Scientific report on the Workshop

"Noncommutative algebraic geometry and its applications to physics"

Lorentz Center, Leiden, March 19 to 23, 2012

The main purpose of the workshop was to create a unified view of the landscape of different noncommutative geometries, and their applications in theoretical physics, notably quantum field theory and string theory. As indicated by the title of the workshop, it was our intention to stress in particular the algebraic approaches to noncommutative geometry. Moreover, we wanted to highlight the connections of this theory with geometric invariants, enumerative geometry, string theory, and integrable systems.

The algebraic approach to noncommutative geometry was illustrated by Lieven Le Bruyn, with his algebraic theory of D-branes, Paul Smith (noncommutative curves and Penrose tilings), Gonçalo Tabuada, who gave an introduction to the theory of noncommutative motives, and Jan Jitse Venselaar (Spin structures on noncommutative tori and their Morita 'equivalences'). Related to this aspect of the theory were also the talks by Dimitri Kaledin (about the Hochschild-Witt complex), Yuri Berest (Derived representation schemes), Alexander Kuznetsov (Categorical resolution of singularities), Lucio Cirio (categorification of the Kniznhik-Zamolodchikov connection), Sebastian Klein (Chow groups for tensor-triangulated categories).

Links with the physics of quantum fields were established by the talks by Walter van Suijlekom (Renormalizability conditions for almost commutative manifolds) and Alexander Gorsky (Supersymmetric QCD, integrability and cyclic RG flows). Relations with integrable systems were discussed by Vladimir Sokolov (Integrable non-abelian ODE's: a bi-Hamiltonian approach). Interesting applications to the geometry of moduli spaces were proposed by Tom Sutherland (Stability conditions for Painlev quivers), Richard Szabo (Instantons and noncommutative toric varieties), Ludmil Katzarkov (From Higgs bundles to stability conditions), and Simon Brain (Gauge-theoretic Invariants of toric noncommutative manifolds).

Interesting connections with other areas of mathematics were explored by Ralph Kaufmann (Noncommutative geometry of wire network graphs) and Matilde Marcolli (Quantum statistical mechanics, Kolmogorov complexity, and the asymptotic bound of codes).

It is the opinion of the organizers that the workshop fulfilled its scopes in a satisfactory way. The talks were interesting, and the structure of the workshop has left space for personal discussion. The workshop has allowed many of the participants to get in touch with the most recent advances in the field.

The organization of the Lorentz Center, and the work of its personnel, have been impeccable, and have given a fundamental contribution to the success of the workshop.

Ugo Bruzzo

Trieste, 27 May 2012