

## 几何与物理中的高阶结构

近来，高阶结构或者数学结构的范畴化在代数、代数拓扑、微分几何、代数几何以及数学物理等数学分支中大量涌现，也出现在量子场论诸如凝聚态物理、弦理论等理论物理分支。具体来说有扩展拓扑量子场论（Extended TQFT）、无穷范畴（ $\infty$ -categories）、同伦代数、导出/shifted 辛几何（泊松几何），factorization homology 等。

物理中高阶结构的研究方兴未艾、进展迅速，为促进不同领域的交叉融合和相互了解，特邀请国内在该方向深有造诣的杰出学者开设短期课程，系统介绍相关方向的基本理论和想法，为有意进入该领域的研究生和青年学者提供一交流学习之平台。

会议原定于 2021 年 9 月 6 日-9 月 10 日在天津南开大学陈省身数学研究所举行。会议期间我们计划开设四个短课程，每个课程 5 小时；课程主题涉及拓扑序、量子化以及高阶范畴等数学物理方向。主讲人为孔良、李思、艾颖华、周杰、桂政平和张智浩。

本次会议得到陈省身数学研究所的大力支持，适逢陈省身先生百一十周年诞辰之际，我们愿藉此机会致敬陈先生深刻的数学和高尚的人格！

受疫情影响，会议延期到 2021 年 11 月 22 日-11 月 26 日线上举行。我们将使用腾讯会议，信息如下：

孙善忠 邀请您参加腾讯会议

会议主题：几何与物理中的高阶结构研讨会

会议时间：2021/11/22-2021/11/26 08:30-18:00(GMT+08:00) 中国标准时间 - 北京，每天

点击链接入会，或添加至会议列表：

<https://meeting.tencent.com/dm/Bib1vq6oG046>

会议 ID: 425 9252 2768

会议密码: 112226

# 日程表

	周一(11.22)	周二(11.23)	周三(11.24)	周四(11.25)	周五(11.26)
9:00-10:00	周杰	周杰	周杰	周杰	周杰
10:10-11:10	孔良/张智浩	孔良/张智浩	孔良/张智浩	孔良/张智浩	艾颖华
11:20-11:50	曾杰恒	张宇	余思睿	赵虎	刘雷雷
11:50-14:00			午 休		
14:00-15:00	艾颖华	艾颖华	艾颖华	艾颖华	孔良/张智浩
15:10-16:10	李思/桂政平	李思/桂政平	李思/桂政平	李思/桂政平	李思/桂政平

注：2021年11月22日上午8:45会有简短的开幕式。

短课程名称如下：

- (1) An invitation to topological orders and category theory (孔良、张智浩);
- (2) Quantization and Factorization algebra (李思、桂政平);
- (3) Introduction to infinity categories (艾颖华)
- (4) A short introduction to homological mirror symmetry (周杰)

短课程摘要

(1): An invitation to topological orders and category theory

授课人：孔良（南方科技大学）、张智浩（中国科技大学）

摘要: Although it has been a well-known fact, for more than two decades, that the category theory is needed for the study of topological orders, it is still a non-trivial challenge for students and working physicists to master the abstract language of category theory. In this series talks, for those who have no background in category theory, we explain in great details how the structure of a (braided) fusion category naturally emerges from lattice models and physical intuitions. Moreover, we show that nearly all mathematical notions and constructions in fusion categories and its representation theory, such as (monoidal) functors, Drinfeld center, module categories and Morita equivalence, can all be derived from lattice models and physical intuitions. In this process, we also introduce basic notions and state important facts of topological orders, and clarify subtle issues or misunderstandings that are common in literature.

短课程 (2): Quantization and Factorization Algebra

授课人：李思（清华大学）、桂政平（ICTP）

摘要: We give an introduction to basic ideas and various recent mathematical developments about quantization that arises from quantum field theory and string theory. Several applications to geometry and topology, including recent work on

factorization homology and index theory, will be discussed along the journey.

**短课程 (3):** Introduction to infinity categories

授课人: 艾颖华 (清华大学)

**摘要:** This talk will give a brief overview of the theory of infinity categories developed by Jacob Lurie, and study some basic examples of infinity category.

**短课程 (4):** A short introduction to homological mirror symmetry

授课人: 周杰 (清华大学)

**摘要:** This lecture series will be aimed at explaining some basics of homological mirror symmetry, with an emphasis on the descriptions and computations on the higher categorical structures.

Plan:

Lecture 1. Fukaya category

Lecture 2. Calculation on structure constants through examples

Lecture 3. Derived category of coherent sheaves

Lecture 4. Calculation on structure constants through examples

Lecture 5. Mirror symmetry via Fourier-Mukai transform

**短报告**

报告人: 张宇 (南开大学)

Title: Structured ring spectra and Topological Quillen homology

Abstract: Many naturally occurring examples in topology come equipped with generalized algebraic structures such as associative or commutative up to coherence homotopy. We can encode these sorts of higher structures by the action of certain operads  $O$ . Spectra equipped with  $O$ -actions are called structured ring spectra. Topological Quillen homology (TQ-homology) is the homology theory for structured ring spectra analogous to singular homology of topological spaces.

In this talk, we will draw the analogy between structured ring spectra and topological spaces to introduce the idea of operads and TQ-homology. We will also discuss the TQ-homological Whitehead theorem of structured ring spectra.

报告人: 余思睿 (四川大学)

Title: Poisson manifolds with semisimple modular symmetry.

Abstract: In this talk, we study the "twisted" Poincare duality of smooth Poisson manifolds, and show that, if the modular symmetry is semisimple, that is, the modular vector is diagonalizable, there is a mixed complex associated to the Poisson complex which, combining with the twisted Poincare duality, gives a Batalin-Vilkovisky algebra structure on the Poisson cohomology, and a gravity algebra structure on the negative cyclic Poisson homology. This generalizes the previous results obtained by Xu et al for unimodular Poisson algebras. We also showed that the two algebraic structures Artin-Shelter algebra and Frobenius algebra, are preserved under Kontsevich's deformation quantization, and in the

case of polynomial algebras, they are also preserved by Koszul duality. This talk is based on a joint work with Chen, Liu and Zeng.

报告人：赵虎（四川大学）

Title: Commutativity of quantization and reduction in quiver representations

Abstract: Given a finite quiver, its double may be viewed as its non-commutative “cotangent” space, and hence is a non-commutative symplectic space. Crawley-Boevey, Etingof and Ginzburg constructed the non-commutative reduction of this space while Schedler constructed its quantization. In this talk, I will show that the non-commutative quantization and reduction commute with each other. Via the quantum and classical trace maps, such a commutativity induces the commutativity of the quantization and reduction on the space of quiver representations.

报告人：曾杰恒（四川大学）

Title: Singularity categories of toric Gorenstein varieties with isolated singularities.

Abstract : We study certain toric Gorenstein varieties with isolated singularities which are the quotient spaces of generic unimodular representation spaces by the one-dimensional torus, or the product of the one-dimensional torus with a finite abelian group. Based on the works of \v{S}penko and Van den Bergh [Invent. Math. 210 (2017), no. 1, 3-67] and Mori and Ueyama [Adv. Math. 297 (2016), 54-92], we show that the singularity categories of these varieties admit tilting objects, and hence are triangle equivalent to the derived categories of some finite dimensional algebras

报告人：刘雷雷（中山大学）

Title: Twisted bi-symplectic structure on Koszul twisted Calabi-Yau algebras.

Abstract: For a Koszul Artin-Schelter regular algebra (also called twisted Calabi-Yau algebra), we show that it has a ``twisted'' bi-symplectic structure, which may be viewed as a noncommutative and twisted analogue of the shifted symplectic structure introduced by Pantev, To\"en, Vaqui\'e and Vezzosi. This structure gives a quasi-isomorphism between the tangent complex and the twisted cotangent complex of the algebra, and may be viewed as a DG enhancement of Van den Bergh's noncommutative Poincar\'e duality; it also induces a twisted symplectic structure on its derived representation schemes. This talk is based on a joint work with X. Chen, A. Eshmatov and F. Eshmatov.