Summary

Jan. 9th Monday

Beijing time: 10: 00-11: 00 am
Speaker: Mikhail Kapranov <mikhail.kapranov@protonmail.com>
Title: Algebra of the Infrared, Fourier transform and resurgence
Abstract:

A part of the Algebra of the Infrared can be interpreted as a categorification of the study of the Fourier transform for perverse sheaves (or holonomic regular D-modules) on the complex line $\mathbf{C}$. The talk will summarize this approach, developed in an earlier work with Y. Soibelman and L. Soukhanov and discuss a possible generalization to the context of resurgence. This generalization involves perverse sheaves on $\mathbf{C}$ which are algebras with respect to additive convolution. Such perverse sheaves can have infinitely many singularities.

Beijing time: 04: 00-05:00 pm
Speaker： Alexey Bondal <bondal@mi-ras.ru>
Title: Noncommutative resolutions of singularities and schobers
Abstract：

We discuss the relation of the null-category of noncommutative resolutions with relative singularity categories and application to relevant schobers.

Beijing time: 5: 15-6: 15 pm
Speaker: Timothy Logvinenko <LogvinenkoT@cardiff.ac.uk>
Title: Skein-triangulated representations of generalised braids
Abstract:

The braid group Br_n encodes configurations of n non-touching vertical strands ("braids") up to continuous transformations. There are many examples where Br_n acts on the derived category of an algebraic variety: the minimal resolutions of Kleinian singularities, the cotangent bundles of flag varieties, etc.

In this talk, I introduce a new structure: the category GBr_n of generalised braids. These are the braids whose strands are allowed to touch in a certain way. For triangulated categories, it is natural to impose certain relations which result in the notion of a skein-triangulated representation of GBr_n. These relations generalise the famous skein relation used to define oriented link invariants such as Jones polynomial.

We give two examples of skein-triangulated actions of GBr_n: on the cotangent bundles of varieties of full and partial flags in $\mathbf{C}^n$ and on categorical nil-Hecke algebras. The latter example shows that any categorical action of Br_n can be lifted to a skein-triangulated action of GBr_n, generalising a result of Ed Segal for n=2. This is a joint work with Rina Anno.

Jan. 10th Tuesday

Beijing time: 08:30-09:30 am
Speaker: Ludmil Katzarkov <lkatzarkov@gmail.com>
Title: New Birational Invariants
Abstract:

In this talk we will offer new birational invariants connected with Non commutative Hodge structures. Examples will be considered.

Beijing time: 10:00-11:00 am
Speaker: David Nadler <denadler@gmail.com>
Title: Morse theory for sheaves of categories
Abstract:

I will take the opportunity to describe some arguments appearing in joint work with Penghui Li and Zhiwei Yun on the cocenter of the affine Hecke category. We use some elementary aspects of Morse theory for sheaves of categories on a manifold. I will describe what we encounter, how we handle it, and raise some questions motivated by it.

Beijing time: 04: 00-05:00 pm
Speaker: Sibasish Banerjee <sibasishbanerjee@live.in>
Title: BPS state counting with Exponential networks
Abstract:

I will describe the framework of Exponential Networks for computing the BPS spectrum of M-theory on a local Calabi-Yau threefold times $\mathbf{R}^4 \times \mathbf{S}^1$. Exponential networks define the counting of special Lagrangians in the mirror Calabi-Yau threefold. Therefore, from the geometric data of mirror curves, we propose how to compute the related DT invariants. I will briefly sketch how this is achieved for some concrete examples and discuss some relations with BPS quivers.

Beijing time: 05:15-06:15 pm
Speaker: Pietro Longhi <longhip@phys.ethz.ch>
Title: Counting Lagrangian A-branes with networks
Abstract:

The framework of spectral networks was introduced in physics as a way to compute BPS states of 4d N=2 gauge theories. In this talk I will review a generalization, known as exponential networks, which produces enumerative invariants associated to special Lagrangians in certain Calabi-Yau threefolds. Applications include the computation of the exact spectrum for the mirror of the local Hirzebruch surface. I will also sketch a new derivation of this framework, which elucidates the geometric meaning of the invariants in terms of elementary data of A-branes.

Jan. 11th Wednesday

Beijing time: 08:30-09:30 am
Speaker: Gregory W. Moore <gwmoore@physics.rutgers.edu>
Title andAbstract:
For details, please refer to
http://www.physics.rutgers.edu/~gmoore/SoibelmanSeminar-September22-2021.pdf

Beijing time: 10:00-11:00 am
Speaker: Jie Gu   <eij.ug.phys@gmail.com>
Title: Resurgent quantum periods and BPS invariants

Abstract:

Quantum periods appear in many contexts, from quantum mechanics to local mirror symmetry. They can be described in terms of topological string free energies and Wilson loops, in the so-called Nekrasov－Shatashvili limit. We consider the trans-series extension of the holomorphic anomaly equations satisfied by these quantities, and we obtain exact multi-instanton solutions for these trans-series. Building on this result, we propose a unified perspective on the resurgent structure of quantum periods. We show for example that the Delabaere－Pham formula, which was originally obtained in quantum mechanical examples, and which is similar to the Kontsevich-Soibelman transformation for the wall-crossing formulas of BPS invariants, is a generic feature of quantum periods, and therefore the Stokes constants of quantum periods could be interpreted as BPS invariants. We illustrate our general results with explicit calculations for the quantum mirror curve of local $\mathbf{P}^2$.

Beijing time: 04: 00-05:00 pm
Speaker: Johannes Walcher   <walcher@uni-heidelberg.de>
Title: Exponential Networks for Linear Partitions

Abstract:

Previous work has given proof and evidence that BPS states in local Calabi-Yau 3-folds can be described and counted by exponential networks on the mirror curve. The depictive representation is appealing for its elementarity, but so far only a handful of examples have been successfully worked out in detail. In this talk, we will exhibit an explicit correspondence between torus fixed points of the Hilbert scheme of points on $\mathbf{C}^2 \subset \mathbf{C}^3$ and anomaly free exponential networks attached to the quadratically framed pair of pants. (Joint work with S. Banerjee, M. Romo and R. Senghaas.)

Beijing time: 05:15-06:15 pm

Speaker: Maxim Kontsevich <maxim@ihes.fr>

Title: Non-holomorphic deformations of Landau-Ginzburg models

Abstract:

With a non-singular complex variety Y together with a holomorphic function W one can associate a sheaf of differential graded Lie algebras on Y consisting of polyvector fields with the differential given by the commutator with W. The formal germ of the derived moduli space is smooth and finite-dimensional if the critical locus is compact, Y is a Kähler and carries a non-vanishing holomorphic volume element. A part of the derived moduli space can be interpreted as moduli of holomorphic deformations of the pair (Y, W), but the whole derived moduli space does not have a direct holomorphic interpretation. Such spaces are of great interests as they carry a weakened form of the Frobenius manifold structure, and are expected to describe genus 0 Gromov-Witten invariants for general symplectic manifolds. I'll talk about Fukaya-theoretic and Hodge-theoretic aspects of non-holomorphically deformed LG models, including a generalization of theory of spectra for isolated singularities.

Jan. 12th   Thursday

Beijing time: 08:30-09:30 am

Speaker: Ahsan Khan <khan@ias.edu>

Title: Three Possible Generalizations of the Algebra of the Infrared

Abstract:

The algebra of the infrared is a remarkable structure that describes certain aspects of massive two-dimensional $N = (2,2)$ theories. It is interesting to consider whether similar structures may exist in other physical contexts. In this talk, I will present three different contexts where we may expect such a structure. The first comes from considering a more general kind of two-dimensional $N = (2,2)$ theory; one that allows for non-trivial twisted masses, leading to the possibility of particles in addition to solitons. The second concerns the study of four-dimensional $N = 2$ theories and their BPS particles. Finally, I will discuss some ideas relating to three-dimensional $N = 4$ theories and hyperKahler moment maps.

Beijing time: 10:00-11:00 am

Speaker: Yan Soibelman <soibel@math.ksu.edu>

Title: Wall-crossing structures and Chern-Simons theory.

Abstract:

The algebra of the infrared gives rise to a categorification of the Picard-Lefschetz wall-crossing formulas. Same wall-crossing formulas control the behavior of finite-dimensional exponential integrals. More general notion of wall-crossing structure was introduced 10 years ago by Kontsevich and myself. Recently we explained how it was related to the resurgence properties of

many generating series in mathematics and physics. In this talk I am going to explain a speculative approach to the wall-crossing structure in complexified Chern-Simons theory. In the end it should give a conceptual explanation of analytic properties of the perturbative expansions in Chern-Simons theory.

Beijing time: 04: 00-05:00 pm
Speaker: Vadim Schechtman <vschechtman@gmail.com>
Title: Vanishing cycles and Dold - Kan correspondence
Abstract:
We will be discussing some analogies between vanishing cycles and normalized chains
appearing in the Dold - Kan correspondence between simplicial objects and chain complexes
in an abelian category.

Beijing time: 05:15-06:15 pm
Speaker: Lev Soukhanov <merlin@solcery.xyz>
Title: Algebra of the infrared and real Morse theory
Abstract:
I will talk about the occurrence of the Algebra of the Infrared structure in the different geometric
setting: the solutions of a pair of commuting gradient vector fields.

Jan. 13th   Friday

Beijing time: 08:30-09:30 am
Speaker: Si Li   <sili@mail.tsinghua.edu.cn>
Title: Elliptic chiral homology and chiral index
Abstract:
We present an effective quantization theory for chiral deformation of two-dimensional conformal field theories. We explain a connection between the quantum master equation and the chiral homology for vertex operator algebras. As an application, we construct correlation functions of the curved beta-gamma/b-c system and establish a coupled equation relating to chiral homology groups of chiral differential operators. This can be viewed as the vertex algebra analogue of the trace map in algebraic index theory. The talk is based on the recent work arXiv:2112.14572 [math.QA].

Beijing time: 10:00-11:00 am
Speaker: Bohan Fang   <bohanfang@gmail.com>
Title: Mirror curves and homological mirror symmetry for toric CY 3-orbifolds
Abstract:

For the mirror curve of a toric Calabi-Yau 3-orbifold, one can assign a Fukaya-type category. This category is modeled on the category of constructible sheaves on the 1-dim Lagrangian core of the mirror curve. They form a cosheaf and also have some sheaf properties, allowing us to show the equivalence to the matrix factorization category for the toric CY 3-orbifold by gluing, achieving a version of homological mirror symmetry. This talk is based on the joint work with Qingyuan Bai.

Beijing time: 04: 00-05:00 pm
Speaker: Andrey Losev   <aslosev2@yandex.ru>
Title: Towards counting of toric surfaces in complex manifolds through the Algebra of the Infrared I
Abstract:
It is well-known how effective WDVV equations are in counting rational curves in complex manifolds.The complex dimension 2 analogue of rational curves are toric surfaces. So, is it possible to get dim 2 version of WDVV?
In the first part of my talk I would explain why WDVV is a refinement of Bott-Morse equation $D^2=0$.In the second I will go to complex dimension 2 and will relate holomorphic maps of toric surfaces to a theory what Lev Soukhanov and I are calling 2-Morse theory. This theory studies 2-trajectories, i.e. Maps from R^2 to the target manifold along the pair of commuting vector fields.Evolution along commuting. In the last part I will present the analogue of Morse-Bott equations for generating function for 2-trajectories passing through some cycles in the target space. I will explain the work of Soukhanov who showed that the 2-analogue of Morse equation is the Maurer-Cartan equation in the Algebra of the Infrared. Thus, we will stop one step from getting the 2-analogue of WDVV, that we still do not know.

Beijing time: 05:15-06:15 pm
Speaker: Yu-Wei Fan   <yuweifanx@gmail.com>
Title: On classification of autoequivalences of certain Calabi-Yau categories
Abstract:
The Nielsen-Thurston classification states that any mapping class of a Riemann surface is either of finite order, reducible, or pseudo-Anosov. Motivated by the analogy between Teichmuller theory and the theory of stability conditions on triangulated categories, we investigate the categorical analogue of the classification. First, we discuss the notion of pseudo-Anosov autoequivalences (joint work with Filip, Haiden, Katzarkov, and Liu). Second, for the finite order elements, we discuss the categorical Nielsen realization problems (ongoing work with Lai).