



Progress in String, Field and Particle Theory

Edited by

Laurent Baulieu, Eliezer Rabinovici,
Jeff Harvey, Boris Pioline and Paul Windey

NATO Science Series

Table of Contents

Preface	v
I Lectures	1
THE NON-ADS/NON-CFT CORRESPONDENCE, OR THREE DIFFERENT PATHS TO QCD	3
by <i>OFER AHARONY</i>	
1 Introduction	3
2 Review of AdS/CFT	4
3 From AdS/CFT to QCD	7
4 Deformations of N=4 SYM	9
5 Compactification scenarios	17
6 The Klebanov-Strassler background	21
7 Summary	22
PHYSICS OF LOW SCALE STRING MODELS	25
by <i>IGNATIOS ANTONIADIS</i>	
1 Preliminaries	25
2 Heterotic string and motivations for large volume compactifications	26
3 M-theory on S^1/Z_2 "x" Calabi-Yau	28
4 Type I/I' string theory and D-branes	29
5 Type II theories	33
6 Theoretical implications	37
7 Scenario for studies of experimental constraints	45
8 Extra-dimensions along the world brane: KK excitations of gauge bosons	46
9 Extra-dimensions transverse to the brane world: KK excitations of gravitons	54
10 Dimension-eight operators and limits on the string scale	58
11 D-brane Standard Model	61
12 Appendix: Supersymmetry breaking in type I strings	67
SUPERGRAVITY VERSUS TOPOLOGICAL GRAVITY	
by <i>LAURENT BAULIEU</i> ,	

THE HOLOGRAPHIC PRINCIPLE

75

by RAPHAEL BOUSSO

1	Introduction	75
2	Entropy bounds from black holes	82
3	Towards a holographic principle	94
4	A spacelike entropy bound?	100
5	The covariant entropy bound	106
6	The dynamics of light-sheets	119
7	Applications and examples	125
8	The holographic principle	138
9	Holographic screens and holographic theories	141
A	General relativity	155

TWO TALKS ON A TENTATIVE THEORY OF LARGE DISTANCE PHYSICS

167

by DANIEL FRIEDAN

1	The need to produce QFT	168
2	The general nonlinear model	168
3	The coupling constants λ^i	169
4	At short 2d distances Λ^{-1}	171
5	The manifold of general nonlinear models	172
6	The general nonlinear model in string theory	172
7	The infrared failure of string theory	173
8	Every handle diverges logarithmically	174
9	Potentially realistic string scattering	175
10	Local handles	176
11	Cancel the cutoff dependence of local handles	177
12	The λ -model	178
13	The <i>a priori</i> measure	180
14	Nonperturbative 2d effects in the λ -model?	182
15	General covariance and gauge invariance	182
16	The effective worldsurface	183
17	The form of the theory	183
18	Dynamical background independence	184
19	What the cancelling means	185
20	Physics at finite spacetime distance	186
21	What needs to be done	187

A TOY MODEL FOR THE M5-BRANE

by JEFF HARVEY, lecture notes not included

D-BRANES ON THE CONIFOLD AND $\mathcal{N} = 1$ GAUGE/GRAVITY DUALITIES

189

by C.P. HERZOG, I.R. KLEBANOV AND P. OUYANG

1	Introduction	189
2	D3-branes on the Conifold	192

3	The RG cascade	200
4	The Chiral Anomaly	204
5	Deformation of the Conifold	211
6	Infrared Physics	215
DEFECTS, DECAY, AND DISSIPATED STATES		225
<i>by EMIL J. MARTINEC</i>		
1	Introduction	225
2	Open strings	229
3	Closed strings	239
STRING DYNAMICS ON PP-WAVES FROM YANG MILLS THEORY		
<i>by SHIRAZ MINWALLA, lecture notes not included</i>		
SEIBERG-WITTEN PREPOTENTIAL, HIGHER CASIMIRS, AND FREE FERMIONS		263
<i>by NIKITA A. NEKRASOV</i>		
1	Introduction	263
2	The method	264
3	Calculation	269
4	U(1) example in greater detail	270
ASPECTS OF STRING MOTION IN TIME-DEPENDENT BACKGROUNDS		275
<i>by ELIEZER RABINOVÍCI</i>		
1	Introduction	275
2	Some Questions regarding Cosmologies in General Relativity . . .	276
3	Stringy Attempts to Address the Questions	277
4	Exact Time-Dependent Backgrounds	281
5	Algebraic, Dynamic and Geometrical Aspects of Coset backgrounds	282
6	Cosmology and Whiskers	285
7	From Big Bang to Big Crunch and Beyond	290
8	The coset	297
9	An algebraic analysis of the superstring on the NW background . .	310
10	Summary	314
ON THE GEOMETRY OF HIGHER-SPIN GAUGE FIELDS		319
<i>by DARIO FRANCIA AND AUGUSTO SAGNOTTI</i>		
1	Introduction	319
2	Gauge-invariant equations for unconstrained bosons	322
3	Gauge-invariant equations for unconstrained fermions	324
4	Free-field geometry	325
5	The issue of gauge fixing	327
6	Higher-spin geometry and String Theory	329
7	Conclusions	332

OPEN STRING CREATION BY S-BRANES	335
<i>by ANDREW STROMINGER</i>	
1 Introduction	335
2 Scalar Field with Time-Dependent Mass	337
3 Minisuperspace Approximation	339
4 The Half-s-brane and Boundary Liouville Theory	340
5 Hagedorn Divergence	341
TOPICS IN GAUGE THEORY/STRING THEORY DUALITY	
<i>by ERIK VERLINDE, lecture notes not included</i>	
OPEN STRING STAR ALGEBRA AND ROLLING TACHYONS	
<i>by BARTON ZWIEBACH, lecture notes not included</i>	
II Gong Show	345
SUPERCONFORMAL BOUNDARY CONDITIONS OF THE $N=1$ NONLINEAR SIGMA MODEL	347
<i>by CECILIA ALBERTSSON</i>	
BACKGROUNDS OF 2D STRING THEORY FROM MATRIX MODELS	351
<i>by SERGUEI ALEXANDROV</i>	
THE $D3 \perp D1$-BRANE INTERSECTION AND MONOPOLE SCATTERING	357
<i>by JESSICA BARRETT AND PETER BOWCOCK</i>	
HOLOGRAPHY AND INFRARED CONFORMALITY IN TWO DIMENSIONS	361
<i>by MARCUS BERG</i>	
STABILIZATION OF D-BRANES IN GENERAL GROUP MANIFOLDS	365
<i>by PEDRO BORDALO</i>	
ORIENTIFOLDS AND K-THEORY	369
<i>by VOLKER BRAUN</i>	
A RESOLUTION OF THE COSMOLOGICAL SINGULARITY WITH ORIENTIFOLDS	373
<i>by LORENZO CORNALBA AND MIGUEL COSTA</i>	
D-BRANES AND ORIENTIFOLDS OF S^3 AND RP^3	377
<i>by NICOLAS COUCHAUD</i>	

BOUNDARY STATES IN RATIONAL CFT <i>by GIUSEPPE D'APPOLLONIO</i>	381
QUASILOCALIZATION IN BRANE WORLD MODELS AND ON D-BRANES <i>by SERGEI L. DUBOVSKY</i>	385
S-CHARGE MONODROMY MECHANISM IN $N=2$ SYM FROM SEMICLASSICAL POINT OF VIEW <i>by ANATOLY DYMARSKY AND DMITRY MELNIKOV</i>	389
SINGULAR AND SMOOTH TIME-DEPENDENT ORBIFOLDS <i>by MICHAL FABINGER</i>	393
TYPE IIB 7-BRANE SOLUTIONS FROM NINE-DIMENSIONAL DOMAIN WALLS <i>by E. BERGSHOEFF, U. GRAN AND D. ROEST</i>	397
α'-CORRECTIONS TO FLUX INDUCED POTENTIALS IN TYPE IIB <i>by MICHAEL HAACK</i>	401
NONCOMMUTATIVE MULTI-SOLITONS <i>by MATTHEW HEADRICK</i>	405
SYMMETRIES IN M THEORY: MONSTERS, INC. <i>by P. HENRY-LABORDÈRE AND B. JULIA AND L. PAULOT</i>	409
SPACETIME DIFFEOMORPHISMS AND THE GEODESIC APPROXIMATION <i>by JÜRIG KÄPPELI</i>	413
GEPNER MODEL BOUNDARY STATES FROM GEOMETRY <i>by KRISTIAN D. KENNAWAY</i>	417
INSTANTON EXPANSIONS IN 5D $N = 2$ PREPOTENTIALS <i>by THOMAS KINGABY</i>	421
YANG-MILLS THEORY FROM STRING FIELD THEORY ON D-BRANES <i>by SEMEN KLEVTSOV</i>	425
MAGNETIZED TYPE I ORBIFOLDS IN FOUR DIMENSIONS <i>by MARIANNA LAROSA</i>	429
DE SITTER SPACE IN NON-CRITICAL STRING THEORY <i>by ALEXANDER MALONEY</i>	433

RIBBON GRAPHS AND SURFACES	437
<i>by</i> DMITRY MALYSHEV	
A MYSTERIOUS DUALITY: M-THEORY AND DEL PEZZO SURFACES	441
<i>by</i> ANDREW NEITZKE	
SUPER YANG-MILLS MATRIX INTEGRALS FOR AN ARBITRARY GAUGE GROUP	445
<i>by</i> VASILY PESTUN	
ON ADS₃ STRING THEORY	449
<i>by</i> P. MARIOS PETROPOULOS	
CUBIC FREE FIELD THEORY	453
<i>by</i> BORIS PIOLINE	
ON THE COVARIANT QUANTIZATION OF SUPERSTRINGS	457
<i>by</i> GIUSEPPE POLICASTRO	
OPEN STRINGS AND 3D TOPOLOGICAL FIELD THEORY	461
<i>by</i> J. FUCHS, I. RUNKEL AND C. SCHWEIGERT	
OBSERVER COMPLEMENTARITY IN DE SITTER SPACE	465
<i>by</i> IVO SAVONIJE	
REMARKS ON SURFACE STATES AND DERIVATIONS IN STRING FIELD THEORY	469
<i>by</i> MARTIN SCHNABL	
MULTIPLE TRACE DEFORMATIONS, BOUNDARY CONDITIONS AND ADS/CFT	473
<i>by</i> AMIT SEVER AND ASSAF SHOMER	
MODULI STABILIZATION FROM FLUXES	477
<i>by</i> MICHAEL B. SCHULZ	
TIME DEPENDENT BACKGROUND FROM NONSUPERSYMMETRIC STRINGS	481
<i>by</i> CRISTINA TIMIRGAZIU	
THE NS FIVE-BRANE PARTITION SUM	485
<i>by</i> MARCEL VONK	
GRAVITATIONAL APPROACH TO TACHYON MATTER	489
<i>by</i> TAKASHI YOKONO	

D-BRANES FROM N=2 SIGMA MODELS	493
<i>by MAXIM ZABZINE</i>	
Appendix	499
LIST OF SPEAKERS	501
LIST OF PARTICIPANTS	503