CLP7

Categories, Logic, and Physics

Birmingham 21-Sep-2010

Program

10:30-11:00	**Welcome (Atrium Computer Science)**
11:00-12:00	Martin Escardo **Maybe locales are made out of points after all**
12:00-13:00	Christopher J. Mulvey **Constructive Aspects of Gelfand Duality**
13:00-14:00	**Lunch Break**
14:00-15:00	Ronnie Brown **What is and what should be 'higher dimensional group theory'?**
15:00-16:00	Catherine Meusburger **Higher categories and observables for generalised Turaev-Viro models**
16:00-16:30	**Coffee/Tea Break (Atrium Computer Science)**
16:30-17:30	Simon Willerton **Two 2-traces**
17:30-18:30	Cecilia Flori **Topos Formulation of history quantum theory**
19:00- –:–	**Pub Session**

All talks will take place in Lecture Theater 1, Sports and Exercise Science building Y14.

Abstracts:

Ronnie Brown: What is and what should be 'higher dimensional group theory'?

The presentation will show, including some knot demos, some of the problems and intuitions which have led to this question, and how certain cubical algebraic structures with partial operations whose domains are given by geometric conditions have been found quite natural for expressing modes of higher dimensional subdivision and composition which are related to long term concerns in algebraic topology.

Martin Escardo Maybe locales are made out of points after all

Like topology in analysis, locale theory is about open sets, continuous functions, compact spaces, approximation and limit processes, and things like that. Both topology and locale theory start with opens. In topology, an open is made out of points, but in locale theory, a point is made out of opens. The localic view makes physical and computational sense: points are infinitely small (and carry an infinite amount of information), and hence are not directly observable, but each point is uniquely characterized by its (infinite) collection of observable properties. The opens are the observables, and locale theory takes the notion of observation as primitive, and all other

notions, including that of point, as derived. (Moreover, some perfectly good spaces in locale theory have a rich supply of opens without allowing any point at all, but this is not what I will emphasize in my talk).

Although the match of (physical or computational) reality with locale theory is arguably better than with topology, locale theory may be more mathematically demanding, or at least is certainly unfamiliar to most of us. In this talk I'll discuss how one can think of locales as if they were made out of points, like the spaces of classical analysis and geometry, trying to make them more familiar, manageable, and intuitive, without loss of rigour, so that we can reason and work with them efficiently.

Cecilia Flori Topos Formulation of history Quantum Theory

In this talk I will describe a topos formulation of consistent histories obtained using the topos reformulation of standard quantum mechanics put forward by Doering and Isham. Such a reformulation leads to a novel type of logic with which to represent propositions. In the first part of the talk I will introduce the topos reformulation of quantum mechanics. I will then explain how such a reformulation can be extended so as to include temporally-ordered collection of propositions as opposed to single time propositions. Finally I will show how such an extension will lead to the possibility of assigning truth values to temporal propositions.

Catherine Meusburger Higher categories and observables for generalised Turaev-Viro models

Generalised Turaev-Viro models that are formulated in terms of spherical categories play an important role in three-dimensional quantum gravity, where they are interpreted as discrete path integrals or state sum models of quantised three-manifolds. We discuss the role and interpretation of these models in quantum gravity and comment on the problem of defining observables for these models. We show how this problem can be addressed by using higher categories and discuss the mathematical properties and the physical interpretation of the resulting observables. The talk is based on joint work with John W. Barrett.

Christopher J. Mulvey Constructive Aspects of Gelfand Duality

One of the important foundational aspects of recent approaches to developing quantum theories of space and time has been the existence of a constructive theory of Gelfand duality for commutative C*-algebras. In this talk, we shall outline the way in which this theory was developed, examine its application to the context of quantum physics, and consider its extension to the non-commutative case.

Simon Willerton Two 2-traces

Over recent years, in several areas of mathematics the notion of 'categorified trace' or '2-trace' has arisen. For instance, in higher representation theory where groups act on linear categories there is the notion of a '2-character'; in Khovanov knot homology the Hochschild homology is viewed as a categorical trace. It transpires that there are actually two orthogonal, and sometimes dual, notions of 2-trace in common usage and I will explain how they arise and give various examples from various areas of mathematics.

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