# COST MP-1405, Working Group 2

Branislav Jurčo, Charles University, Prague, Czech Republic

Brussels

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## Proposed Core Group

Branislav Jurčo, Prague (leader)
Martin Schlichenmaier, Luxembourg (vice leader)
Pierre Bieliavsky, Louvain (proponent)
Alberto Cattaneo, Zurich (proponent)
Giovanni Landi, Trieste (proponent)

## MC members partipicipating in WG2

L. Jonke, O. Lechtenfeld, V. Dobrev, F. Lizzi, H. Steinacker, C.P. Martin, D. Bahns, S. Brain, W. van Suijlekom, A. Borowiec, J. Grazia-Bondia, P. Schupp, P. Vitale, A. Sitarz, T. Jurić, S. Meljanac, G. Fiore, R. Nest, J. Barrett

## Noncommutative Geometry Structures

Aim:
produce new constructions of fields, matter and quantum spacetimes in NCG

Topics:

different approaches to NCG, and their extensions to NA and higher geometries

- models of quantum spacetime (spectral triples, quantum groups, fuzzy spaces, minimum length scales)
- NC generalisations of nonperturbative degrees of freedom and associated moduli
- NCG and HGS in String and M-theory (D-branes, higher gauge theory, flux compactifications), supergravity and LQG
- quantisation of NCG and HGS structures
- generalised geometry, Courant algebroids
- geometry of gerbes and multisymplectic forms
- geometrising and quantising non-geometric fluxes (membrane sigma models)
- double field theory and non-geometric models in ST

Scientific work plan:

- Comparison of new constructions of models of quantum spacetime with spaces having minimum length scales
- Further studies of gauge theories in NCG: Their nonperturbative configurations such as instantons, and gauge theory invariants of NC spaces
- Clarification of the various notions of symmetry in NCG: Symmetries in the continuum versus symmetries in the discrete and NCG, variational principles and notion of gauge symmetry in the NC world
- Formal developments of a theory of NC principal bundles, together with duality, NC gauge transformations and automorphisms, and NC parallel transport
- Construction of QFTs, including gravity, on fuzzy spaces which properly incorporate spinors
- Further development of the geometry of fluxes by relating generalised geometry and double field theory to their dual descriptions in terms of NC and NA geometry
- Development of quantisation schemes for higher geometry, such as multisymplectic phase spaces, relevant for NA geometry

Methods and means:

- Rigorous constructions of new examples of spectral triples in NCG, and in particular of finite-dimensional spectral triples and their relation to fuzzy geometries
- Development of KK-factorisation in bivariant K-theory, and further studies of K-theory and K-homology of NC spaces
- Further developments of connections between quantum groups and NCG, including studies of quantum group internal symmetries and integrability in QFT, and the Weil homomorphism for Hopf algebras
- Further developments of spin geometry and other facets of the NCG of fuzzy spaces, using finite matrices and projectors, and explicit constructions of projective modules and Dirac operators on fuzzy complex projective spaces, Grassmannians and flag manifolds, and also on fuzzy spheres
- Developments of new (multi-)matrix model techniques suitable to the study of QFT on fuzzy spaces
- Extensions of Drinfeld twist techniques to study the geometry of NC gauge transformations and NC parallel transport, including the study of non-formal Drinfeld twists

- Development of NC descriptions of algebroids and Cartan geometry, and their occurences in topological sigma-models
- Developments of (higher-)categorical generalisations of NCGT
- Extensions of the Seiberg-Witten map and its higher versions
- Further studies of Nambu-Lie three-algebras and fuzzy three-manifolds

Proposed Conferences, Schools and Workshops relevant to WG2:

- 2015 School on Geometry and Quantization Sept. 7–18, 2015, ICMAT, Madrid, Spain
- Corfu 2015 Workshop on Noncommutative Field Theory and Gravity Sep. 20–26, 2015, Corfu, Greece
- School on Higher Structures in String Theory and Quantum Field Theory, Nov. 23–Dec.4, 2015, Vienna, Austria
- Workshop on Homotopy Algebras, Deformation Theory and Quantization Jan., 2016, Vienna, Austria
- Tux Winter Conference on Quantum Gravity and Noncommutative Geometry Feb., 2016, Tux, Austria
- 2016 Nordic String Meeting Feb. 22–23, 2016, Bremen, Germany
- Workshop on Gauge Theory and Noncommutative Geometry Apr. 4–8, 2016, Nijmegen, The Netherlands
- Bayrischzell 2016 Workshop on Noncommutativity and Physics: Quantum Spacetime Structures Apr. 29–May 2, 2016, Bayrischzell, Germany
- Dublin Institute for Advanced Studies 5 activities Nov./2015–May/2016, Dublin, Ireland

Further activities

- pursuing concrete scientific collaborations (not only) between members of WG2 and within smaller groups across all WG's, e.g. within STSM
- supporting participation of PhD students and ECI in the activities of WG2, training school
- interaction and collaboration with other Working Groups, active participation on their and cross-WG activities
- close collaboration with non COST countries