Classical and Quantum Integrable Systems - Alessandro Torrielli

Monday 16 September 2019 - Friday 20 September 2019

Instituto Galego de Física de Altas Enerxías (IGFAE)

Scientific Programme

Classical and Quantum Integrable Systems - Program

• **Session 1** (2 hours) **Classical integrability part 1**:
- Liouville theorem, examples of classically integrable dynamical systems, superintegrability (1 hour) [1];
- Lax pair, monodromy and transfer matrix, example of the Non-Linear Schrödinger Equation (NLS) (1 hour) [1, 2].
Prerequisites: Classical Mechanics

• **Session 2** (2 hours) **Classical integrability part 2**:
- Classical r-matrices, Belavin-Drinfeld theorems, non-local charges, example of the Principal Chiral Model (1 hour) [1, 3];
- Classical inverse scattering method, solitons (1 hour) [1, 3].
Prerequisites: Lie algebras

• **Session 3** (2 hours) **Quantum integrability part 1**:
- Hopf algebras and universal R-matrix, quantum groups, example of Uq(su(2)) (1 hour) [4];
- RTT relations, Algebraic Bethe Ansatz, example of the NLS (1 hour) [5–7].
Prerequisites: Quantum Mechanics

• **Session 4** (2 hours) **Quantum integrability part 2**:
- Exact S-matrices, bound states, perturbation theory of the NLS (1 hour) [8, 9];
- Coordinate Bethe ansatz and Thermodynamic Bethe ansatz (1 hour) [10].
Prerequisites: Classical and Quantum Statistical Mechanics

• **Session 5** (2 hours) **Quantum integrability part 3**:
- massless scattering and massless flows, example of the Tricritical to
Critical Ising Model (1 hour) [11];
- Quantisation of the Kadomtsev-Petviashvili equation (1 hour) [12];
Prerequisites: Quantum Field Theory

References

[1] Alessandro Torrielli. Lectures on Classical Integrability. J. Phys., A49(32):323001, 2016.
[2] E. K. Sklyanin. Quantum version of the method of inverse scattering problem. J. Sov. Math., 19:1546–1596,
1982. [Zap. Nauchn. Semin.95,55(1980)].
[3] Olivier Babelon, Denis Bernard, and Michel Talon. Introduction to Classical Integrable Systems. Cambridge
Monographs on Mathematical Physics. Cambridge University Press, 2003.
[4] C. Kassel. Quantum groups. 1995.
[5] L. D. Faddeev. How algebraic Bethe ansatz works for integrable model. In Relativistic gravitation and
gravitational radiation. Proceedings, School of Physics, Les Houches, France, September 26-October 6, 1995,
pages pp. 149–219, 1996.
[6] Fedor Levkovich-Maslyuk. The Bethe ansatz. J. Phys., A49(32):323004, 2016.
[7] H. B. Thacker. Exact Integrability in Quantum Field Theory. In 4th Workshop on Current Problems in
High-Energy Particle Theory Bad Honnef, Germany, June 2-4, 1980, page 0179, 1980.
[8] P. Dorey. Exact S matrices. In Conformal field theories and integrable models. Proceedings, Eotvos Graduate

Course, Budapest, Hungary, August 13-18, 1996, pages 85–125, 1996.
[9] Diego Bombardelli. S-matrices and integrability. J. Phys., A49(32):323003, 2016.
[10] Stijn J. van Tongeren. Introduction to the thermodynamic Bethe ansatz. 2016. [J. Phys.A49,no.32,323005(2016)].
[11] P. Fendley and H. Saleur. Massless integrable quantum field theories and massless scattering in
(1+1)-dimensions. In Proceedings, Summer School in High-energy physics and cosmology: Trieste, Italy, June
14-July 30, 1993, pages 301–332, 1993. [,87(1993)].
[12] Karol K Kozlowski, Evgeny Sklyanin, and Alessandro Torrielli. Quantization of the KadomtsevPetviashvili
equation. Theor. Math. Phys., 192(2):1162–1183, 2017.