

# Preface

Geometric concepts often play an essential role in obtaining a profound understanding of many areas of analysis and mechanics, for instance, in the theory of Fourier integral operators and in (semi)classical mechanics. This interaction between geometry and analysis or mechanics is a very dominant and also unifying theme in the publications of Hans Duistermaat. At the occasion of his 65th birthday, leading investigators convened at Utrecht University, in August 2007, to discuss recent developments along these lines and in other areas related to the scientific interests of Duistermaat. This volume contains refereed contributions from most of the speakers at this conference and, additionally, two from invited speakers who were unable to attend.

During the preparation of the conference proceedings, Hans Duistermaat passed away unexpectedly, on March 19, 2010. There is no doubt in our minds that Duistermaat would have wished the publication of these proceedings as planned. Accordingly, we decided to leave the format unchanged, but to add an overview of Duistermaat's scientific work as well as some reminiscences by V.W. Guillemin, A. Weinstein, G. Heckman, and R.H. Cushman, as friends and co-authors.

The thirteen research articles published in this volume cover grosso modo three different topics: pseudodifferential operators and (inverse) spectral problems, index theory and localization, and group actions.

**Pseudodifferential operators and (inverse) spectral problems.** A characterization of the local solvability for square systems of pseudodifferential operators is the topic of the paper of N. Dencker, while J. Sjöstrand describes results on eigenvalue distributions and Weyl laws for non-self-adjoint operators. F. Alberto Grünbaum discusses matrix-valued polynomials satisfying differential equations both with respect to the space and the spectral variables. There are three papers, by S. Vũ Ngọc, Y. Colin de Verdière and V.W. Guillemin, and Y. Colin de Verdière, respectively, on the question to what extent the semiclassical spectrum of an operator determines properties of the operator.

**Index theory and localization.** In his article, J.-M. Bismut explains the relations between refined versions of index theory on a manifold  $X$  and the localization formulas of Duistermaat–Heckman on  $LX$ , the associated loop space. P.-E. Paradan studies the local invariants associated to the Hamiltonian action of a compact torus and obtains wall-crossing formulas between invariants attached to adjacent connected components of regular values of the moment map. L. Boutet de Monvel, E. Leichtnam, X. Tang, and A. Weinstein use equivariant Toeplitz operator calculus in order to give a new proof of the Atiyah–Weinstein conjecture on the index of Fourier integral operators and the relative index of CR structures. L.C. Jeffrey and B. McLellan consider the analog of nonabelian localization results of Beasley and Witten when the gauge group  $G$  is the abelian group  $G = U(1)$ . Finally, E. Meinrenken explains how to define the quantization of  $q$ -Hamiltonian  $SU(2)$ -spaces as push-forwards in twisted equivariant  $K$ -homology, and to prove the “quantization commutes with reduction” theorem for this setting.

**Group actions.** On a symplectic manifold equipped with a Hamiltonian torus action a real locus is defined to be a set of fixed points for an equivariant smooth anti-symplectic involution. J.-C. Hausmann and T. Holm observe that certain cohomological relations between such a real locus and the ambient manifold can be explained in terms of a purely topological structure, rather than a symplectic one. There is a close relationship between Mumford’s geometric invariant theory (GIT) in algebraic geometry and the process of reduction in symplectic geometry. F. Kirwan’s paper describes ways in which nonreductive compactified quotients, which cannot be treated by means of classical GIT, can be studied using symplectic techniques.

**List of all speakers.** Nalini Anantharaman (École Polytechnique, Palaiseau), Nicole Berline (École Polytechnique, Palaiseau), Jean-Michel Bismut (Université Paris-Sud), Yves Colin de Verdière (Université Grenoble), Richard Cushman (Utrecht University), Nils Dencker (Lund University), F. Alberto Grünbaum (University of California at Berkeley), Victor Guillemin (Massachusetts Institute of Technology), Tara Holm (University of Connecticut), Frances Kirwan (University of Oxford), Eugene Lerman (University of Illinois at Urbana-Champaign), Jiang-Hua Lu (University of Hong Kong), Eckhard Meinrenken (University of Toronto), Richard Melrose (Massachusetts Institute of Technology), Paul-Emile Paradan (Université Montpellier 2), Reyer Sjamaar (Cornell University), Gunther Uhlmann (University of Washington at Seattle), San Vũ Ngọc (Université Grenoble), Alan Weinstein (University of California at Berkeley).

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