

名古屋量子情報セミナー連続講演会のお知らせ

Oxford 大学 Computing Laboratory, Quantum Group の Andreas Doering 氏をお招きして、量子力学の基礎へのトポス理論からのアプローチに関する入門的連続講演会を開催致します。ふるってご参加ください。

日時：9月6日（月）—9月8日（水）13:30—17:00（質疑応答、討論会を含む）

会場：名古屋大学大学院情報科学研究科棟 1 階第 3 講義室

<http://www.is.nagoya-u.ac.jp/intro/contact.html>

講師：Andreas Doering (Oxford University)

<http://www.comlab.ox.ac.uk/people/Andreas.Doering/>

題目：An introduction to the topos approach to the formulation of physical theories

内容：

I. Motivation, background, and basic structures

The topos approach to the formulation of physical theories aims to provide a framework for the formulation of physical theories in general, and a mathematically and conceptually novel formulation of quantum theory in particular. The long-term goal is to find theories 'beyond quantum theory', in the direction of quantum gravity and quantum cosmology.

In the first talk, we will consider the suggested conceptual framework of 'neo-realist' physical theories, its realisation in the form of formal languages attached to physical systems and their representation in suitable topoi. We will determine the topos attached to a quantum system and introduce the basic mathematical structures, in particular the spectral presheaf, which is a space without points in a suitable technical sense.

II. Topos quantum logic and noncommutative spectra

The spectral presheaf serves as a 'quantum state space', and its subobjects represent propositions about the quantum system at hand. These subobjects form a Heyting algebra, the algebraic representative of a propositional intuitionistic logic. We will discuss the properties of daseinisation of projections, a 'translation' mapping between Birkhoff-von Neumann quantum logic and our new form of topos quantum logic. Moreover, the representation of vector states and the assignment of truth-values to all propositions will be presented. Here, the internal logic of the topos plays a role.

In the second part, we will consider the spectral presheaf in a different, more topological light. As a locale associated with the C^* - or von Neumann algebra of physical quantities, it has many properties of a generalised Gel'fand spectrum of the algebra. We will indicate how this may lead to a generalised Gel'fand duality for noncommutative operator algebras, with the spectral presheaf as a noncommutative spectrum.

III. States as measures, generalised Gel'fand transforms, and open problems

In the final talk, we show a new representation of quantum states (mathematically, states on a von Neumann algebra). Each state determines a probability measure on the spectral presheaf. Measures can be characterised abstractly, and each measure determines a unique quantum state. We will also consider the topos-internal representation of physical quantities via daseinisation of self-adjoint operators, a certain generalisation of the

Gel'fand transformation. This leads to the consideration of a presheaf of 'values' that are not just real numbers in general, but rather real intervals.

Finally, we want to point out a few ideas how to (maybe) go 'beyond quantum theory', a number of open problems and topics of active research.

連絡先：参加費無料でどなたでも参加できますが，会場準備の都合上予め下記までご連絡いただければ幸いです．また、僅少なながら旅費援助のご相談も受け付けています．

小澤正直（名古屋大学大学院情報科学研究科）
ozawa@is.nagoya-u.ac.jp

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Masanao Ozawa
Graduate School of Information Science
Nagoya University
Chikusa-ku, Nagoya 464-8601, JAPAN
Email: ozawa@is.nagoya-u.ac.jp
Phone & Fax: +81-52-789-3075