Preface to the Series

The Niels Henrik Abel Memorial Fund was established by the Norwegian government on January 1. 2002. The main objective is to honor the great Norwegian mathematician Niels Henrik Abel by awarding an international prize for outstanding scientific work in the field of mathematics. The prize shall contribute towards raising the status of mathematics in society and stimulate the interest for science among school children and students. In keeping with this objective the board of the Abel fund has decided to finance one or two Abel Symposia each year. The topic may be selected broadly in the area of pure and applied mathematics. The Symposia should be at the highest international level, and serve to build bridges between the national and international research communities. The Norwegian Mathematical Society is responsible for the events. It has also been decided that the contributions from these Symposia should be presented in a series of proceedings, and Springer Verlag has enthusiastically agreed to publish the series. The board of the Niels Henrik Abel Memorial Fund is confident that the series will be a valuable contribution to the mathematical literature.

Ragnar Winther
Chairman of the board of the Niels Henrik Abel Memorial Fund

Preface

The Abel Symposium 2008 focused on the modern theory of differential equations and their applications in geometry, mechanics, and mathematical physics. Following the tradition of Monge, Abel and Lie, the scientific program emphasized the role of algebro-geometric methods, which nowadays permeate all mathematical models in natural and engineering sciences. The ideas of invariance and symmetry are of fundamental importance in the geometric approach to differential equations, with a serious impact coming from the area of integrable systems and field theories. More specifically, the following topics were central to the Symposium:

- Integrability methods for linear and non-linear differential equations
- Geometric analysis of the solutions and their moduli spaces
- Symmetries, conservation laws, recursion operators and generalizations
- Lie equations and geometric structures
- Pseudogroup actions and the algebra of differential invariants
- Topics from Hamiltonian and celestial mechanics
- Differential equations within field theories and quantum physics.

The Symposium was hosted by the University of Tromsø, the world's northernmost university, from June 17–22, 2008, and was organized by:

- Ian Anderson, Utah State University
- Alain Chenciner, Université Paris VII and IMCCE
- Boris Kruglikov, University of Tromsø
- Demeter Krupka, Palacky University
- Valentin Lychagin, University of Tromsø
- Eldar Straume, NTNU-Trondheim

Leading researchers from 13 different countries, working in these areas were invited to participate. A total of 43 participants were invited, including five Ph.D. students and post-doctoral researchers from Norway. The daily program consisted of lectures and discussions, held in an open and encouraging atmosphere. The following 28 plenary lectures were given:

1. Alain Albouy: *Projective dynamics of a classical particle or a multiparticle system*,
2. Ian Anderson: *Symmetry reduction and Darboux integrability*,
3. Ugo Bruzzo: *Framed bundles on Hirzebruch surfaces and equivariant cohomology of moduli spaces*,
4. Andreas Cap: *BGG sequences and geometric overdetermined systems*,
5. Alain Chenciner: *Action minimization and global continuation of Lyapunov families stemming from relative equilibria*,
6. Philippe Delanoe: *Transport equations and geometry: a survey*,
7. Boris Dubrovin: *On deformations of integrable hierarchies*,
8. Vladislav Goldberg (together with V. Lychagin): *Abelian equations and differential invariants of planar 4-webs*,
9. Michael Hazewinkel: *Niceness theorems*,
10. Wu-Yi Hsiang: *On the critical optimality for sphere packings of mixtures of two sizes*,
11. Nail Ibragimov: *Symmetries and conservation laws: a general theorem for arbitrary differential equations*,
12. Niky Kamran: *Focal systems for Pfaffian systems with characteristics*,
13. Boris Kruglikov (together with V. Lychagin): *Algebraic aspects of the compatibility of PDEs*,
14. Demeter Krupka: *Differential invariants in gauge theory*,
15. Boris Kupershmidt: *Phase spaces in algebra*,
16. Bernard Malgrange: *Lie pseudogroups and differential Galois theory*,
17. Andrei Marshakov: *Gauge/string duality, integrable equations and Abelian differentials*,
18. John Mather: *Tonelli minimizers and relative Tonelli minimizers*,
19. Vladimir Matveev: *Projective vector fields: Solution of Lie and Schouten problems*,
20. Sergei Merkulov: *Wheeled props, deformation theory and quantization*,
21. Richard Moeckel: *Topics on the three-body problem*,
22. Juan Morales-Ruiz (together with D. Blazquez): *Local and global properties of Lie-Vessiot systems*,
23. Jesu Rodriguez: *Characteristics of PDE in the framework of Lie-Weil jet spaces*,
24. Vladimir Roubtsov: *Partition function of SOS elliptic models with domain wall boundary conditions and projection method*,
25. Per Tomter: *Isometric immersions of homogeneous hyperspheres into complex hyperbolic space*,
26. Alexander Verbovetsky (together with P. Kersten, J. Krasilshchik and R. Vitolo): *Hamiltonian structures for general PDEs*,
27. Raffaele Vitolo (together with M. Modugno and C. Tejero Prieto): *Geometric aspects of the quantization of a rigid body*,
28. Keizo Yamaguchi: *Contact geometry of second order*.

In addition to the above speakers (and organizers), the following invited guests also attended the symposium:

 1. David Blazquez, Barcelona
 2. Tor Flå, Tromsø
 3. Hilja Lisa Huru, Oslo
 4. Marte Høyem, Tromsø
 5. Per Jakobsen, Tromsø
 6. Cathrine Jensen, Tromsø
 7. Joseph Krasilshchik, Moscow
 8. Alexey Kushner, Astrakhan
 9. Einar Mjølhus, Tromsø
10. Martin Rypdal, Tromsø
11. Mahdi Khajeh Salehani, Trondheim
12. Alexey Samokhin, Moscow
13. Lars Sydnes, Trondheim

We are grateful to all the participants for their valuable contributions and for making the symposium a successful event. We would also like to express our gratitude to the Abel Foundation and the Norwegian Mathematical Society for giving us the opportunity to arrange the Abel Symposium 2008.

Moreover, we would like to thank the University of Tromsø for providing us with additional support and practical assistance related to the preparation and organization of the symposium.

Tromsø and Trondheim   *Boris Kruglikov*
January 28, 2009   *Valentin Lychagin*
                                                                          Eldar Straume