

MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

Report No. 43/2010

DOI: 10.4171/OWR/2010/43

Deformation Methods in Mathematics and Physics

Organised by
Alice Fialowski, Budapest
Jürg Fröhlich, Zürich
Martin Schlichenmaier, Luxembourg

September 25th – October 1st, 2010

ABSTRACT. Deformations of mathematical structures play an important role in most parts of mathematics but also in theoretical physics. In this interdisciplinary workshop, different aspects of deformations and their applications were discussed. The workshop was attended by experts in the fields, but also by quite a number of young post-docs and PhD students. One of the goals was to foster interactions between different communities.

Mathematics Subject Classification (2000): 16xx, 17xx, 53xx, 70xx, 81xx, 83xx.

Introduction by the Organisers

The workshop *Deformation Methods in Mathematics and Physics*, was organised by Alice Fialowski (Budapest), Jürg Fröhlich (Zürich), and Martin Schlichenmaier (Luxembourg) and took place from September 25 to October 1st, 2010 at the Mathematisches Forschungsinstitut Oberwolfach (MFO).

Deformation theory plays an important role in many branches of mathematics and physics. In mathematics, deformation theoretical methods are crucial for constructing and for studying classifying spaces (moduli spaces). Furthermore, by deformation one obtains new interesting mathematical objects from known ones.

In physics, the mathematical theory of deformations is a powerful tool to construct new theories of physical reality from known ones. The concepts of *symmetry* and *deformations* are considered to be two fundamental guiding principle for further developing physical theory.

In 2006, there was a precursor workshop in Oberwolfach (2006/3) with the title "Deformations and Contractions in Mathematics and Physics", where both mathematicians and physicists participated. The Workshop was an enlightening

experience for the participants and turned out to be very successful. Both groups - mathematicians and physicists - benefited from the week. For a more detailed description of the talks presented, see Oberwolfach Reports 2006/3.

Based on the success of the workshop, the organizers were invited by the Editor of the International Journal of Theoretical Physics to prepare a special volume (Vol. 46, No. 11, 2007) dedicated to the topics presented at the workshop .

To a certain extent the actual workshop took up the challenges and open problems of the 2006 workshop. But, equally important, it evolved into new directions. The infinite-dimensional case was more in the center of interest and deformations of higher order algebraic structures played a prominent role.

The following is a (non-exhaustive) list of topics discussed at the workshop.

- (1) Formulations of formal deformations in the context of differential graded Lie algebras, Maurer Cartan elements, higher structures, (curved) A_∞ algebras, operads, graph complexes, in particular also the deformation of diagrams.
- (2) Constructions of moduli spaces, versal families for a given deformation problem, in particular also the discussion of global versus formal deformations and the question of rigidity. There exist (infinite-dimensional) algebras which are formally rigid but admit nontrivial (non-formal) deformations (sometimes called parameters).
- (3) The deformation quantization of symplectic and Poisson manifolds, in particular also the question to find subalgebras for which the deformation quantization converges, furthermore the behaviour of deformation quantizations under reduction by a group action, Drinfeld associators.
- (4) Deformed Geometry and Gravity, with the help of fuzzy space geometries, large N limits of Yang-Mills matrix models, Anti-de-Sitter space time.
- (5) Quantum Field Theory, in particular the deformation of the local observable algebra, renormalisation and regularisation of QFT, family of Dirac operators.

The talks were supplemented by two talks of overview character on deformation quantization and on the deformation philosophy in physics.

The workshop was attended by 49 participants from all over the world. The official program consisted of 21 lectures.

On Thursday night a Young Researchers Session took place. Five advanced PhD students and post-docs gave short presentations on results obtained during their PhD research. This activity was well received by the speakers and by the audience.

Beside the official program, there was ample time for further activities of the participants, such as self-organised sessions and discussion groups.