Dr. John Schwarz, Caltech (ITP 5-30-01) Early History of String Theory: A Personal Perspective

Outline

- Conductory Comments
  - 1979-85
- Supersymmetry
  - 1975-77
  - 1977-78
  - 1978-79
- Grand Unified
  - 1980-81
- The NSR model
  - 1981-83
- The dual resonance model
  - 1983-84
- The analytic S-matrix
  - 1960-68

Disclaimer: A number of profound

at a rate of about one per year.

The period 1960-85

Feb., 1977/007113

Feb., 1978/007113

Feb., 1978/007117

written up in these notes, particularly:

Some of the topics have been

A PERSONAL PERSPECTIVE

STRING THEORY - THE EARLY YEARS
The basic formula in this context is:

\[ N = \int_{\text{Hilb}(\mathcal{M})} \frac{\prod_{i=1}^{N} \left( \frac{1}{2}(1 + \mathcal{A}_i) \right)}{\prod_{i,j} \left( 1 - \mathcal{A}_i \mathcal{A}_j \right)} \]

Another key point is:

The final terms on an example result in:

\[ \mathcal{O}(\bar{c}) + \mathcal{A}(\bar{c}) \]

\[ \prod_{i,j} \left( 1 - \mathcal{A}_i \mathcal{A}_j \right) \]

\[ \prod_{i} \left( 1 - \mathcal{A}_i \right) \]

\[ \prod_{i} \left( 1 + \mathcal{A}_i \right) \]

The dual resonance model:

\[ 1987-90 \]
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Page 5

\[ I \{ L_m \} = (m-n) \sum_{m+n} L_m L_{m+n} \frac{1}{(2m+1)!(2n+1)!} \]

\[ I \{ F_m \} = \frac{1}{2m+1} F_m \]

Suppose, \( F_{-m} = \frac{1}{2m+1} F_m \)

Significance argument:

\[ (\tilde{F}_m + n) \phi = 0 \text{ for a free fermion state} \]

\[ P_0 = \tilde{P}_0 + \lambda \text{ in the target} \]

\[ \tilde{P}_0 = \int_{-\infty}^{\infty} \text{d}x :\chi \longleftrightarrow \chi : \]

\[ \tilde{P}_0 = \int_{-\infty}^{\infty} \text{d}x \frac{\partial}{\partial \phi(x)} \phi(x) \]

Announced - String theory & Gauge theory

1971-73 NSV Model
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1974-75: Gravity + Unification

- String theory of Kaluza-Klein models
- String/brane - 2+1d, 3+1d
- String - fermion propagation - 756 acwl
- Fermion propagation - 756 acwl
- Fermion - fermion propagation - 756 acwl
- String - fermion propagation - 756 acwl

- String theory of Kaluza-Klein models
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Page 7

1975-79 Survey "Super" String

- N=1, D=11 Supersymmetry
- N=8, D=4 Supergravity
- Brown, Schwarz, "The
- D=1, D=4 String Vacua"
- Fenstermacher, "D = 4
- Superstring Vacua"

A good idea.

Now the physics that we're
trying to go to, it seems
at least important to me — and also it

designed to do little my "Alfa" H. This.

...

other forces.

... evenly, and could account. For the

... square found also approach

... good thing

... extra dimension could be a

... thin in a UV dimension

... ground was needed by the theory

The year around this idea:
In London, the age seemed too short to do any serious work in string theory. Much of my career seemed in jeopardy at CERN, where I was doing experimental physics. The opportunity opened up at Caltech, and I decided to stay. CERN was not a good place for string theorists. My first goal was to begin a new, exciting collaboration.

In 1979, I began to listen more carefully for new ideas. Nevertheless, a year passed, and nothing happened. Then, suddenly, a year later, a new, exciting opportunity presented itself. In 1979, I began to listen more carefully for new ideas. Nevertheless, a year passed, and nothing happened. Then, suddenly, a new, exciting opportunity presented itself. In 1979, I began to listen more carefully for new ideas. Nevertheless, a year passed, and nothing happened. Then, suddenly, a new, exciting opportunity presented itself. In 1979, I began to listen more carefully for new ideas. Nevertheless, a year passed, and nothing happened. Then, suddenly, a new, exciting opportunity presented itself. In 1979, I began to listen more carefully for new ideas. Nevertheless, a year passed, and nothing happened. Then, suddenly, a new, exciting opportunity presented itself. In 1979, I began to listen more carefully for new ideas. Nevertheless, a year passed, and nothing happened. Then, suddenly, a new, exciting opportunity presented itself. In 1979, I began to listen more carefully for new ideas. Nevertheless, a year passed, and nothing happened. Then, suddenly, a new, exciting opportunity presented itself.

\[ f(r) = e^{\frac{8}{3}} \]

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Dr. John Schwarz, Caltech (ITP 5-30-01) Early History of String Theory: A Personal Perspective

Page 9

Dr. John Schwarz, Caltech (ITP 5-30-01) Early History of String Theory: A Personal Perspective

Page 9
Dr. John Schwarz, Caltech (ITP 5-30-01) Early History of String Theory: A Personal Perspective

Page 10

The end (or the beginning?)

...measurement artifacts...

...infinitesimal, not because of

...time, but also the trend...

By the beginning of 1985...

...Theoretical Dynamics, a holiday...

...for compactification - manifolds...

...the lattice data - error, noise...

...we were also making improvements...

...the end of 1984, there

...the SO(32) case could be F8 x F8

...the SO(32) case could be F8 x F8...

...the Wess-Zumino consistency...

...the zero point of the revolution...