspidal parabolic subgroup of a real reductive Lie group Boe and Collingwood study when such representations are multiplicity free Vogan's Problem 3 and the problem of describing their composition factors in closed form The results obtained are strikingly similar to those of Enright and Shelton for highest weight modules Connections with two different flag variety decompositions are discussed

The Problem of Integrable Discretization Yuri B. Suris, 2012-12-06 An exploration of the theory of discrete integrable systems with an emphasis on the following general problem how to discretize one or several of independent variables in a given integrable system of differential equations maintaining the integrability property This question related in spirit to such a modern branch of numerical analysis as geometric integration is treated in the book as an immanent part of the theory of integrable systems also commonly termed as the theory of solitons Most of the results are only available from recent journal publications many of them are new Thus the book is a kind of encyclopedia on discrete integrable systems It unifies the features of a research monograph and a handbook It is supplied with an extensive bibliography and detailed bibliographic remarks at the end of each chapter Largely self contained it will be accessible to graduate and post graduate students as well as to researchers in the area of integrable dynamical systems

Algebraic Integrability of Nonlinear Dynamical Systems on Manifolds A.K. Prykarpatsky, I.V. Mykytiuk, 2013-04-09 In recent times it has been stated that many dynamical systems of classical mathematical physics and mechanics are endowed with symplectic structures given in the majority of cases by Poisson brackets Very often such Poisson structures on corresponding manifolds are canonical which gives rise to the possibility of producing their hidden group theoretical essence for many completely integrable dynamical systems It is a well understood fact that great part of comprehensive integrability theories of nonlinear dynamical systems on manifolds is based on Lie algebraic ideas by means of which in particular the classification of such compatibly bi Hamiltonian and isospectrally Lax type integrable systems has been carried out Many chapters of this book are devoted to their description but to our regret so far the work has not been completed Hereby our main goal in each analysed case consists in separating the basic algebraic essence responsible for the complete integrability and which is at the same time in some sense universal i.e. characteristic for all of them Integrability analysis in the framework of a gradient holonomic algorithm devised in this book is fulfilled through

three stages 1 finding a symplectic structure Poisson bracket transforming an original dynamical system into a Hamiltonian form 2 finding first integrals action variables or conservation laws 3 defining an additional set of variables and some functional operator quantities with completely controlled evolutions for instance as Lax type representation **Associated Graded Algebra of a Gorenstein Artin Algebra** Anthony Ayers Iarrobino,1994 In 1904 Macaulay described the Hilbert function of the intersection of two plane curve branches It is the sum of a sequence of functions of simple form This monograph describes the structure of the tangent cone of the intersection underlying this symmetry Iarrobino generalizes Macaulay's result beyond complete intersections in two variables to Gorenstein Artin algebras in an arbitrary number of variables He shows that the tangent cone of a Gorenstein singularity contains a sequence of ideals whose successive quotients are reflexive modules Applications are given to determining the multiplicity and orders of generators of Gorenstein ideals and to problems of deforming singular mapping germs Also included are a survey of results concerning the Hilbert function of Gorenstein Artin algebras and an extensive bibliography Weakly Nonlinear Dirichlet Problems on Long Or Thin Domains Edward Norman Dancer,1993 Soliton Equations and their Algebro-Geometric Solutions: Volume 1, (1+1)-Dimensional Continuous Models Fritz Gesztesy, Helge Holden,2003-06-05 The focus of this book is on algebro geometric solutions of completely integrable nonlinear partial differential equations in 1+1 dimensions also known as soliton equations Explicitly treated integrable models include the KdV AKNS sine Gordon and Camassa Holm hierarchies as well as the classical massive Thirring system An extensive treatment of the class of algebro geometric solutions in the stationary as well as time dependent contexts is provided The formalism presented includes trace formulas Dubrovin type initial value problems Baker Akhiezer functions and theta function representations of all relevant quantities involved The book uses techniques from the theory of differential equations spectral analysis and elements of algebraic geometry most notably the theory of compact Riemann surfaces The presentation is rigorous detailed and self contained with ample background material provided in various appendices Detailed notes for each chapter together with an exhaustive bibliography enhance the presentation offered in the main text **Notices of the American Mathematical Society** American Mathematical Society,1992 *Mathematical Reviews* ,2003 **Forthcoming Books** Rose Arny,1992 **The Cumulative Book Index** ,1992 A world list of books in the English language **Proceedings of the CRM Workshop on Hamiltonian Systems, Transformation Groups and Spectral Transform Methods** Université de Montréal. Centre de recherches mathématiques,1990 **American Book Publishing Record** ,1992 Books in Print ,1991 **International mathematical news** ,1993 *Reviews in Partial Differential Equations, 1980-86, as Printed in Mathematical Reviews* ,1988 □□□□ ,2007 **Government Reports Announcements & Index** ,1993 **Whitaker's Books in Print** ,1998 *Non-linear Integrable Systems--classical Theory and Quantum Theory* Mikio Satō,1983

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