Lectures by Walter van Suijlekom at ISI Kolkata

Professor Walter van Suijlekom (www.waltervansuijlekom.nl) from the Radboud University of Nijmegen, Netherlands is visiting India as the Jubilee Chair Professor 2024 of the Indian Academy of Sciences. In first week of his visit, he will give a series of four lectures at Indian Statistical Institute, Kolkata on noncommutative geometry. The dates are 23, 24, 25 and 26 January 2024.

1. Lecture I: 23rd January

Venue: L-infinity, 5th floor, Kolmogorov Bhavan, ISI Kolkata Time: 16.45 Live-streaming link: https://www.youtube.com/@csscisikolkata5034/streams

Title: The spectral approach to geometry: spectral triples

Abstract:

We give a gentle introduction to the spectral approach to geometry, where we replace spaces by commutative C^* -algebras, and capture the (Riemannian) metric in terms of a Dirac operator, both acting on the same Hilbert space of spinors. This is our first example of a spectral triple, motivating the general (noncommutative) definition. We illustrate this concept with many examples and also show how to reconstruct geometry from this spectral data in the commutative case.

2. Lecture II: 24th January

Venue: L-infinity, 5th floor, Kolmogorov Bhavan, ISI Kolkata Time: 16.15 (Note the change in time) Live-streaming link: https://www.youtube.com/@csscisikolkata5034/streams

Title: Inner fluctuations of geometry: Morita equivalence and connections

Abstract:

We investigate the notion of symmetry transformations between spectral triples, starting with unitary equivalence and building towards Morita equivalences. The latter are described by connections on modules over the algebra, and yield so-called inner fluctuations of geometry. Examples include Yang-Mills connections and Higgs fields; we briefly describe these in relation to particle physics.

3. Lecture III: 25th January

Venue: L-infinity, 5th floor, Kolmogorov Bhavan, ISI Kolkata Time: 16.15 (Note the change in time) Live-streaming link: https://www.youtube.com/@csscisikolkata5034/streams

Title: Second quantization of spectral geometry: entropy and the spectral action

Abstract:

We now take the step from the one-particle description given by spectral triples to include multi-particle states. This demands the introduction of a process called second quantization, and we analyze the resulting Clifford algebras as well as the unique equilibrium (KMS) state. We compute its von Neuman information entropy which turns out to be a special case of a spectral action functional.

4. Lecture IV: 26th January

Venue: L-infinity, 5th floor, Kolmogorov Bhavan, ISI Kolkata Time: 16.15 (Note the change in time) Live-streaming link: https://www.youtube.com/@csscisikolkata5034/streams

Title: Geometric spaces at finite resolution: operator systems

Abstract:

We extend the framework of noncommutative geometry in order to deal with two types of approximations of metric spaces. On the one hand, we consider spectral truncations of geometric spaces, while on the other hand, we consider metric spaces up to finite resolution. In our approach, the traditional role played by C^* -algebras is taken over by so-called operator systems. Essentially, this is the minimal structure required on a space of operators to be able to speak of positive elements, states, pure states, etc. We illustrate our methods in concrete examples obtained by spectral truncations of the circle and of metric spaces up to finite resolution.