DOCTORAL STUDIES COURSE UNIT DESCRIPTION

Name of subject	Scientific Field	Faculty	Center/Institute/ Department
Classical and Quantum Integrable Models (8 ECTS credits)	Physics N 002	Faculty of Physics	Institute of theoretical physics and astronomy
Student's workload	Hours	Student's workload	Hours
Lectures		Consultations	20
Individual study	180	Seminars	

Course annotation
1. Classical integrable models
Classical dynamical systems. Liouville's theorem. Canonical transformations and action-angle variables. Lax pairs. Hamiltonian formalism. Symplectic manifolds. Poisson brackets. Conserved quantities. Classical r-matrix and the classical Yang-Baxter equation. Inverse scattering method. Solitons. Sine-Gordon and Korteweg–de Vries equations.
2. Quantum groups
Finite and infinite-dimensional Lie algebras. Hopf algebras. Deformation-quantisation. Highest-weight representation theory. Irreducible finite-dimensional representations. R-matrices and the quantum Yang-Baxter equation.
3. Quantum integrable models
Vertex models. One-dimensional magnets. Spin chains. Lax operators. Monodromy and transfer matrices. Conserved quantities. Algebraic Bethe ansatz and Bethe equations, eigenvectors and eigenvalues.

List of literature
1. G. Arutyunov, "Student seminar: classical and quantum integrable systems". Lectures delivered at Utrecht University during 2006-2007.

2. O. Babelon, D. Bernard and M. Talon, "Introduction to classical integrable systems". CUP, 2003.
3. V. Chari and A. Pressley, "A guide to quantum groups". CUP, 1994.
4. M. Dunajski, "Integrable systems". Lectures delivered at Cambridge University during 2012.
5. C. Gomez, M. Ruiz-Altaba and G. Sierra, "Quantum groups in two-dimensional physics". CUP, 1996.
6. M. Jimbo and T. Miwa, "Algebraic analysis of solvable lattice models". CBMS Regional Conference Series in Mathematics, AMS, 1993.
7. V. E. Korepin, N. M. Bogolyubov and A. G. Izergin, "Quantum Inverse Scattering Method and Correlation Functions". CUP, 1993.
8. A. Torrielli, "Lectures on Classical Integrability". J. Phys. A49 (2016) 323001.

Consulting teachers	Scientific degree	Pedagogical name	Main scientific works published in a scientific field in last 5 year period
Vidas Regelskis	Dr.		1. A. Gerrard and V. Regelskis, "Nested algebraic Bethe ansatz for orthogonal and symplectic open spin chains". Nucl. Phys. B (2020). DOI: 10.1016/j.nuclphysb.2019.114909

			2. N. Guay, V. Regelskis and C. Wendlandt, "Vertex representations for Yangians of Kac-Moody algebras", J. Éc. polytech. Math. 6 (2019), 665-706. DOI: 10.5802/jep.103
			3. A. Gerrard and V. Regelskis. "Nested algebraic Bethe ansatz for open spin chains with even twisted Yangian symmetry". Ann. Henri Poincare 20 (2019), 339-392. DOI: 10.1007/s00023-018-0731-1
			4. N. Guay, V. Regelskis and C. Wendlandt, "Representations of twisted Yangians of types B, C, D: II", Trans. Groups 24 (2019), 1015-1066. DOI: 10.1007/s00031-019-09514-x
			5. N. Guay, V.Regelskis and C. Wendlandt, "Equivalences between three presentations of orthogonal and symplectic Yangians", Lett. Math. Phys., 109 (2019), 327-379. DOI: 10.1007/s11005-018-1108-6
			6. V.Regelskis and B. Vlaar, "Solutions of the Uq(slN) reflection equations", J. Phys. A 51 (2018), 345204. DOI: 10.1088/1751-8121/aad026
			7. N. Guay, V.Regelskis and C. Wendlandt, "Representations of twisted Yangians of types B, C, D: I", Sel. Math. New Ser. 23 (2017), 2071–2156. DOI: 10.1007/s00029-017-0306-x
			8. A. De La Rosa Gomez, N. MacKay and V.R, "How to fold a spin chain: Integrable boundaries of the Heisenberg XXX and Inozemtsev hyperbolic models", Phys. Lett. A 381 (2017), 1340–1348. DOI: 10.1016/j.physleta.2017.02.039
			9. N. Guay, V.R. and C. Wendlandt, "Twisted Yangians of small rank", J. Math. Phys. 57 (2016), 041703. DOI: 10.1063/1.4947112
			10. N. Guay and V.Regelskis, "Twisted Yangians for symmetric pairs of types B, C, D", Math. Z. 284 (2016), 131-166. DOI: 10.1007/s00209-016-1649-2

Certified during Doctoral Committee session 02/02/2022, protocol No. (7.17 E) 15600-KT-32

Committee Chairman prof. S. Juršėnas