Giorgio 90

Mario Greco, INFN – Roma3

14th International Conference on High Energy Physics (ICHEP 68) Vienna, August '68

TWO-BODY PROCESSES

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1. ELASTIC SCATTERING AND TOTAL CROSS-SECTIONS

1.1 Proton-proton elastic scattering

As you know, the pp elastic differential cross-section depends a priori on two variables, for instance the energy and the scattering angle. However, up to one year ago the experimentalists working in high-energy pp scattering were accustomed to presenting their data as a function of a single variable. Such a variable thus contained both an energy and an angle dependence, and it was chosen in such a way that data at many angles and energies were distributed along a single simple pattern. This procedure is justified by the idea that in this way the single variable -- if it exists -- on which the interaction depends will be naturally indicated by the data. The most popular example of this is Orear's plot of s $d\sigma/d\Omega$ versus $p_\perp$ [1] (s = c.m. total energy squared, $p_\perp$ = = p sin θ = transverse momentum). Several other presentations of the data have recently been proposed [2-4].

The most successful approach was made by Krisch [3], who was able to display all data available up to about one year ago in the fashion shown in Fig. 1. Krisch interpreted the existence of three "slopes" separated by "breaks" in this picture as evidence for the existence of structure within the proton. Much discussion on the significance of these structures has recently been continued in the literature [5]. However, in order to obtain this presentation use was made of an ideal cross-section $d\sigma^+/dt$ for distinguishable protons; it is this "true" cross-section which, in the idea of Krisch, is likely to show a simple pattern. The function needed to derive such a "true" cross-section depends on the unknown cross-section itself

$$d\sigma(\theta) = d\sigma^+(\theta) + d\sigma^+(\pi-\theta)$$

$$d\sigma^+(\theta) = f(\theta)\, d\sigma(\theta)$$

$$f(\theta) = \frac{d\sigma^+(\theta)}{d\sigma^+(\theta) + d\sigma^+(\pi-\theta)}$$

(θ = c.m. scattering angle), and therefore the construction of $d\sigma^+/dt$ from the experimental data is

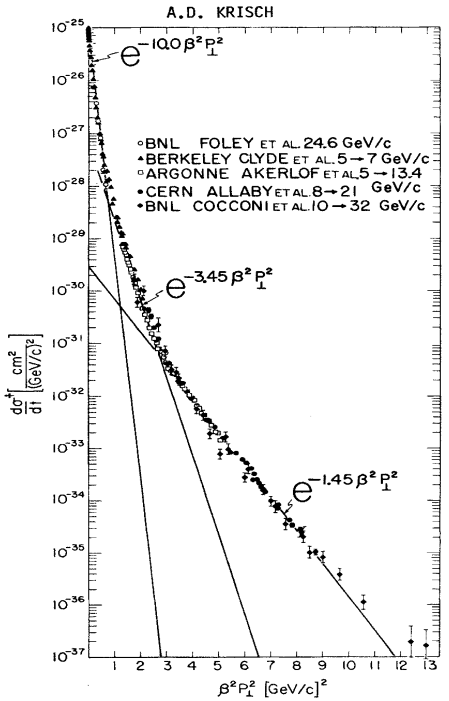
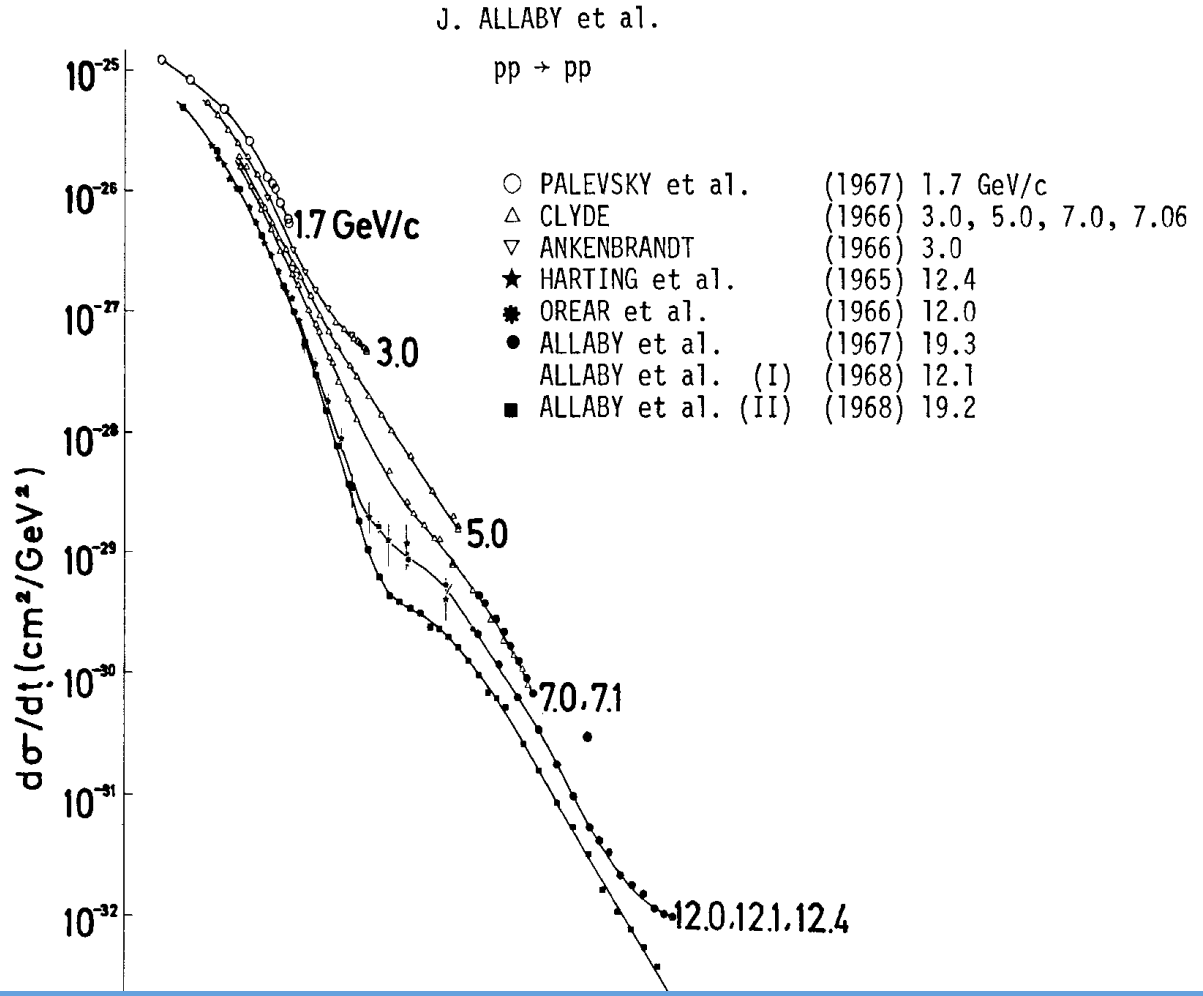


Fig. 1 Plot of $d\sigma^+/dt$ versus $\beta^2 p_\perp^2$ (β = proton velocity in the c.m., $p_\perp$ = p sin θ = transverse momentum) for all high-energy proton-proton elastic scattering data (Ref. 3). For references on the experimental data and for further discussions on this presentation, see Ref. 3.

np elastic scattering (n and p are indeed distinguishable). This would imply at $\theta = 90°$ $d\sigma(np) = 1/2$ and some new structure appears to be brought in. At $\theta = 90°$, the distributions at different energies end



LARGE ANGLE p-p ELASTIC SCATTERING

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Received 5 June 1968

In the past few years a great deal of experimental effort has been devoted to study accurately the elastic scattering of strongly interacting particles, at high energy and large momentum transfers. Several experiments [1-5] have measured particularly the proton-proton scattering, where a very high accuracy has been achieved because of the high intensities of proton beams. A considerable amount of very precise data, with a close spacing of the data points, ar now available. Any reliable theory must be able to reproduce these results. Many speculations concerning high-energy processes have been made [e.g. 6], and a wide range of models and ideas, more or less accepted, have been suggested. Many attempts [3,7-9] have been also done to search for a suitable universal function which would represent all the large momentum transfer data.

In the present note we wish to make the following formula for the differential cross section for the elastic nucleon-nucleon scattering:

$$\frac{d\sigma}{dt} = \frac{A}{p^4} \exp\left\{-(\sqrt{t} + \sqrt{s})/T\right\} \qquad (2)$$

where t is the momentum transfer, s is the square of the total energy in C.M.S., p is the nucleon momentum in C.M.S., A and T are two constants.

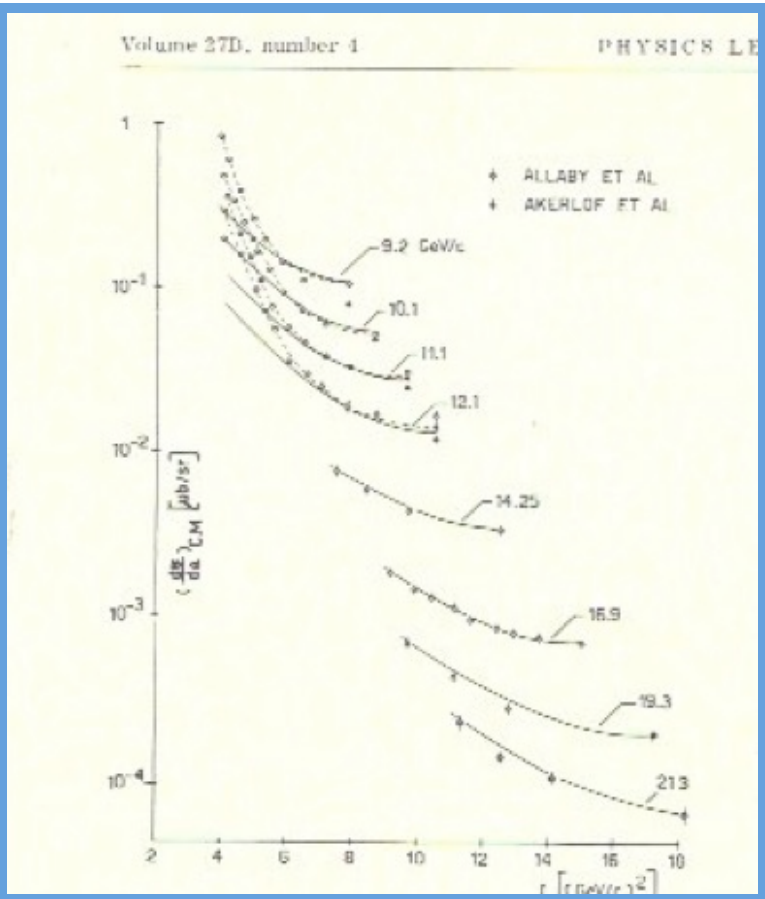
The formula (2) is valid in asymptotic conditions, and shows the following features:

a) It is relativistic invariant.

b) It is consistent with the upper limits which have been set on the scattering amplitudes by Cerulus and Martin [10].

c) It is in a very good agreement with the experimental results, when it is compared to the asymptotic proton-proton scattering data.

More explicity let us now define $P_{NB}(t)$ as the probability that a nucleon does not break up



$$\left(\frac{d\sigma}{d\Omega}\right)_{p-p} = \frac{B}{p^2} \exp[-\sqrt{s}/T] \left\{ \exp[-\sqrt{t}/T] + \exp[-\sqrt{u}/T] \right\} \qquad (13)$$

where u is defined as: $u = 2p^2(1 + \cos\theta)$.

Rencontres de Moriond 1973

TOTAL PROTON-PROTON CROSS-SECTION AT THE ISR

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Istituto Nazionale di Fisica Nucleare, Sezione di Pisa

Abstract: The recent ISR data on total proton-proton cross-section for centre-of-mass energy between ≈ 23 and ≈ 53 GeV are reviewed from an experimentalist's point of view.

Résumé : Les expériences récentes aux ISR sur la section efficace totale proton-proton sont discutées et analysées, surtout du point de vue d'un expérimentateur.

(WANTED)

G. Bellettini – LNF Director

01/03/1974 - 28/02/1977

ADONE: Multihadron production $R \approx 2$

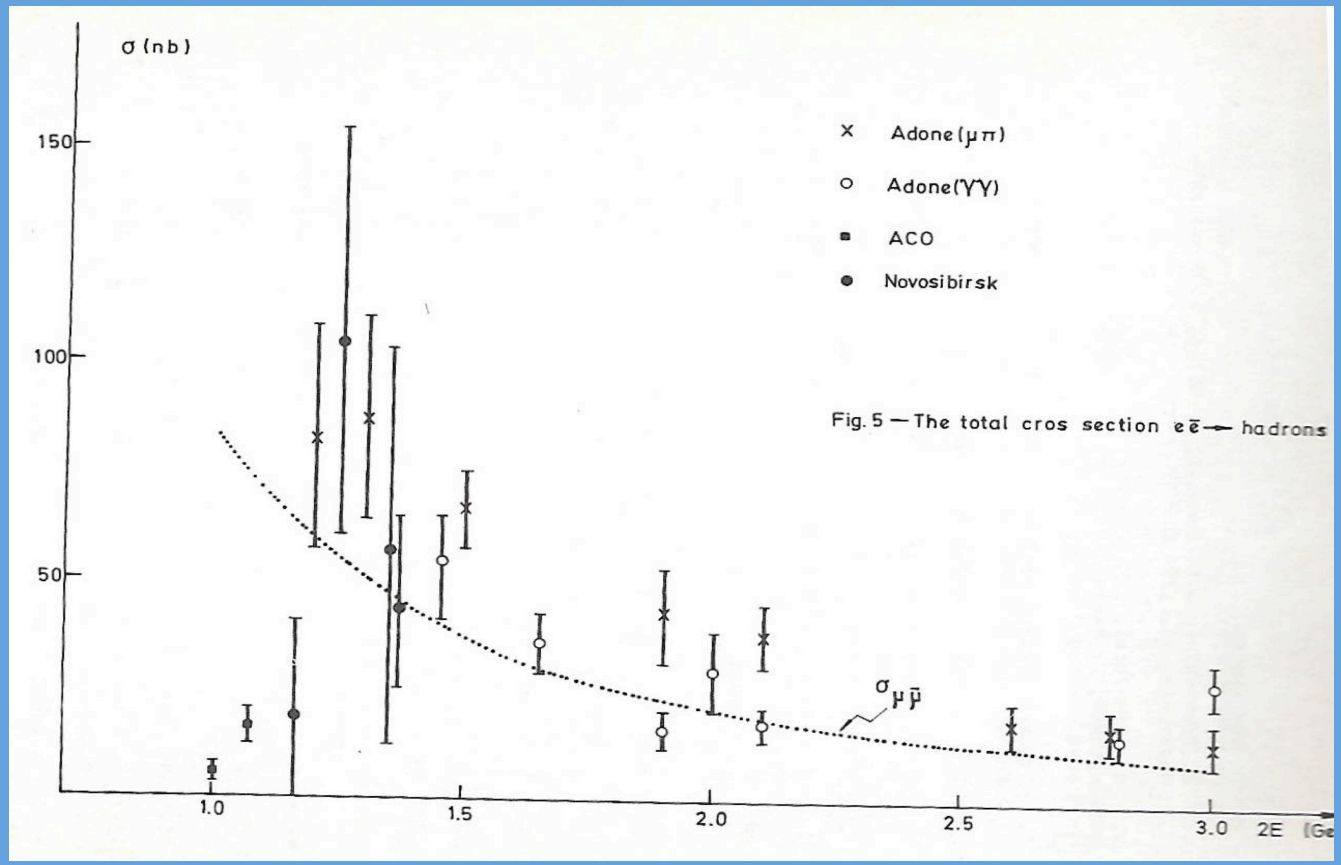
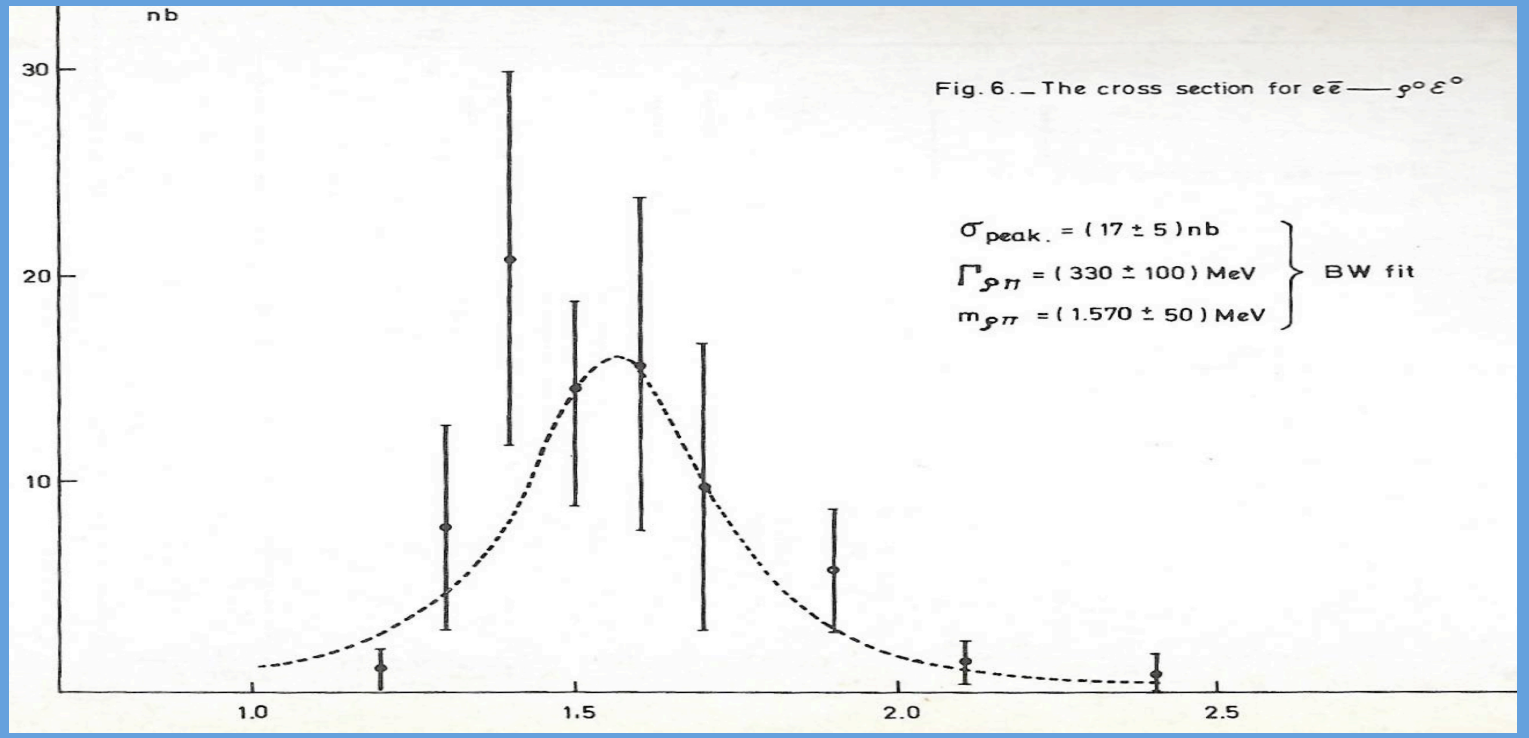


Fig. 5 — The total cros section $e\bar{e} \rightarrow$ hadrons

G. Bellettini – LNF Director
01/03/1974 - 28/02/1977

ADONE: Multihadron production $R \approx 2$

New vector mesons, ρ’



G. Bellettini – LNF Director

01/03/1974 - 28/02/1977

ADONE: Multi-hadron production $R \approx 2$

New vector mesons, ρ’

TH Activities: (Bramon, Etim, Greco)

ρ’, Extended VMD model (as Veneziano m.) B. G.

Extended VMD approach to scale invariance B. E. G.

Duality sum rules in e+ e- annihilation E. G.

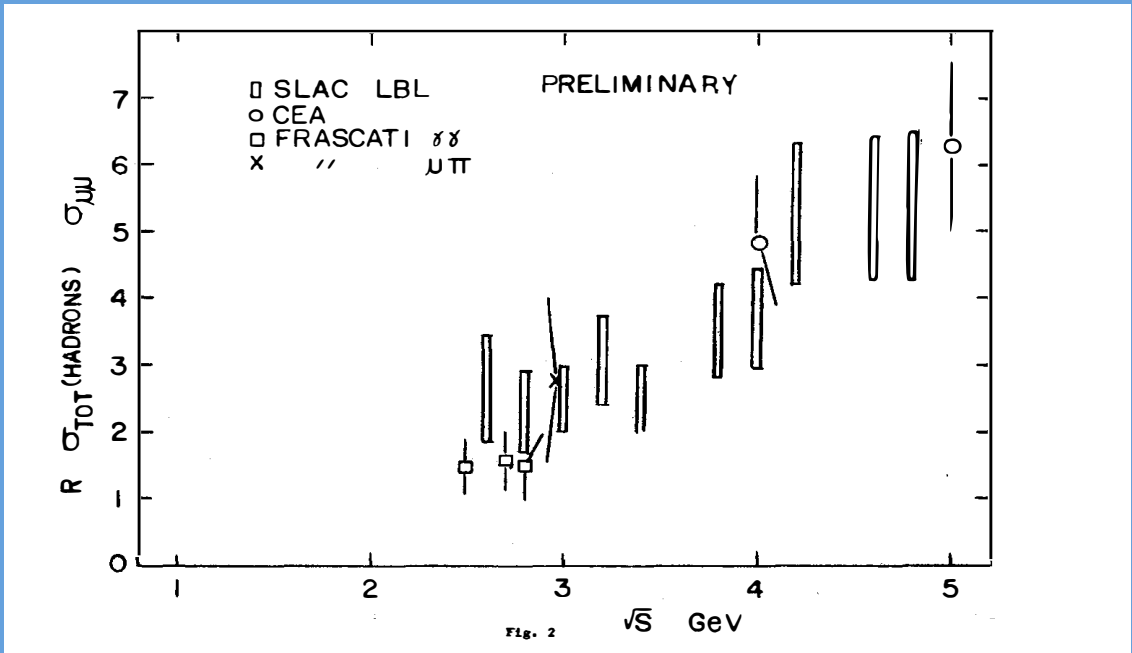
Asymptotic value of R related to low energy resonances (duality). With u, d, s quarks:

$$R \simeq \frac{8\pi^2}{f_\varrho^2} = 2{,}5$$

Parton Model (Cabibbo, Parisi, Testa) $R = \Sigma_i \, Q_i^2$

G. Bellettini – LNF Director
01/03/1974 - 28/02/1977

CEA and SPEAR: New intriguing data were showing R increasing !



November Revolution

- Stanford, November 11, 1974

B. Richter and S. Ting announced the discovery of the J/Ψ at SPEAR and Brookhaven.

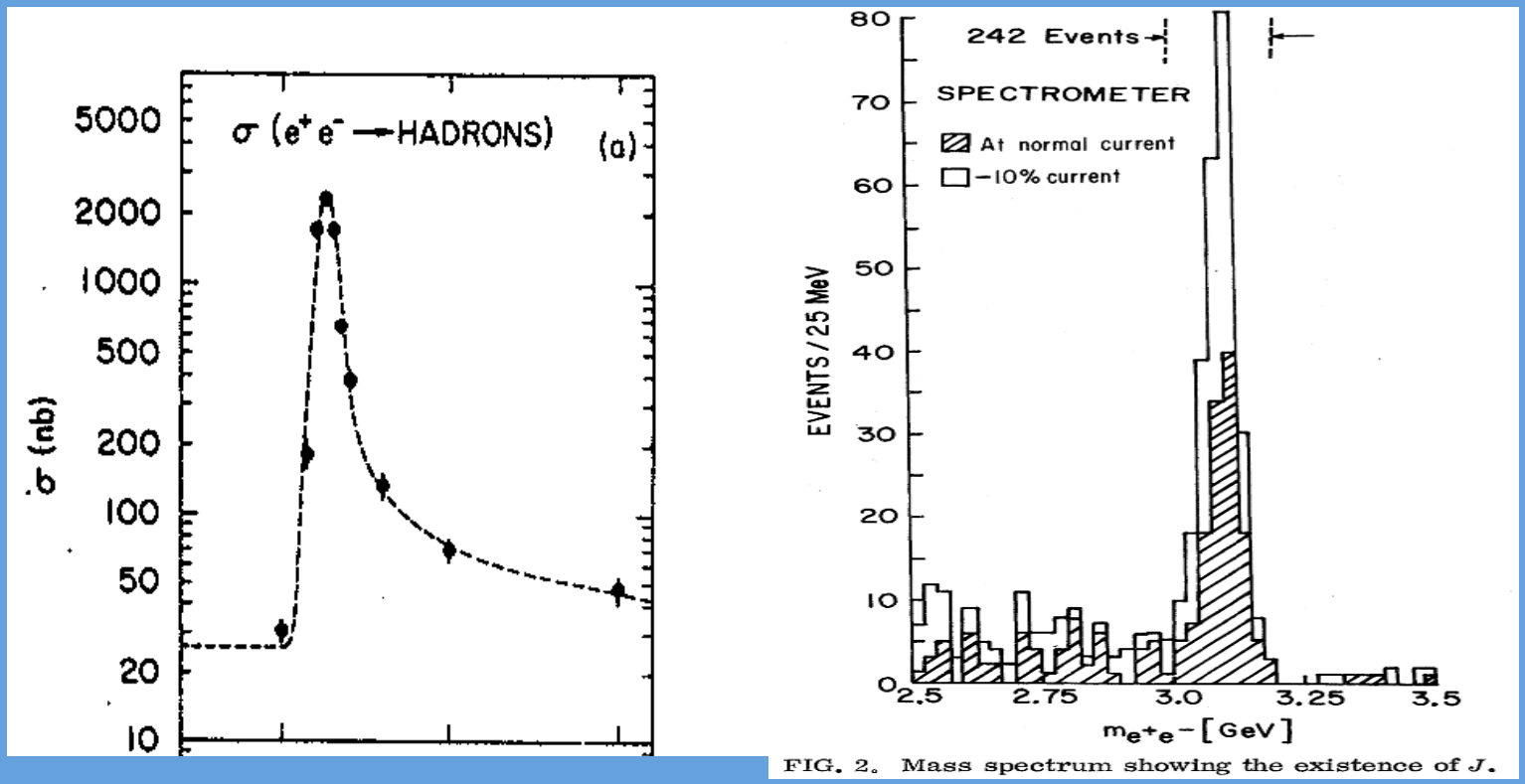


FIG. 2. Mass spectrum showing the existence of J.

November Revolution

- Stanford, November 12, 1974

M.G. arrived at SLAC invited by Sid Drell to give a seminar on the duality works.
Lot of excitement in th discussion room.
From the details of the SLAC discovery, I realized that the J/Ψ could be seen at ADONE.
I called Giorgio at LNF from the private office of Drell and gave him the exact position of J/Ψ.
The night after the resonance was observed at Frascati.
I left SLAC 2 days after to Mexico City with the J/Ψ data and some hints for the Ψ'.

Frascati, November 18, 1974

Giorgio Salvini communicated the results of LNF to PRL on the phone and the paper was published in the same issue of the American results: *Phys.Rev.Lett.* 33 (1974) 1408.

Theoretical interpretation of J/Ψ

Are the New Particles Baryon-Antibaryon Nuclei?

Alfred S. Goldhaber and Maurice Goldhaber

Interpretation of a Narrow Resonance in e+ e- Annihilation

Julian Schwinger

Possible Explanation of the New Resonance in e+ e- Annihilation

S. Borchardt, V. S. Mathur, and S. Okubo

Model with Three Charmed Quarks R. Michael Barnett

Heavy Quarks and e+ e- Annihilation Thomas Appelquist and H. David Politzer

Is Bound Charm Found? A. De Rújula and S. L. Glashow

Possible Interactions of the J Particle

H. T. Nieh, Tai Tsun Wu, and Chen Ning Yang

Is the 3104-MeV Vector Meson the psi - Charm or the W0?
G. Altarelli, N. Cabibbo, R. Petronzio, L. Maiani, G. Parisi

Charm, EVDM and Narrow Resonances in e^+e Annihilation
C. A. Dominguez and M. Greco

Fig. 15. Immediate interpretations of the J/ψ, with their titles. PRL is Phys. Rev. Lett. **4**, Jan. 6th, 1975. The last two papers[88,89] are in Lett. Nuovo Cim.

A. De Rujula, Int. J. Mod. Phys. A 34 (2019) 32 .

Sam Ting at Frascati for BTML 2013

Theoretical interpretation of J/Ψ

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Preprint

Title	**Charm, EVDM and narrow resonances in e+e- annihilation**
Author(s)	Domínguez, C A ; Greco, Mario
Affiliation	(CNEN Frascati) ; (Inst. Politech. Nac. Mexico City)
Imprint	18 Nov 1974. - 6 p.
Subject category	Particle Physics - Phenomenology

Theoretical interpretation of J/Ψ

- New series of resonances.
- From the duality sum rule

$$\int_{s_0}^{\bar{s}} ds \left(Im\Pi(s) - \frac{\alpha R}{3} \right) = 0,$$

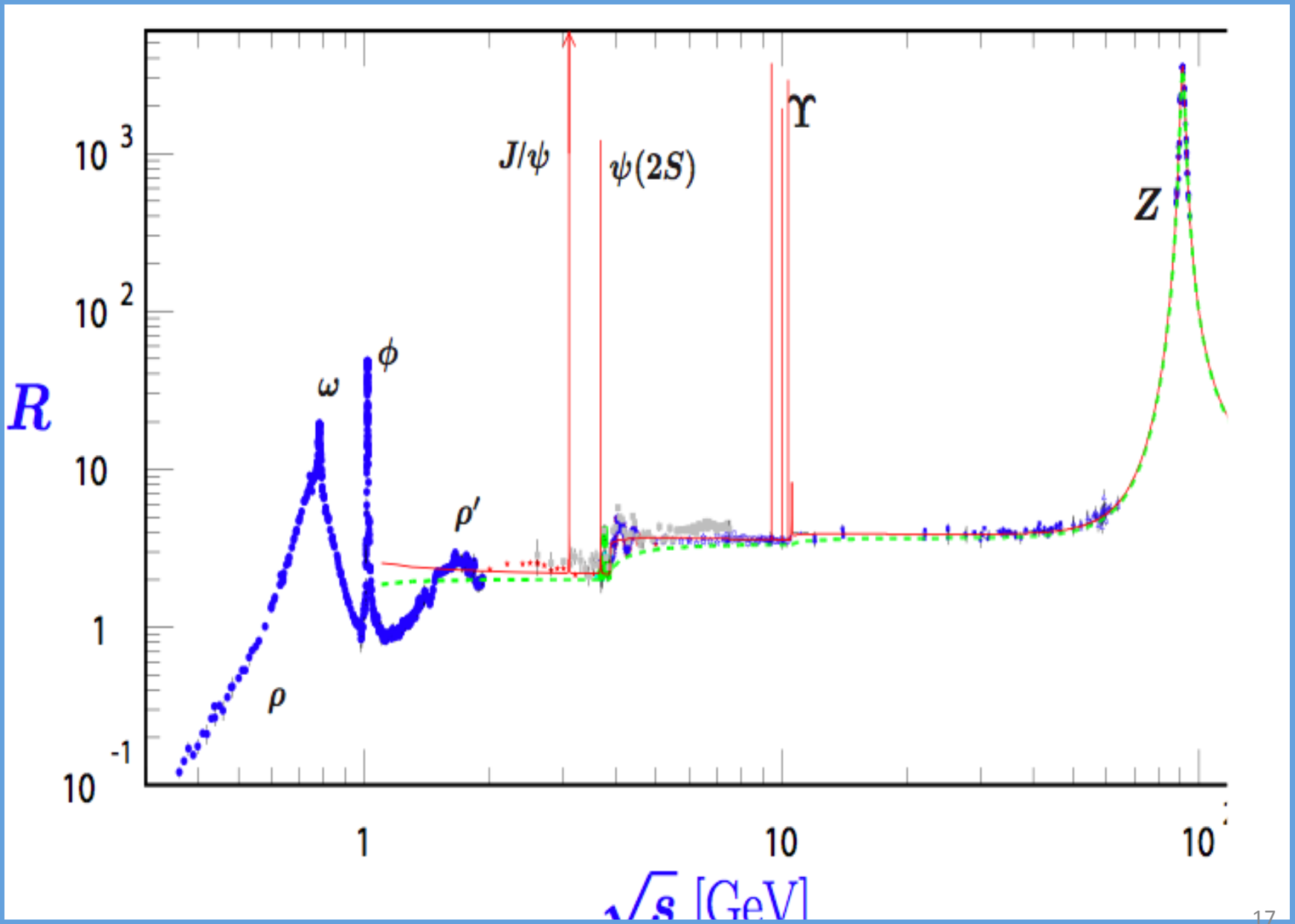
where

$$\mathrm{Im}\Pi\,(s) = s\ \sigma_{had}(s) / 4\pi\alpha$$

→ Q=2/3 for the charge of the new quark.

A new series of c-cbar resonances giving:

$$R = R_{normal} + R_{charm} \approx 3.7$$


R
10 3
10 2
10
1
10 -1
1
10
10
J/ψ
ψ(2S)
ϒ
Z
ω
ϕ
ρ′
ρ
√s [GeV]

From the J/Psi to La Thuile adventure

- Giorgio President of the INFN–CSN1 and his support to phenomenology. Introduction of a th observer in CSN1.
- The CDF adventure at the Tevatron: big support and resources from LNF.
- p-pbar Workshop In St. Vincent (Aosta Valley) in 1985.
- Rencontres in Aosta valley. Searching for a site → La Thuile
- LHC Workshop in January 1987 in La Thuile.

Les Rencontres de Physique de la Vallée d'Aoste

La Thuile 1987 - 2024

Les Rencontres de Physique de la Vallée d'Aoste

La Thuile 1987 - 2024

- February 1987 – Supernova 1987a
- Special regional law for Rencontres (INFN-Aosta Valley gov.)
- 1995 – Top discovery
- ν-oscillations, Higgs, GW, …

- S. Ting → AMS, U. Amaldi → Thera, …

- Giorgio Chiarelli, Gino Isidori

- Moriond at La Thuile

La Thuile 1987

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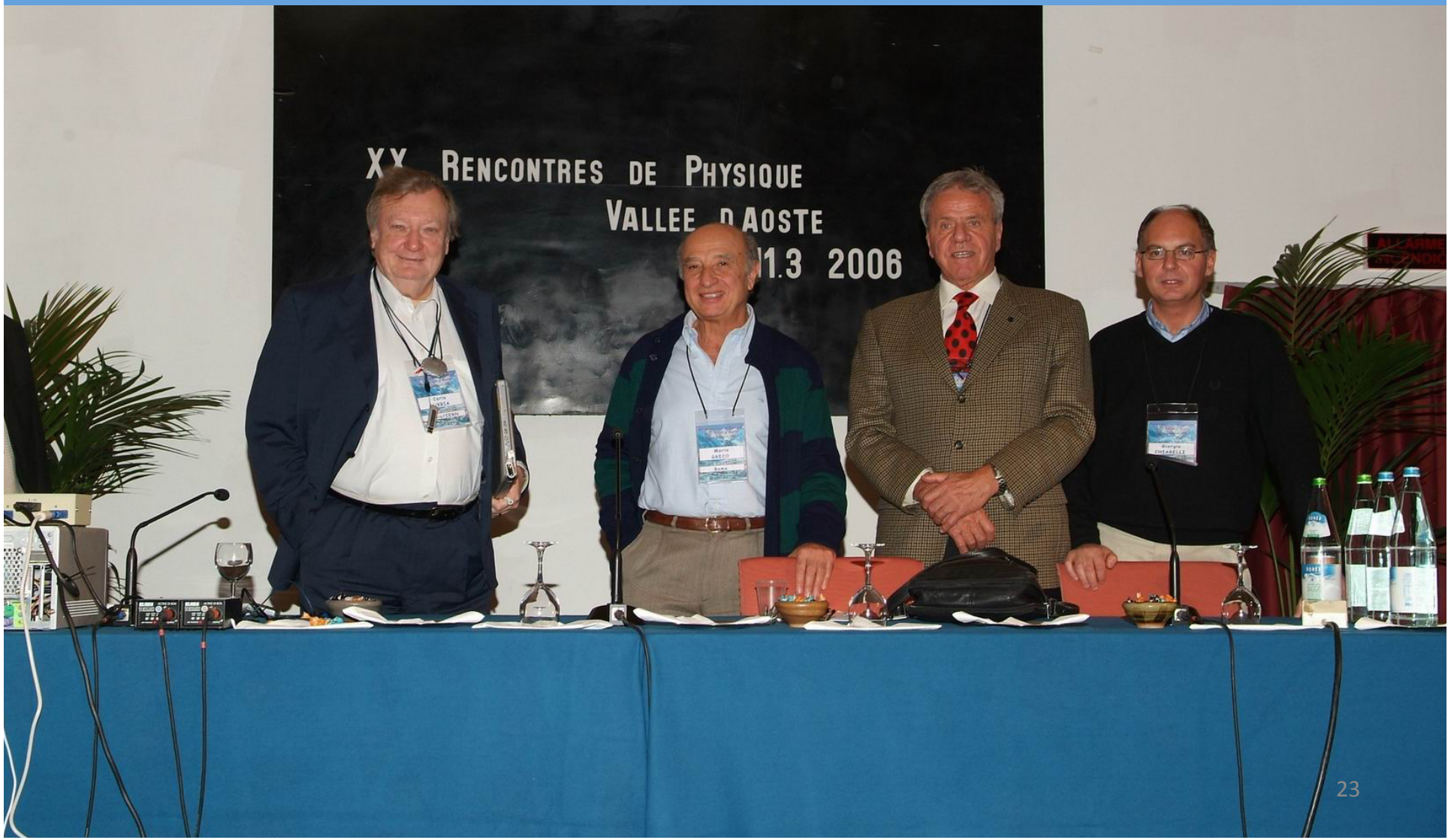
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2006