Dear friends and colleagues,

I want to share with you or your colleagues or your students some amount of mathematical physics related to what I temporary call B-theory (see the attachment). Maybe you or your colleagues or students are interested in a piece of it, maybe you would like to correct my understanding – you are very welcome.

I. Therefore, I am starting a mathematical physics program "Introduction to B-theory" (see section II). I will start with description of what is going to happen.

1. Lectures on Wednesdays from 3pm to 5:20 pm Beijing time, that is 10 am to 12:20 pm Moscow time that is 8 am to 10:20 am Paris time.
(40 min Lecture +10 min break +40 min Lecture +10 min break + 40 min seminar).
     I am not that crazy to think that anyone in Western Europe may join the lecture at 8am, but someone can join the 40 min seminar at 9:40 after looking through presentation of the talk that would be available before the talk.

The Zoom link for lectures is
Sen Hu 邀请您参加预先安排的 Zoom 会议。

主题：Zoom meeting invitation - Sen Hu 的 Zoom 会议

时间：2020年11月4日 03:00 下午 北京，上海

加入 Zoom 会议
https://zoom.com.cn/j/7983994886
会议 ID：798 399 4886

2. Seminars on Thursdays on 8:30pm-10:50pm Beijing time, 3:30-5:50pm Moscow time, 1:30-3:50 (40 min mostly for Chinese and Russians+ 10 min break + 40 min for everybody+10 min break + 40 min mostly for West Europe and Russians). The first part of the seminar would strongly overlap with the third one for convenience of visitors from different regions.
The registration for these seminars is done by Euler International Mathematics Institute (St.Petersburg, Russia) https://pdmi.ras.ru/EIMI/ , address for registration is https://indico.eimi.ru/event/132/.
Registered participants would get the zoom link.
If for some reason you do not want to register, or have a registration problems, just write to aslosev2@yandex.ru.

3. Seminars on Fridays mostly for Americans who would like to join the program but cannot do it because of time difference and for Europeans that would like to participate but prefer evenings. These seminars would repeat Thursdays seminars. They would be held at (3-5:20 am Beijing time, 10pm-12:20 pm Moscow, 8pm-10:20 pm Paris, 2pm-4:20pm East Coast, 11am-1:20pm at West Coast) 40 min+10 min break+40 min+10 min break+40 min (again, first 40 min would basically repeat last 40 min for convenience of visitors).
 The registration for these seminars is also done by Euler International Mathematics Institute (St.Petersburg, Russia) https://pdmi.ras.ru/EIMI/ , address for registration is https://indico.eimi.ru/event/132/.
Registered participants would get the zoom link.

If for some reason you do not want to register, or have a registration problems, just write to aslosev2@yandex.ru.

4. Videos of talks, both seminars and ppt of the coming talk would be available, in particular, on the site of EIMI.

5. Later we can add complementary talks and seminars on details of particular subjects for people interested in such details.

Therefore, the core course would consist of 25 talks + many seminars. We plan to unify scientist and students from different countries interested in this piece of mathematical physics.

II.   INTRODUCTION TO B-THEORY (by Andrey Losev)

The aim of this course is to give a detailed introduction to B-theory that I hope may be considered as a competitor to superstring theory at least in the soft particle scattering.

All that started when Witten introduced A and B topological strings. Later, in a paper "Chern-Simons as a string theory" he briefly outlined that probably we should develop not the string theories we used to study but some kind of universal string theory. Theories studied before should be considered just as realizations of the universal theory. He also pointed out that it should be a CS-like theory.

This was developed in the prominent work of Bershadsky, Cecotti, Ooguri and Vafa (BCOV) who studied the field theory corresponding to type B topological string theory. They also showed that their theory can reproduce subsector of superstring theory. However, their treatment was restricted to compact Calabi-Yau case and did not include so-called gravitational descendants. They also did not mean that they can approach the full string theory this way.

The next step was done by Berkovits who proposed the pure spinor string theory that did not contain super ghosts of the worldsheet supersymmetry but can reproduce the tree-level, one-loop and two-loop amplitudes of the superstring in 15 pages compared to 150 page calculation of preceding superstring approach. He also proposed a pure spinor particle in eleven dimensions whose polarizations correspond to linearized theory of 11-dimensional supergravity.

The recent crucial step was done by Costello and Li who included gravitational descendants into BCOV approach together with making drastic changes in the structure of BCOV action, studied open strings sector and holography, and related it to what they called twist of supergravity by considering the background with superghost condensation.

I think that understanding of Berkovits string theory as a version of B-type topological string and joining tools of these two approaches may lead to a theory that could compete with standard superstring theory.

Since this theory came from B-topological strings, was developed by BCOV and Berkovits and does not have a common name, I propose to call it B-theory.

In this course I will begin with Dirac-Segal axioms of QFT and TQFT (and derive from it Witten's proposal of universal string theory). Then I will discuss in detail different one-dimensional examples, traditional(with b-c ghosts) and so-called topological of A and B type.

I will explain BV treatment of quantum field theory that seems to be the proper language when we talk about B-theory. I will also argue that BV theory seems to follow from the tau-theory that unifies space-time and fields.

I will apply this language to the homotopical transfer in homological algebra and come out with infinity-structures and their quantum generalizations. I will show that application of the same construction to traditional representation leads to standard definition of amplitudes in Quantum Field Theory.

Meanwhile, I will present instantonic theories of Frenkel, Losev and Nekrasov that are universal A-models. I will also discuss AKSZ formalism and universal B-models.

I will derive the simplest mirror transformation from the A to B model in dimension 2.

I will discuss complex tropicalization and show how 2-dimensional A-model tropicalizes exactly to BCOV-like theory. I will explain in which sense field theory may be considered as a tropicalization of string theory. Then I will argue that large volume limit tropicalizes B topological strings to BCOV field theory.

In parallel I will explain how conventional string theory is another realization of universal string theory and how BV antifields and ghosts arise in conventional string.

I will discuss gravitational descendants, how they arise in B-model and discuss how to incorporate them into action starting from Losev-Shadrin and ending with Costello-Li.

Then I will move to supersymmetry and discuss pure spinor derivation of SYM from CS-like action. It would also lead to explanation of the SUSY in d=10 SYM, that is the infinity-realization of SUSY and why before it was called on-shell closure.

I will openly discuss results and problems in treatment of pure spinor (Berkovits) superparticle and strings, and how the superghost backgrounds like that of Nekrasov and Costello-Li may save the day. I consider this topic as not completed and I will invite everybody for collaboration.

I will outline Berkovits string theory, its advantages and open problems, and discuss what may happen if we put it in the superghost background.

I would conclude by attempt to joint the ideas of generalized BCOV theory in the sense of Costello-Li and Berkovits string theory. I strongly believe that joining these two B can lead to a B-theory that may try to compete with superstring theory at least in description of soft particle scattering. At the end we will discuss open problems of the B-theory.

Let me remark that even if this attempt of construction of the B-theory would fail, those who would attend the course would get quite a lot of useful information that may help them in their studies in mathematical physics.

WELCOME TO THE PROGRAM,

Andrey Losev