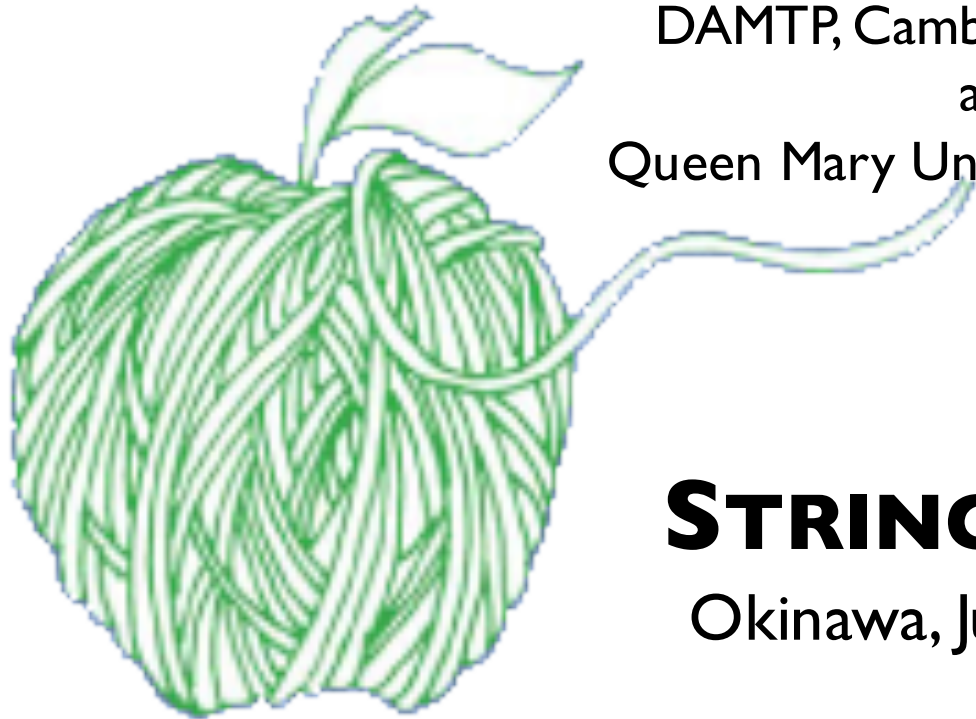


50 YEARS OF STRING THEORY

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STRINGS 2018

Okinawa, June 29 2018



UNIVERSITY OF
CAMBRIDGE



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STRING THEORY EMERGED DIRECTLY OUT OF THE EXPERIMENTAL DATA ON THE STRONG FORCE !!

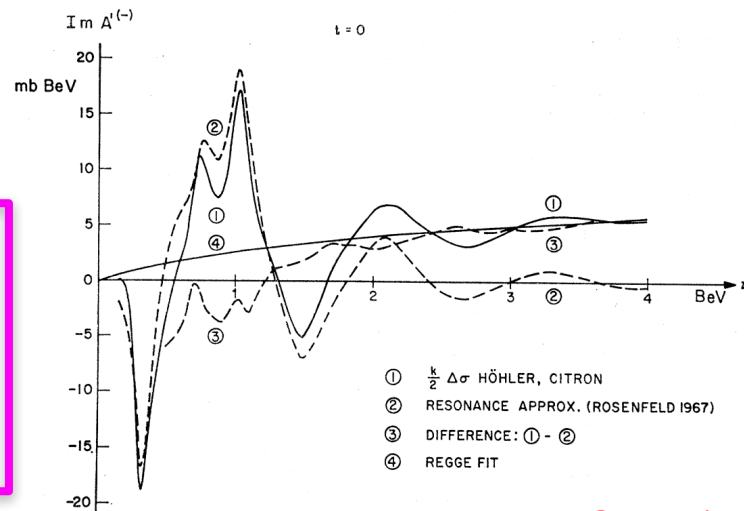
1967 K. Igi and S. Matsuda, Phys. Rev. Lett. 18 (1967) 625
R. Dolen, D. Horn and C. Schmid, Phys. Rev. Lett. 19 (1967) 402

πN charge exchange

As a first application we consider $k [\sigma_T(\pi^- p) - \sigma_T(\pi^+ p)]$ which should be dominated by the ρ Regge pole. There exist very good data for low energies, and a smooth fit by the Regge pole can be observed from 4 GeV onwards. The sum rule holds within experimental accuracy.

Igi and Matsuda, PRL 1967.
Horn and Schmid, 1967.
Logunov et al PL 1967
Dolen Horn Schmid PRL 1967 PR 1968

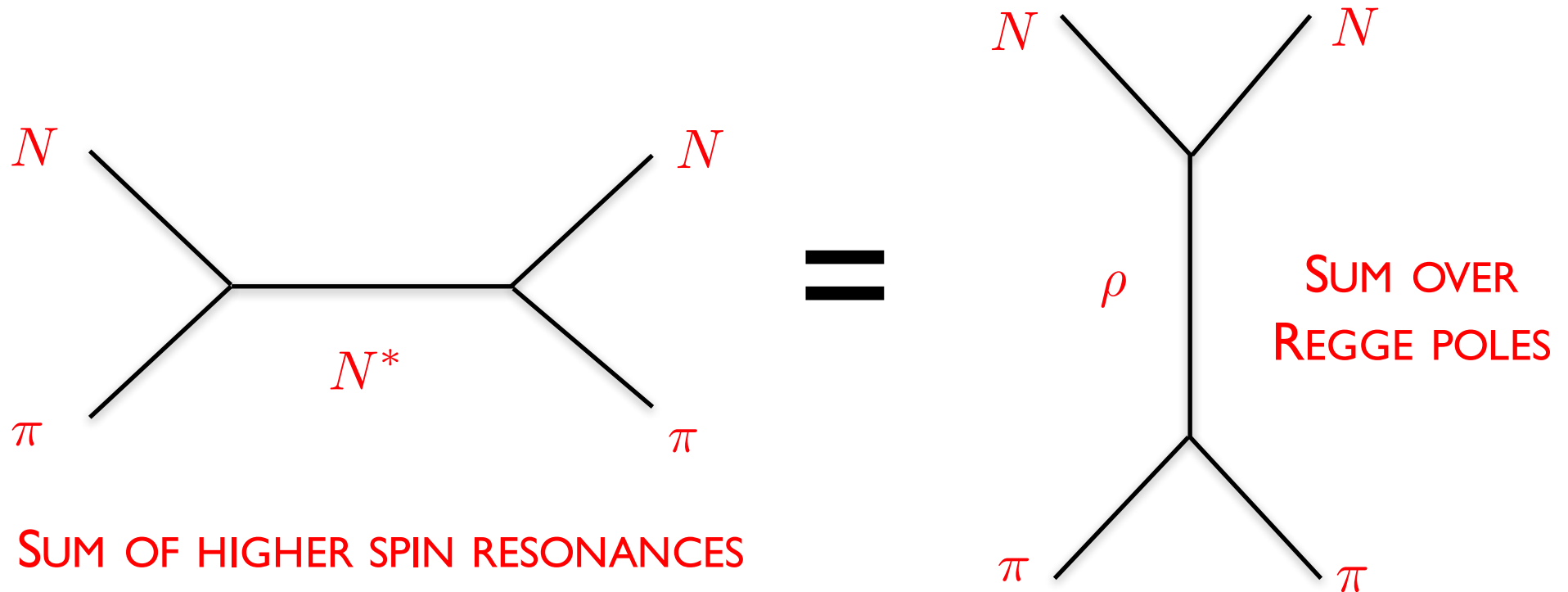
This figure compares $\Delta\sigma_T$ (1) with the Regge fit (4). It shows also that sum of resonances (2) approximates quite well $\Delta\sigma_T$ at low energies.



**From Dolen, Horn, Schmid
Phys. Rev. 166.1768 (1967)**

FINITE ENERGY SUM RULES: Unitarity, Analyticity, Crossing Symmetry

DUALITY: SUM OF RESONANCES = SUM OF REGGE POLES



RADICALLY DIFFERENT FROM CONVENTIONAL QFT

Embodied in the **VENEZIANO MODEL** (Euler beta function) (1968)

PROPERTY OF LARGE-N QCD; CONFORMAL BOOTSTRAP: S-MATRIX BOOTSTRAP
LINKS WITH MANY OTHER MODERN DEVELOPMENTS;

The period **1968-1976** culminated with **Giozzi, Scherk, Olive (1976)**

GSO projection gives space-time supersymmetric spectrum.

But just when everything was in place, research in string theory essentially came to an end.

1979-1984

Period of intense activity in quantum field theory - supersymmetry, supergravity, - but not in string theory (however, **Polyakov 1981, ...**).

John and I (with contributions from Lars Brink) aimed to make space-time SUSY manifest in scattering amplitudes:

LIGHT-CONE SPACE-TIME SUPERSYMMETRIC FORMALISM (1980).

FINITENESS OF TYPE II 4-GRAVITON 1-LOOP AMPLITUDE (1981).

COVARIANT FORMULATION WITH SPACE-TIME SUPERSYMMETRY (1983)

- **Allows for backgrounds with RR**
 - extended by Berkovits (Siegel) to the Pure Spinor formalism

ABSENCE OF CHIRAL GAUGE/GRAVITATIONAL ANOMALIES FOR $SO(32)$, $E_8 \times E_8$ (1984)

SOCIOLOGICAL COMMENT: This was an ideal period in which the subject had a life of its own. John and I met for a few months each year with little worry that anyone else would attack the outstanding problems that we were interested in.

1984- 2??? The World is no longer such a peaceful place
and string theory is no longer a theory of strings.

Rather, “String Theory” has developed into a magnificent general framework that motivates the wide variety of fascinating topics in theoretical physics and mathematics that have been discussed at this wonderful conference.

