**LABORATOIRE DE PHYSIQUE THÉORIQUE**
**DE**
**L'ÉCOLE NORMALE SUPÉRIEURE**

XXXIII$^{\text{ème}}$ INSTITUT D'ÉTÉ

# "ASPECTS GEOMETRIQUES ET COSMOLOGIQUES DES BRANES ET DES SUPERCORDES"

19-30 août 2002

Liste des participants extérieurs au laboratoire

| | | |
|---|---|---|
| **C. ANGELANTONJ** | **G. D'APPOLLONIO** | **M. AXENIDES** |
| **C. CALLAN** | **D. CLEMENTS** | **J. P. DERENDINGER** |
| **E. DUDAS** | **F. FERRARI** | **M. FLORATOS** |
| **E. GAVA** | **J. GAUNTLETT** | **G. GIBBONS** |
| **S. GUKOV** | **J. KALKKINEN** | **P. KASTE** |
| **E. KIRITSIS** | **W. LERCHE** | **R. MINASIAN** |
| **J. MORALES** | **J. MOURAD** | **W. NAHM** |
| **S. NICOLIS** | **H. PARTOUCHE** | **M. PETRINI** |
| **M. PETROPOULOS** | **C. POPE** | **M. PORRATI** |
| **G. PRADISI** | **J. RIZOS** | **A. SCHWARZ** |
| **E. SOKATCHEV** | **K. STELLE** | **P. VAN NIEUWENHUIZEN** |

Organisateurs

| **C. BACHAS** | **E. CREMMER** | **C. KOUNNAS** |
|---|---|---|
| bachas@lpt.ens.fr | cremmer@lpt.ens.fr | kounnas@lpt.ens.fr |


*Les séminaires auront lieu en CONF IV au*
*Laboratoire de physique théorique de l'école normale supérieure*
*24 rue Lhomond Paris(5ème)*
*en principe le matin à 11 heures*
*et, si besoin est, l'après-midi à 15 heures.*

Cet Institut d'été a bénéficié de l'aide du
Centre de Physique Théorique de l'Ecole Polytechnique

**Lundi 19 août**

**11h. Chris POPE** (Texas A& M University, College Station)
*Bohm Metrics and Unstable Higher-Dimensional Black Holes*

"It was recently shown by Bohm that there exist non-standard inhomogeneous Einstein metrics on certain spheres and products of spheres. We describe these metrics, and show how they will give rise to unstable black holes, and violations of the Cosmic Baldness Conjecture."

**15h. Carlo ANGELANTONJ** (CERN, Geneve)
*Type I Strings Dynamics on Magnetised Backgrounds*

"In this talk type I string dynamics on magnetised backgrounds will be reviewed. After a quick survey on open-string magnetic fields and their main implications on D-brane physics, I'll move to reductions on Melvin-like backgrounds where new interesting phenomena occurr: D-brane and O-planes are no more localised sources and original O-planes (may) transmute into new (different) ones."

**Mardi 20 août**

**11h. Massimo PORRATI** (CERN, Geneve)
*Higgs Phenomenon for the Anti de Sitter Graviton*

"We show that standard Einstein gravity coupled to a free conformal field theory (CFT) in Anti de Sitter space can undergo a Higgs phenomenon whereby the graviton acquires a nonzero mass and three extra polarizations. The essential ingredients of this mechanism are discreteness of the energy spectrum in AdS space, and "transparent" boundary conditions on the elementary fields of the CFT."

**15h. Jerome GAUNTLETT** (Queen Mary College, London)
*G-structures and wrapped fivebranes*

"The geometrical structures arising in supergravity solutions describing NS fivebranes wrapping supersymmetric cycles is discussed. These solutions are of interest as they holographically encode information about supersymmetric Yang Mills theories."

**Mercredi 21 août**

**11h. Manolis FLORATOS** (Demokritos, Athenes)
*Scaling Violations from AdS5 String.*

"Detailed presentation of N=0 and N=1 supersymmetric YM anomalous dimensions of Wilson Operators at two loops are presented and their large spin behaviour is discussed.The conjectured LogJ behaviour for large spin is found after cancellations between gauge invariant classes of diagrams even in the non-supersymmetric case. "

**15h. Werner NAHM** (Bonn University)
*Rational points in the moduli space of conformal field theories on K3.*

" It is expected that the moduli space of CFTs on K3 contains a dense subset of rational points and that these points are determined by a condition analogous to the complex multiplication condition on tori. It may be possible to guess the corresponding partition function. Among other things, this would allow the determination of all Ricci flat metrics on K3. Some steps in this direction are described."

## Jeudi 22 août

**11h. Frank FERRARI** (Universite de Neuchatel/LPTENS )
*Four dimensional critical points and double scaling limits*

"I will explain how the discretized, or matrix model, approach to non-critical strings, which was popular at the beginning of the 90s, can be generalized to four dimensions."

**15h. Sergei GUKOV** (Harvard, Boston)
*Conifold Transitions and Condensation of Five-Branes*

"We conjecture a topology changing transition in M-theory on a non-compact asymptotically conical $Spin(7)$ manifold, where a 5-sphere collapses and a $CP(2)$ bolt grows. We argue that the transition may be understood as the condensation of $M5$-branes wrapping the 5-sphere. Upon reduction to ten dimensions, it has a physical interpretation as a transition of $D6$-branes lying on calibrated submanifolds of flat space. In yet another guise, it may be seen as a geometric transition between two phases of type IIA string theory on a $G_2$ holonomy manifold with either wrapped $D6$-branes, or background Ramond-Ramond flux. This is the first non-trivial example of a topology changing transition with only 1/16 supersymmetry."

## Vendredi 23 août

**11h. Kellogg STELLE** (Imperial College, London)
*Large Gauge Transformations in M-theory*

"D=11 supergravity in the doubled formalism allows for cohomologically non-trivial transformations of the electric and magnetic gauge potentials. This talk will discuss how these symmetries come to be realised in the presence of 2-brane and 5-brane coupling, including the anomaly cancelling mechanism. "

## Lundi 26 août

**11h. Ruben MINASIAN** (Ecole Polytechnique, Palaiseau)
*Kaluza-Klein bundles and manifolds of exceptional holonomy*

"We show how in the presence of RR two-form field strength the conditions for preserving supersymmetry on six- and seven-dimensional manifolds lead to certain generalizations of monopole equations. For six dimensions the string frame metric is Kaehler with the complex structure that descends from the octonions if in addition we assume $F^{(1,1)} = 0$. The susy generator is a gauge covariantly constant spinor. For seven dimensions the string frame metric is conformal to a $G_2$ metric if in addition we assume the field strength to obey a selfduality constraint. Solutions to these equations lift to geometries of $G_2$ and $Spin(7)$ holonomy respectively."

**15h. Elias KIRITSIS** (LPTENS/Heraklion)
*pp-waves: String physics and holography*

" General global aspects of pp-wave geometries are discussed. Using exact CFT techniques, strings in pp-wave backgrounds supported by a Neveu-Schwarz flux are quantized. As in Euclidean $AdS_3$, spectral flow and associated long strings are shown to be crucial in obtaining a complete spectrum. Holography is investigated using conformally flat coordinates analogous to those of the Poincaré patch in $AdS$. It is argued that the holographic direction is the light-cone null coordinate $u$, and that the holographic degrees of freedom live on a codimension-one screen at fixed $u$. The usual conformal symmetry on the boundary is replaced by a representation of a Heisenberg-type algebra $H_D \times H_D$, hinting at a new class of field theories realizing this symmetry. A sample holographic computation of 2 and 3-point functions is provided and Ward identities are derived."

## Mardi 27 août

**11h. Peter VAN NIEUWENHUIZEN** (LPTENS/Stony Brook)
*Covariant quantization of the Green-Schwarz superstring*

"We give a derivation from scratch of a new covariant quantization of the superstring and other models. We relax the pure spinor constraint of Berkovits by adding new ghosts whenever needed to achieve BRST nilpotency on all fields. We define physical states by an equivariant cohomology, and obtain the correct spectrum for the open and closed string at the massless and massive level."

**15h. Emery SOKATCHEV** (LAPTH, Annecy-le-Vieux/CERN)
*Conformal fields in the pp-wave limit*

"We study the kinematics of conformal fields in the pp-wave limit in a geometric approach where the effect of the contraction of the conformal algebra can be visualized as an expansion of space-time. We show that the two-, three- and four-point correlation functions of conformal fields can have a well-defined contraction limit if their space-time dependence merges with the dependence on the coordinates of the R symmetry group."

## Mercredi 28 août

**11h. Bernard JULIA** (LPTENS)
*Borcherds Superalgebras and M-theory*

"It is well known but rather mysterious that root spaces of the $E_k$ Lie groups appear in the second integral cohomology of regular, complex, compact, del Pezzo surfaces. The corresponding groups act on the scalar fields (0-forms) of toroidal compactifications of M theory. Their Borel subgroups are actually subgroups of supergroups of finite dimension over the Grassmann algebra of differential forms on spacetime that have been shown to preserve the self-duality equation obeyed by all bosonic form-fields of the theory. We show here that the corresponding duality superalgebras are nothing but Borcherds superalgebras truncated by the above choice of Grassmann coefficients. The full Borcherds' root lattices are the second integral cohomology of the del Pezzo surfaces. Our choice of simple roots uses the anti-canonical form and its known orthogonal complement. Another result is the determination of del Pezzo surfaces associated to other string and field theory models. Dimensional reduction on $T^k$ corresponds to blow-up of $k$ points in general position with respect to each other. All theories of the Magic triangle that reduce to the $E_n$ sigma model in three dimensions correspond to singular del Pezzo surfaces with $A_{8-n}$ (normal) singularity at a point. The case of type I and heterotic theories if one drops their gauge sector corresponds to non-normal (singular along a curve) del Pezzo's. Previous encounters with Borcherds algebras are commented."

**15h. Curt CALLAN** (Princeton)
*String Theory in $AdS_5 \times S^5$:Slightly Beyond the Penrose Limit*

"The worldsheet action of string theory in the Penrose limit of $AdS_5 \times S^5$ is quadratic and soluble. It also has a simple holographic relation to the large R-charge sector of N=4 supersymmetric Yang-Mills theory in four dimensions. Such connections should hold between string theory in the exact geometry and the full Yang-Mills theory. We take some first steps toward establishing such a general result by studying how curvature corrections to the string theory worldsheet action in $AdS_5 \times S^5$ reproduce non-leading large R-charge corrections to dimensions and matrix elements of gauge theory operators."

## Jeudi 29 août

**11h. Edi GAVA** (SISSA, Trieste)
*Open Strings on Plane waves and their Yang-Mills duals*

"The plane wave limit of $AdS_5 \times S^5/Z_2$, which arises as the near horizon geometry of D3-branes at an orientifold 7-plane in type I' theory, is studied. String theory in the resulting plane wave background, which contains open strings, is analyzed. Gauge invariant operators in the dual $Sp(N)$ gauge theory are identified with unoriented closed and open string states. "

**15h. Wolfgang LERCHE** (CERN, Geneve)
*D-Branes, Mirror symmetry and exact N=1 superpotential*

"I will review a geometric approach which allows to systematically and efficiently compute non-perturbatively exact N=1 superpotentials on certain D-brane world-volumes. It is based on a generalization of mirror symmetry to open strings, and represents the N=1 analog of the well-known "N=2 special geometry". It puts the computation of N=1 superpotentials on a similar footing as the familiar computation of the N=2 prepotential."

**Vendredi 30 août**

**11h. Gary GIBBONS** (Cambridge)
*Thoughts on tachyon cosmology*

”I will first review some very basic difficulties one has in obtaining a de-Sitter like state in Supergravity/M-theory. They arise because, in the absence of scalar potentials, the strong energy condition is satisfied. Introduction of a tachyon field à la façon de Sen can circumvent this difficulty but does not yet give a completely satisfactory cosmological model. Moreover the picture that emerges in which the universe evolves to a tachyon state in which all open string states are confined and only closed strings remain is a rather attractive one. I will describe how this might work out at the level of classical field theory. The importance of the dominant energy condition, issues of causal propagation and the Carrollian contraction of the Lorentz group will be stressed.”

**15h. Emilian DUDAS** (LPT, Orsay )
*Nonsupersymmetric string vacua and lorentzian orbifolds*

”We investigate time-dependent backgrounds in nonsupersymmetric string vacua with D-branes localized in the compact space. We find a time-evolution with either a big-bang or a big-crunch singularity. We show that the result can be interpreted as the background of the appropriate supersymmetric string vacua with an additional orbifold operation which is a lorentzian boost. This suggests a way of interpreting string vacua with broken supersymmetry and NS tadpoles in terms of lorentzian orbifolds of supersymmetric vacua.”

# THAT’S ALL FOLKS