Andreas Knauf

Topological and Geometric Ideas in Scattering Theory

Many informations we have about nature are obtained by scattering experiments, and a lot of effort has been concentrated on understanding them mathematically. Yet very simple questions have proved to be quite difficult:

- Do a finite number of balls moving freely on a plane or in space have a finite number of collisions?
- Do atoms and electrons end in clusters of bound states (molecules) moving freely in the limit of large times?

The first question found an affirmative answer[1] only relatively recently, the second property is known as *asymptotic completeness*. It has been shown to be true for quantum systems[2] and is known to be wrong for the n-body system of celestial mechanics. Whether it is *typically* (in the measure theoretical sense) true in the last case, is open since decades.

Since many years I work on the topological and geometrical aspects of scattering, in particular for the Coulomb or gravitational interaction; see the list of publications below. In my course I would present methods and results relevant in the above problems, as well as giving an overwiew over my own results.

Publications relating to Scattering Theory (A. Knauf)

1. — : Ergodic and Topological Properties of Coulombic Periodic Potentials. Commun. Math. Phys. **110**, 89–112 (1987).

2. — : Coulombic Periodic Potentials: The Quantum Case. Annals of Physics **191**, 205–240 (1989).

[1]Burago, D.; Ferleger, S.; Kononenko, A.: Uniform estimates on the number of collisions in semi-dispersing billiards. (English) Ann. Math., II. Ser. 147, No.3, 695–708 (1998)

[2]see: Derezinski, Jan; Gérard, Christian: Scattering theory of classical and quantum N-particle systems. Texts and Monographs in Physics. Berlin: Springer. (1997)

3. with S. Golin and S. Marmi: The Hannay Angles: Geometry, Adiabaticity, and an Example. Commun. Math. Phys. **123**, 95–122 (1989).

4. with C. Gérard: Collisions for the Quantum Coulomb Hamiltonian. Commun. Math. Phys. **143**, 17–26 (1991).

5. with B. Helffer, H. Siedentop and R. Weikard: On the Absence of a First Order Correction for the Number of Bound States of a Schrödinger Operator with Coulomb Singularity. Commun. P.D.E. **17**, 615–639 (1992).

6. with M. Klein: Classical Planar Scattering by Coulombic Potentials. Lecture Notes in Physics m 13. Berlin, Heidelberg, New York: Springer; 1993.

7. with Ya. Sinai: Classical Nonintegrability, Quantum Chaos. DMV–Seminar Band 27. Basel: Birkhäuser 1997.

8. — : Qualitative Aspects of Classical Potential Scattering. Regular and Chaotic Dynamics, **4**, No.1, 1–20 (1999).

9. — : Introduction to Dynamical Systems. In: "The Mathematical aspects of Quantum Maps", M. Degli Esposti, S. Graffi, Eds. Springer 2003.

10. — : The n-Centre Problem of Celestial Mechanics. Journal of the European Mathematical Society **4**, 1–114 (2002).

11. with I. Taimanov: On the Integrability of the n-Centre Problem. Mathematische Annalen **331** , 631–649 (2005).

12. with F. Castella, Th. Jecko: Semiclassical resolvent estimates for Schrödinger operators with Coulomb singularities. (2007); submitted.

13. with M. Krapf: The Non-Trapping Degree of Scattering. Preprint (2007).