

RECONSTRUCTION OF THE TRANSMISSION COEFFICIENT FOR STEPLIKE FINITE-GAP BACKGROUNDS

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Abstract. We consider scattering theory for one-dimensional Jacobi operators with respect to steplike quasi-periodic finite-gap backgrounds and show how the transmission coefficient can be reconstructed from minimal scattering data. This generalizes the Poisson–Jensen formula for the classical constant background case.

Mathematics subject classification (2000): Primary 30E20, 30F30; Secondary 34L25, 47B36.

Keywords and phrases: Jacobi operators, scattering theory, periodic, Abelian integrals.

REFERENCES

- [1] N. I. AKHIEZER, *Elements of the Theory of Elliptic Functions*, Amer. Math. Soc., Providence, 1990.
- [2] A. BOUTET DE MONVEL, I. EGOROVA, AND G. TESCHL, *Inverse scattering theory for one-dimensional Schrödinger operators with steplike finite-gap potentials*, J. Analyse Math., **106** 1 (2008), 271–316.
- [3] W. BULLA, F. GESZTESY, H. HOLDEN, AND G. TESCHL, *Algebro-Geometric Quasi-Periodic Finite-Gap Solutions of the Toda and Kac-van Moerbeke Hierarchies*, Mem. Amer. Math. Soc., **135** 641 (1998).
- [4] V.S. BUSLAEV AND V.N. FOMIN, *An inverse scattering problem for the one-dimensional Schrödinger equation on the entire axis*, Vestnik Leningrad. Univ., **17** 1 (1962), 56–64.
- [5] P. DEIFT AND X. ZHOU, *A steepest descent method for oscillatory Riemann–Hilbert problems*, Ann. of Math. (2), **137** (1993), 295–368.
- [6] I. EGOROVA, J. MICHOR, AND G. TESCHL, *Scattering theory for Jacobi operators with quasi-periodic background*, Comm. Math. Phys., **264** 3 (2006), 811–842.
- [7] I. EGOROVA, J. MICHOR, AND G. TESCHL, *Inverse scattering transform for the Toda hierarchy with quasi-periodic background*, Proc. Amer. Math. Soc., **135** (2007), 1817–1827.
- [8] I. EGOROVA, J. MICHOR, AND G. TESCHL, *Scattering theory for Jacobi operators with steplike quasi-periodic background*, Inverse Problems, **23** (2007), 905–918.
- [9] I. EGOROVA, J. MICHOR, AND G. TESCHL, *Soliton solutions of the Toda hierarchy on quasi-periodic background revisited*, Math. Nach. **282** 4, (2009) 526–539.
- [10] I. EGOROVA, J. MICHOR, AND G. TESCHL, *Scattering theory for Jacobi operators with general steplike quasi-periodic background*, Zh. Mat. Fiz. Anal. Geom., **4** 1 (2008), 33–62.
- [11] H. FARKAS AND I. KRA, *Riemann Surfaces*, 2nd edition, GTM 71, Springer, New York, 1992.
- [12] F. GESZTESY, H. HOLDEN, J. MICHOR, AND G. TESCHL, *Soliton Equations and their Algebro-Geometric Solutions. Volume II: (1 + 1)-Dimensional Discrete Models*, Cambridge Studies in Advanced Mathematics, **114**, Cambridge University Press, Cambridge, 2008.
- [13] S. KAMVISSIS, *On the long time behavior of the doubly infinite Toda lattice under initial data decaying at infinity*, Comm. Math. Phys., **153** 3 (1993), 479–519.
- [14] S. KAMVISSIS AND G. TESCHL, *Stability of periodic soliton equations under short range perturbations*, Phys. Lett. A, **364** 6 (2007), 480–483.
- [15] S. KAMVISSIS AND G. TESCHL, *Stability of the periodic Toda lattice under short range perturbations*, arXiv:0705.0346.
- [16] S. KAMVISSIS AND G. TESCHL, *Stability of the periodic Toda lattice: Higher order asymptotics*, arXiv:0805.3847.

- [17] R. KILLIP AND B. SIMON, *Sum rules for Jacobi matrices and their applications to spectral theory*, Ann. of Math.(2), **158** (2003), 253–321.
- [18] H. KRÜGER AND G. TESCHL, *Long-time asymptotics for the Toda lattice in the soliton region*, Math. Z. (to appear).
- [19] H. KRÜGER AND G. TESCHL, *Long-time asymptotics of the Toda lattice for decaying initial data revisited*, Rev. Math. Phys. **21** 1, (2009) 61–109.
- [20] H. KRÜGER AND G. TESCHL, *Long-time asymptotics for the periodic Toda lattice in the soliton region*, arXiv:0807.0244, Math. Z. (to appear), DOI: 10.1007/s00209-008-0391-9
- [21] A. LAPTEV, S. NABOKO, AND O. SAFRONOV, *On new relations between spectral properties of Jacobi matrices and their coefficients*, Comm. Math. Phys., **241** 1 (2003), 91–110.
- [22] J. MICHOR AND G. TESCHL, *Trace formulas for Jacobi operators in connection with scattering theory for quasi-periodic background*, in Operator Theory, Analysis and Mathematical Physics, J. Janas, et al. (eds.), 51–57, Oper. Theory Adv. Appl., 174 Birkhäuser, Basel, 2007.
- [23] F. NAZAROV, F. PEHERSTORFER, A. VOLBERG, AND P. YUDITSKII, *On generalized sum rules for Jacobi matrices*, Int. Math. Res. Not., **2005** 3 (2005), 155–186.
- [24] B. SIMON AND A. ZLATOŠ, *Sum rules and the Szegő condition for orthogonal polynomials on the real line*, Comm. Math. Phys., **242** 3 (2003), 393–423.
- [25] G. TESCHL, *Oscillation theory and renormalized oscillation theory for Jacobi operators*, J. Diff. Eqs., **129** (1996), 532–558.
- [26] G. TESCHL, *Inverse scattering transform for the Toda hierarchy*, Math. Nach., **202** (1999), 163–171.
- [27] G. TESCHL, *Jacobi Operators and Completely Integrable Nonlinear Lattices*, Math. Surv. and Mon., **72**, Amer. Math. Soc., Providence, R.I., 2000.
- [28] G. TESCHL, *Algebro-geometric constraints on solitons with respect to quasi-periodic backgrounds*, Bull. London Math. Soc., **39** 4 (2007), 677–684.
- [29] V. VOICHICK AND L. ZALCMAN, *Inner and outer functions on Riemann surfaces*, Proc. Amer. Math. Soc., **16** (1965), 1200–1204.
- [30] A. VOLBERG AND P. YUDITSKII, *On the inverse scattering problem for Jacobi Matrices with the Spectrum on an Interval, a finite system of intervals or a Cantor set of positive length*, Comm. Math. Phys., **226** (2002), 567–605.
- [31] A. ZLATOŠ, *Sum rules for Jacobi matrices and divergent Lieb-Thirring sums*, J. Funct. Anal., **225** 2 (2005), 371–382.