What did David do before the string model?

I knew David before he was a string theorist

"I knew Doris Day before she was a virgin."

(Oscar Levant)

Logical Positivism

The philosophy of physics in the era 1954 - 1964

Causality

Titchmarsh Theorem

Fourier transform of a causal function has no ~~poles~~ singularities in the upper half plane

$H(t-t_0) = 0$ for $t < t_0$

Dispersion relations

"When faced with a problem physicists either disperse or form a group" (R.P. Feynman)

"Whereof we cannot speak, thereof we must keep silent"

L. Wittgenstein

$$F(s,t,u) = P + \frac{1}{\pi^2}\iint \rho_{st}(s',t')\frac{ds'dt'}{(s'-s)(t'-t)}$$

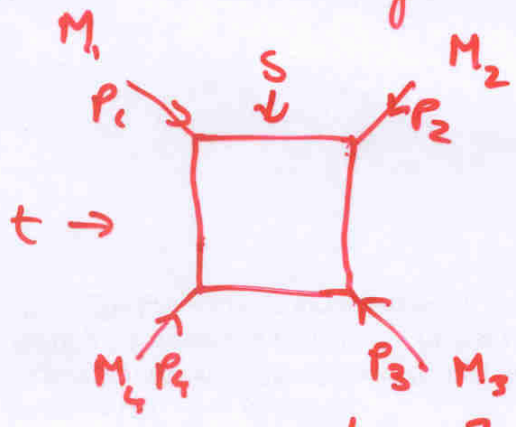
$$+ \frac{1}{\pi^2}\iint \rho_{tu}(t',u')\frac{dt'du'}{(t'-t)(u'-u)}$$

$$+ \frac{1}{\pi^2}\iint \rho_{us}(s',u')\frac{ds'du'}{(u'-u)(s'-s)}$$

Mandelstam Representation 1958

Phys Rev 122, 1344

True for Box Deagram

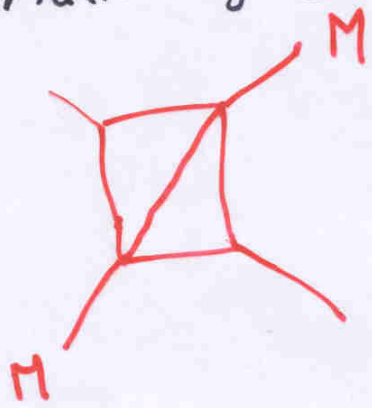


$$s+t+u = \sum_{i=1}^{4} M_i^2$$

Mandelstam representation fails!

Eden Landshoff Polkinghorne Taylor

J Math Phys 2 (1961) 656

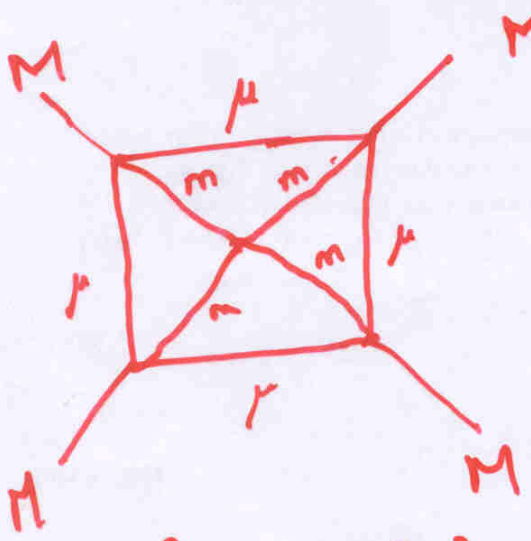


other masses unity

$M^2 > 4 + 2\sqrt{2}$

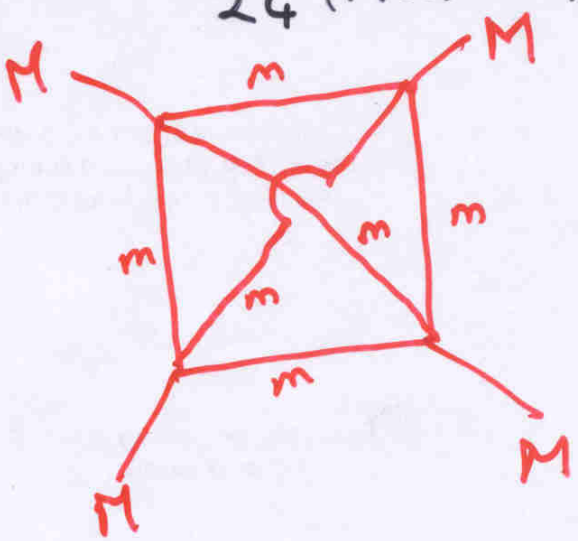
fails.

D Olive and J C Taylor Nuovo Cimento 24 (1962) 814



$M^2 < m^2 + 2\mu^2$

for no singularity



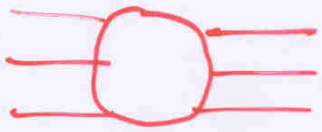
$M^2 > 5m^2$

complex singularities

This example is non planar.

S MATRIX THEORY

J Gunson J Math Phys 6 (1965) 827
(preprint 1963)



3 particle unitarity implies the existence of pole singularities

D.I Olive Phys Rev 135B (1964) 745
developed idea

The ANALYTIC S MATRIX

Eden Landshoff Olive Polkinghorne

CUP 1966

Sequel.

The objective : to determine the form of the S-matrix consistent with the requirements of Lorentz invariance
P, C, T invariance
crossing
unitarity

In 3+1 dimensions 2 indep variables describe 2 particle scattering

In 1+1 dimensions only one is required

In c of mass incoming $(\sqrt{M^2+k^2}, k)$, $(\sqrt{M^2+k^2}, -k)$
outgoing $(\sqrt{M^2+k'^2}, k')$, $(\sqrt{M^2+k'^2}, k')$
$k = \pm k'$

Can carry out the program for Affine Toda Field Theories

David Olive and String 7
Theory.

4 Fermion Amplitude

E Corrigan P Goddard D Olive RA Smith
Nuclear Physics B67 (1973) 477

Used Vertex operator methods

Alessandrini Amati Le Bellac
Olive Phys Lett B32 (1970) 285-290

S Mandelstam also derived
4 fermion amplitude using analogue
methods.

GSO projection
Projection operators for loops

1968 - 1974 1st hadronic string
1984 - 1989 Planck mass scale.

1984 - 1989

New Ideas. Anomaly Cancellation
Calabi Yau Compactification
The Heterotic string
left movers and right movers could be different
chiral model.
5 distinct string models.

1994.... Olive Montonen duality
generalises to unite 5 models.