WORKSHOP ON SUPERMODULI

INSTITUTE FOR GEOMETRY AND PHYSICS
TRIESTE, SEPTEMBER 23 TO 26, 2019

PROGRAMME

	Monday	Tuesday	Wednesday	Thursday
9:30 - 10:30	Hdz. Ruipérez 1	Fré 2	Hdz. Ruipérez 3	Cirafici
10:30 - 11:00	Break	Break	Break	Break
11:00 - 12:00	Sen 1	Sen 2	Re	Codogni
12:00 - 13:00	Cacciatori	Hdz. Ruipérez 2	Fré 3	Polyakov
	Lunch	Lunch	Lunch	Lunch
14:30 - 15:30	Fré 1	Tanzini	Fioresi	
15:30 - 16:00	Break	Break	Break	
16:00 - 17:00	Noja	Grassi	Ott	

Titles and astracts

Pietro Fré (U. Torino). *Minicourse "Introduction to supersymmetry."*

Daniel Hernández Ruipérez (U. Salamanca). *Minicourse "Supergeometry and Supermoduli spaces."*

Sergio Cacciatori (U. Insubria). *Cyclic bar homology, supergeometry, loop manifolds and mirror symmetry.* In this talk I will outline some ideas for a research program in mathematical physics. In particular I will discuss why we could expect that a full development of supergeometry might serve to connect and unify different — and a priori unrelated — branches of mathematics. In doing so, I will shortly discuss cyclic homology of certain DGAs, its relation with loop manifolds cohomology and to supersymmetry, as well as some hints to (2,0) mirror symmetry.

Michele Cirafici (U. Trieste) *Refined BPS spectra and quantum line defects.* I will discuss refined BPS invariants associated with quantum line defects in certain supersymmetric quantum field theories. Such defects can be specified via geometric engineering in the UV by assigning a path on a certain curve. In the IR they are described by framed BPS quivers. I will discuss the associated BPS spectral problem. By modifying a construction by Nekrasov and Okounkov, I will show how the relevant BPS indices arise from the K-theoretic enumerative geometry of the moduli spaces of quiver representations.

Guido Codogni (U. Roma 3). *Moduli and Periods of Supersymmetric curves.* After some preliminary material about super stacks, the moduli space of susy curves and its bosonic

quotient, I will give a description of the infinitesimal period map for susy curves. This is a joint work with F. Viviani. I will then discuss the possibility of extending the period map to the boundary of the moduli space. If time permits, following a recent work of Felder, Kazhdan and Polishchuk, I will also present the relation between these results and the regularity of the superstring supermeasure.

Rita Fioresi (U. Bologna). *Harish-Chandra representations and Supersymmetric Spaces.* During 1955-56 Harish-Chandra published three papers in the American Journal of Mathematics devoted to understanding the theory of representations of a real semisimple Lie group. These modules were constructed both infinitesimally and globally, as spaces of sections of holomorphic vector bundles on the associated hermitian symmetric space. The purpose of this talk is to show how this construction can be replicated in supergeometry to obtain infinite dimensional representations of a real Lie supergroup and their connections to the theory of supersymmetric spaces. In the end we will also present the explicit example of the Siegel superspace.

Pietro A. Grassi (U. Piemonte Orientale). *Integral Forms and Applications to Quantum Field Theory.*

Simone Noja (U. Milano). *Forms in supergeometry: physics and mathematics.* One remarkable feature in supergeometry is that the de Rham complex of differential superforms of a supermanifold is not bounded from above and there is no notion of a "top differential superform" that can be integrated over. This has led to the introduction of new kind of forms, called "integral forms,", that come arranged into a complex which is bounded from above and where sections of the Berezinian bundle correspond to "top integral forms/" In this talk I will review the different notions of forms that appear in supergeometry, their relations, use and characterizing structures, both from the point of view of theoretical physics and mathematics.

Nadia Ott (U. Minnesota). *The Supermoduli space of genus zero super Riemann surfaces with Ramond Punctures.* It has been known since the late 1980s that a superstring scattering amplitude may be expressed as an integral over the supermoduli space $\mathfrak{M}$ of super Riemann surfaces. However, it is not at all obvious that the function we want to integrate over $\mathfrak{M}$ is actually integrable, but a good way to study whether it is or not, is to pass to the compactification of $\mathfrak{M}$. Analogous to the ordinary setting, the Deligne-Mumford compactification of $\mathfrak{M}$ is achieved by adding divisors at infinity corresponding to the two types of degenerations we allow to occur, which we call either Neveu-Schwarz or Ramond degenerations. These divisors at infinity are given by spaces built from the various supermoduli spaces $\overline{\mathfrak{M}}_{g,\mathfrak{n}_{NS}\mathfrak{n}_R}$ of genus g super Riemann surfaces with $\mathfrak{n}_{NS}$ NS punctures and $\mathfrak{n}_R$ Ramond punctures. In particular, it is in the compactification that the notion of a Ramond puncture shows itself to be necessary. For $\mathfrak{n}_R > 4$ we give a construction of $\mathfrak{M}_{0,0,\mathfrak{n}_R}$ as a $n-3|n/2-2$-dimensional supermanifold. This is a continuation of previous work done by Witten in which he showed $(\mathfrak{M}_{0,\mathfrak{n}_R})_{red}$ to be a $n-3$ dimensional supermanifold.

Dimitri Polyakov (Sogang U., Seoul). *Entanglement of Mixed States in Bosonic String Theory.* We study a new class of solutions in linearized open string field theory (OSFT) involving higher-spin modes. Unlike the elementary OSFT solutions (on-shell vertex operators) that, acting on a vacuum, define wavefunctions of pure states (e.g. a tachyon), the solutions that we describe correspond to the reduced density matrices which eigenvalues describe the entanglement between higher-spin modes with different spin values. We compute the entan-

glement entropy on these OSFT solutions, and the answer is expressed in terms of converging series in inverse weighted partition numbers.

Riccardo Re (U. Milano). *Total de Rham complexes of supermanifolds.* Our talk will be partly a revisitation of known results and partly an exposition on work in progress with Simone Noja and Sergio Cacciatori. We consider a well known complex in D-modules theory, the total de Rham complex, in the context of supermanifolds. This can be considered as a complex of differential forms with differential operator coefficients, and it can be viewed as a non-commutative deformation of a complex of differential forms on the total space of the cotangent bundle. We will show its relations with the berezian line bundle of the supermanifold, and some possibly interesting generalizations of it. Emphasis will be given to explicit formulas. and calculations.

Ashoke Sen (Harish-Chandra Research Institute, Allahabad). TBA.

Alessandro Tanzini (SISSA). TBA