Office

Island

BBQ

Home

Дом культуры «Мир»

1932-2014

Юбилейная фотовыставка, посвященная памяти Ю.А.Туманова

> Once the

Standard Model of Particle Phys.

was ignored

1961 Glashow SU(2) x U(1)

THEORY LAID DORMANT ~ 6 y
MORE DARK-AGE YEARS, BUT

SALAM 68
WEINBERG 67 } H+G

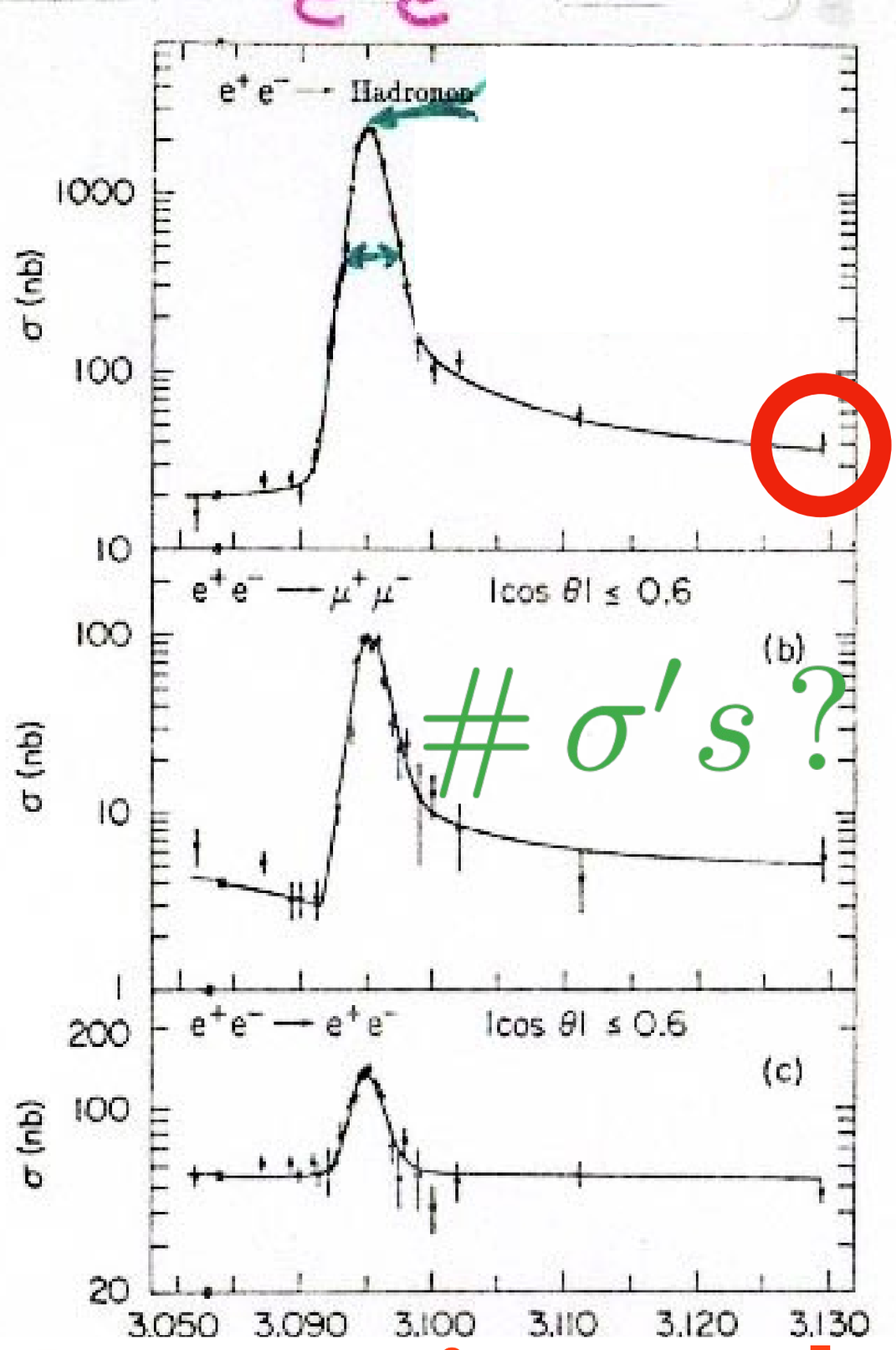
CITATIONS

67 : 0
68 : 0
69 : 0
70 : 1
71 : 4
72 : 64
73 : 162

't HOOFT

SPONTANEOUSLY BROKEN
NON-ABELIAN GAUGE THYS
ARE RENORMALIZABLE

NOVEMBER 1974

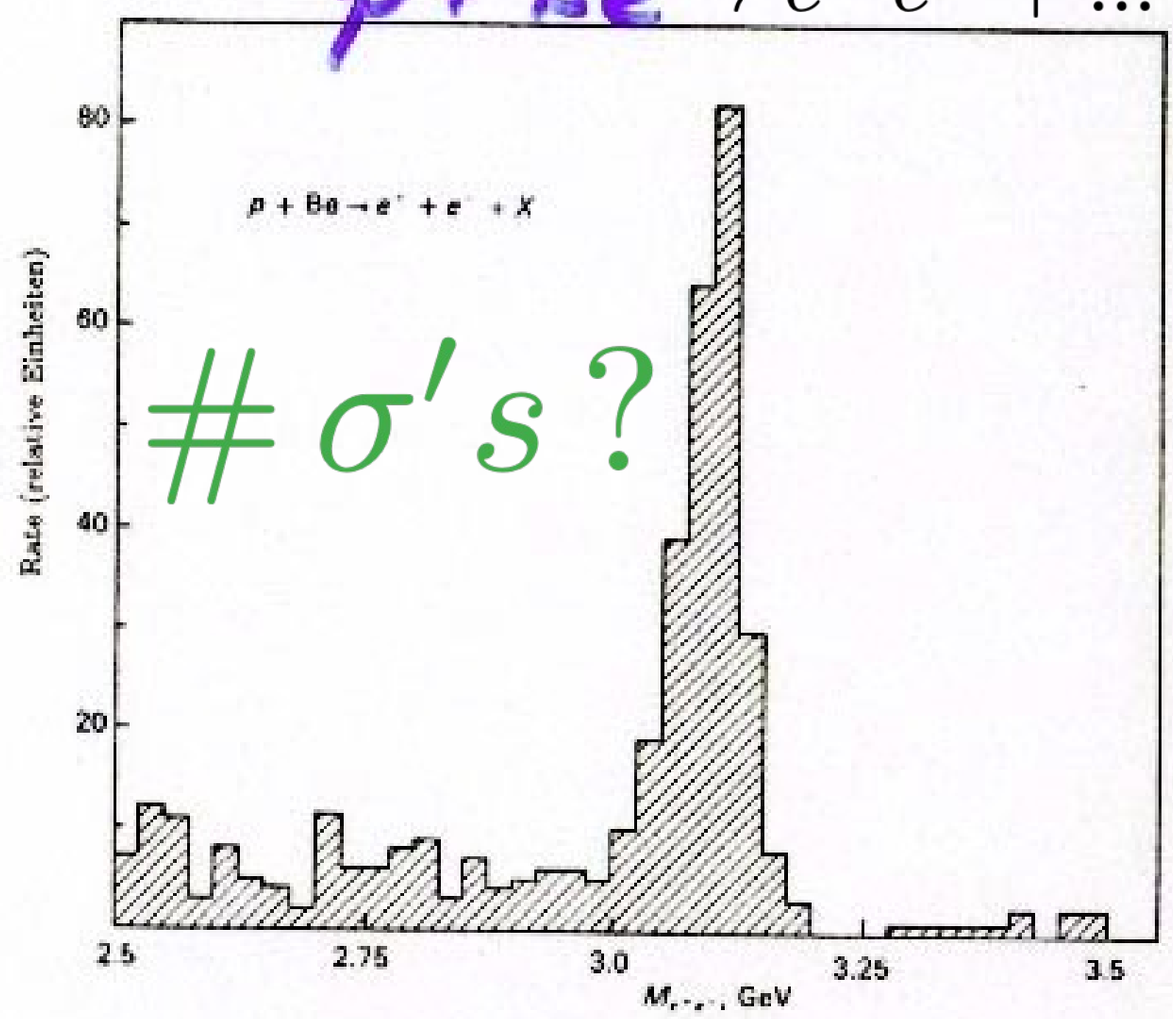


$\#\sigma's$?

Augustin et al.

SLAC, Nov 13. Ψ

$p + Be \to e^+e^- + \ldots$

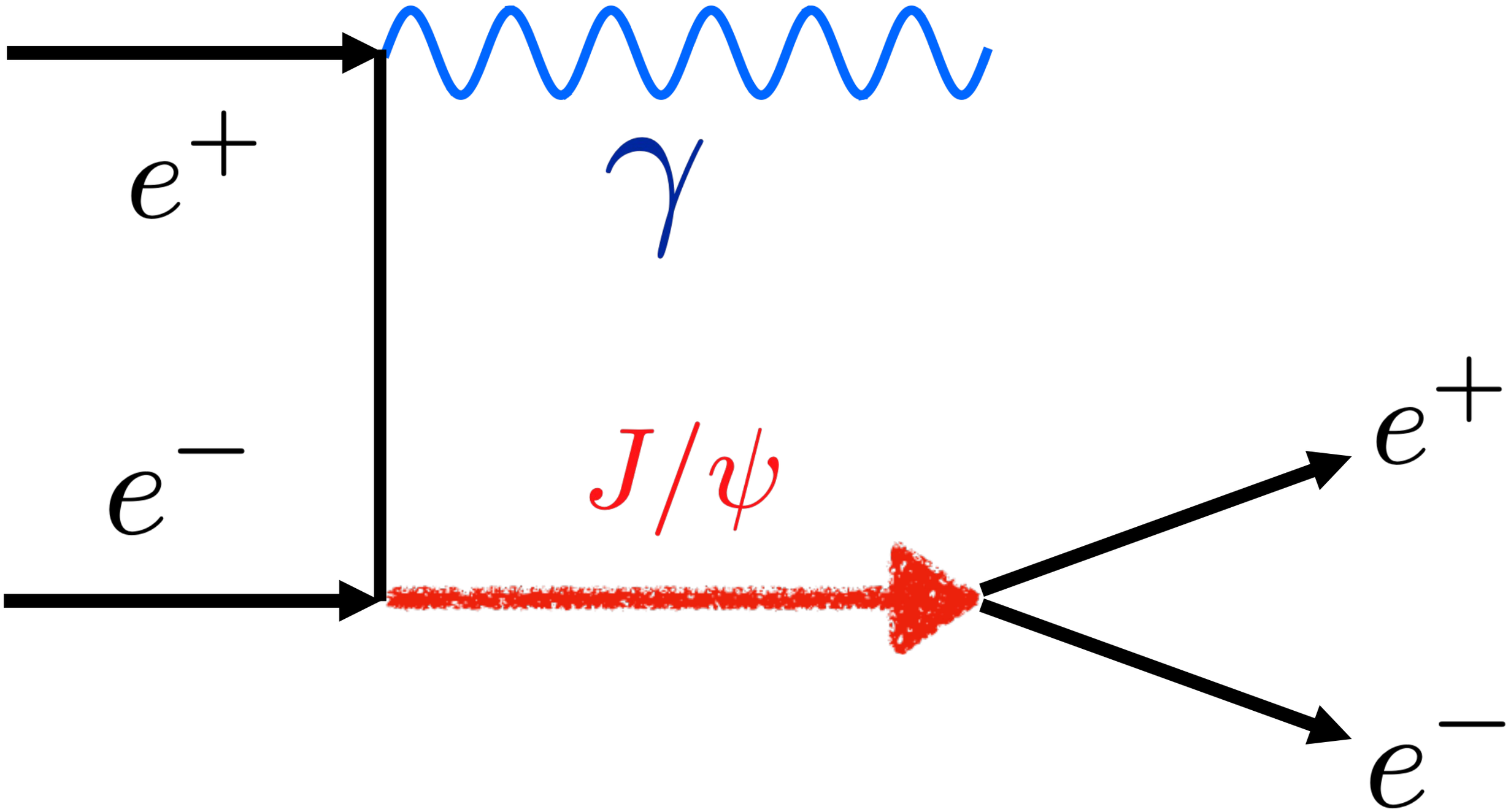


$\#\sigma's$?

Abbildung 5.10 Die Ergebnisse von Aubert et al. (1974) zeigen die schmale J/ψ-Resonanz in der Verteilung der invarianten Masse des e^+e^--Paars, das in inklusiven Reaktionen von Protonen an einem Berylliumtarget erzeugt wurde. Dies Experiment wurde am 28 GeV-AGS des Brookhaven National Laboratoriums ausgeführt

Aubert et al.

BNL, Nov 12. J



$$E(e^+) + E(E^-) > M[J/\psi]$$

secs

γ, ν, e

p, n

-5

μ

π^+ K_L^0 K^+

-10

K_S

Λ Σ^+ Ξ^0 Ξ^- Ω^-

Σ^0

π^0

?

-20

(Z_{FERMI} → hadrons + leptons)

ψ ψ'

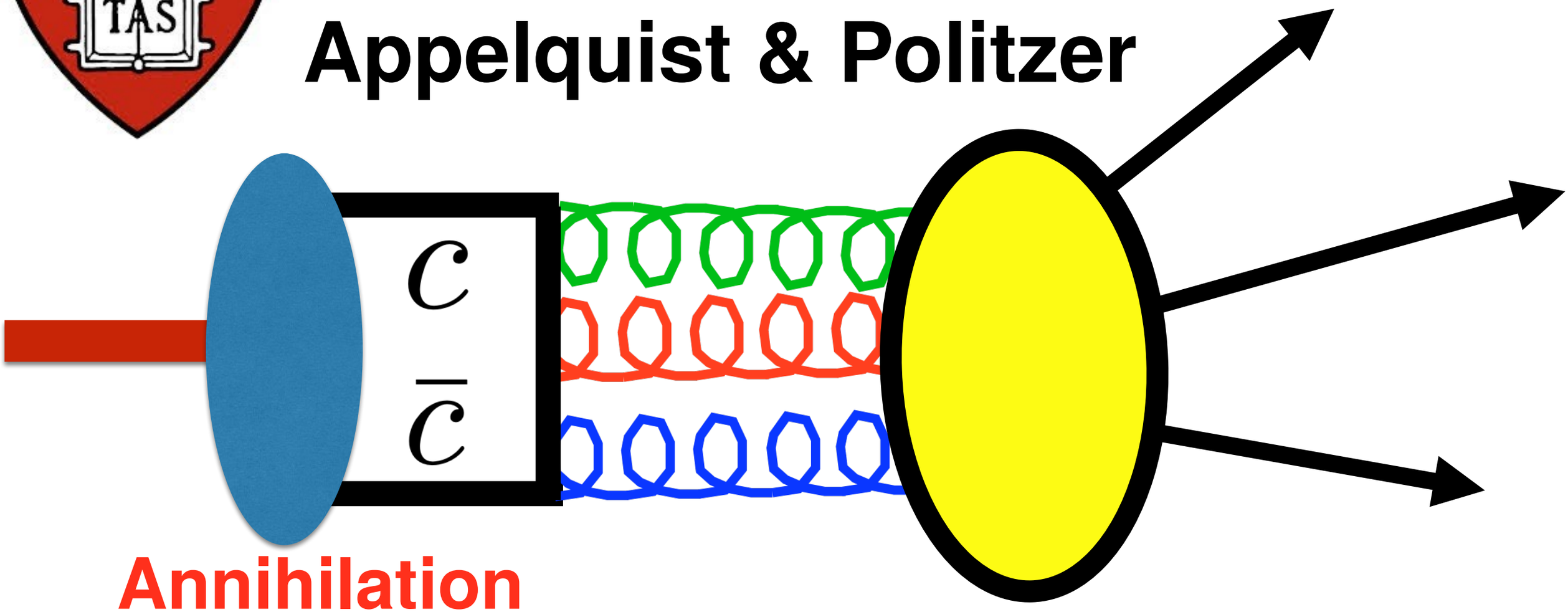
-25

1 2 3

GeV

J/Ψ as CHARMONIUM

Appelquist & Politzer



Annihilation

$d \sim 1/m_c$

$d \sim 1/\Lambda_{\text{QCD}}$

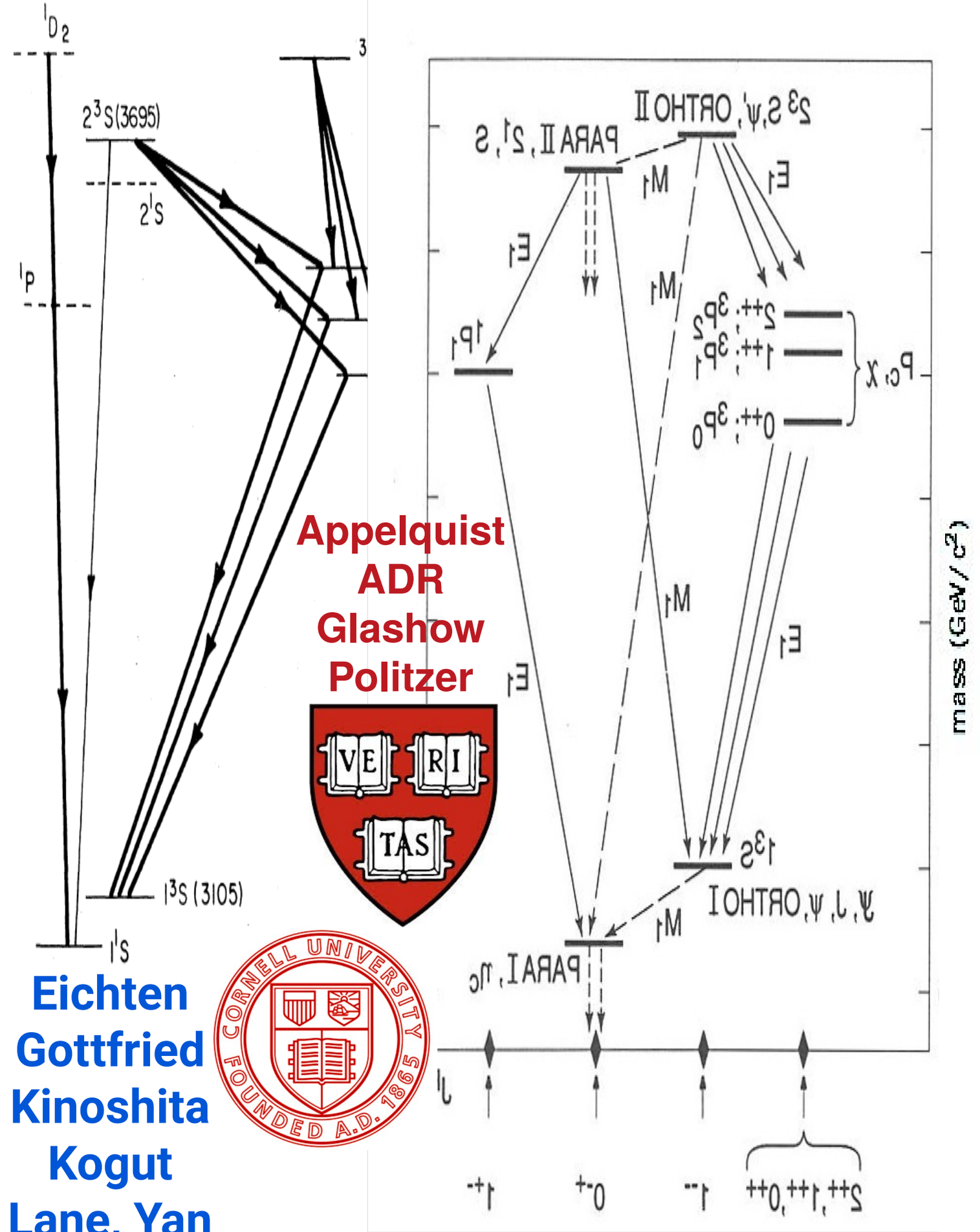
Hadronization !?

Unitary !!

Why so narrow?

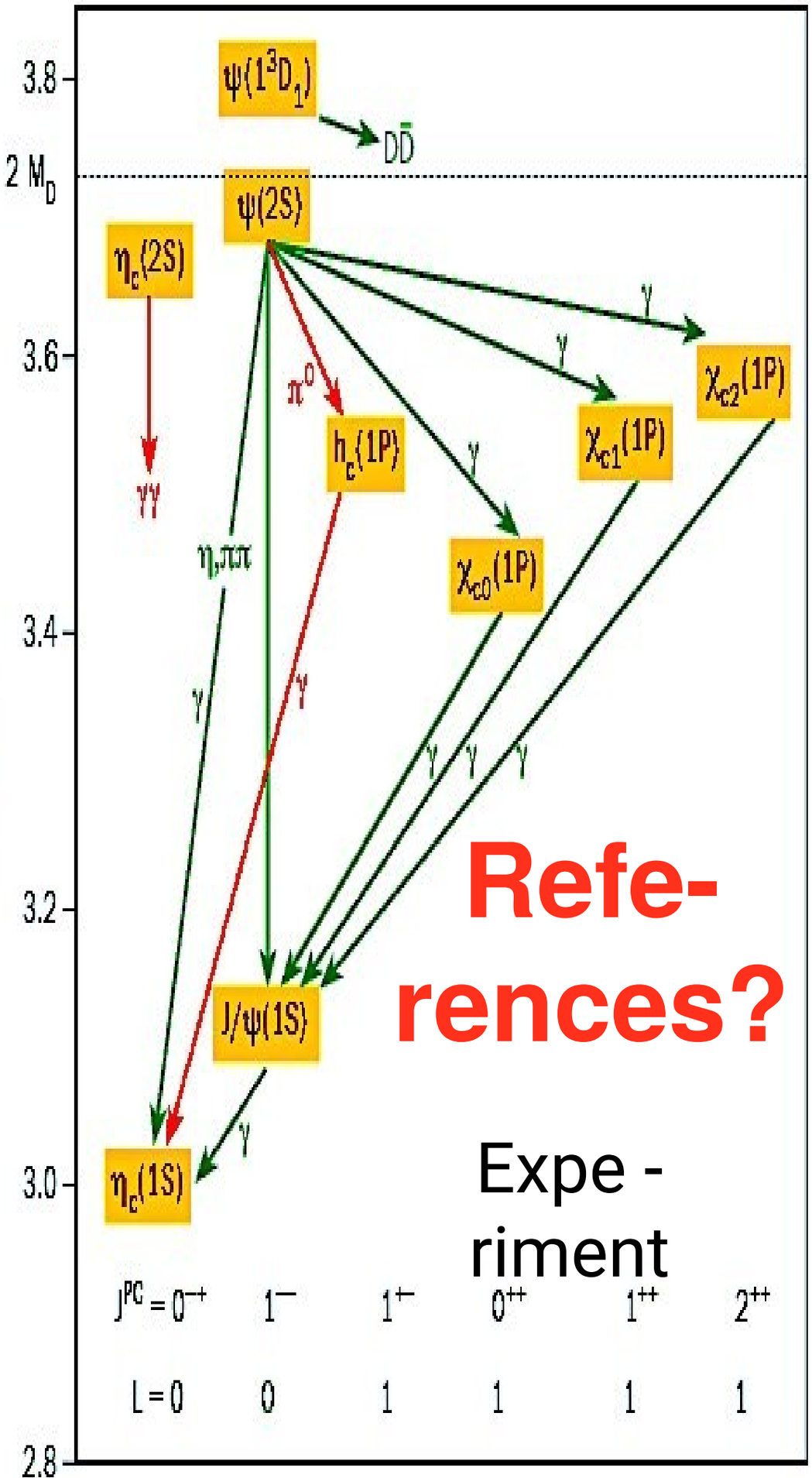
ADR & Glashow

$\varphi(s\bar{s}) \to 3\pi$ ETC



Appelquist
ADR
Glashow
Politzer

Eichten
Gottfried
Kinoshita
Kogut
Lane, Yan



Refe-rences?

Expe - riment

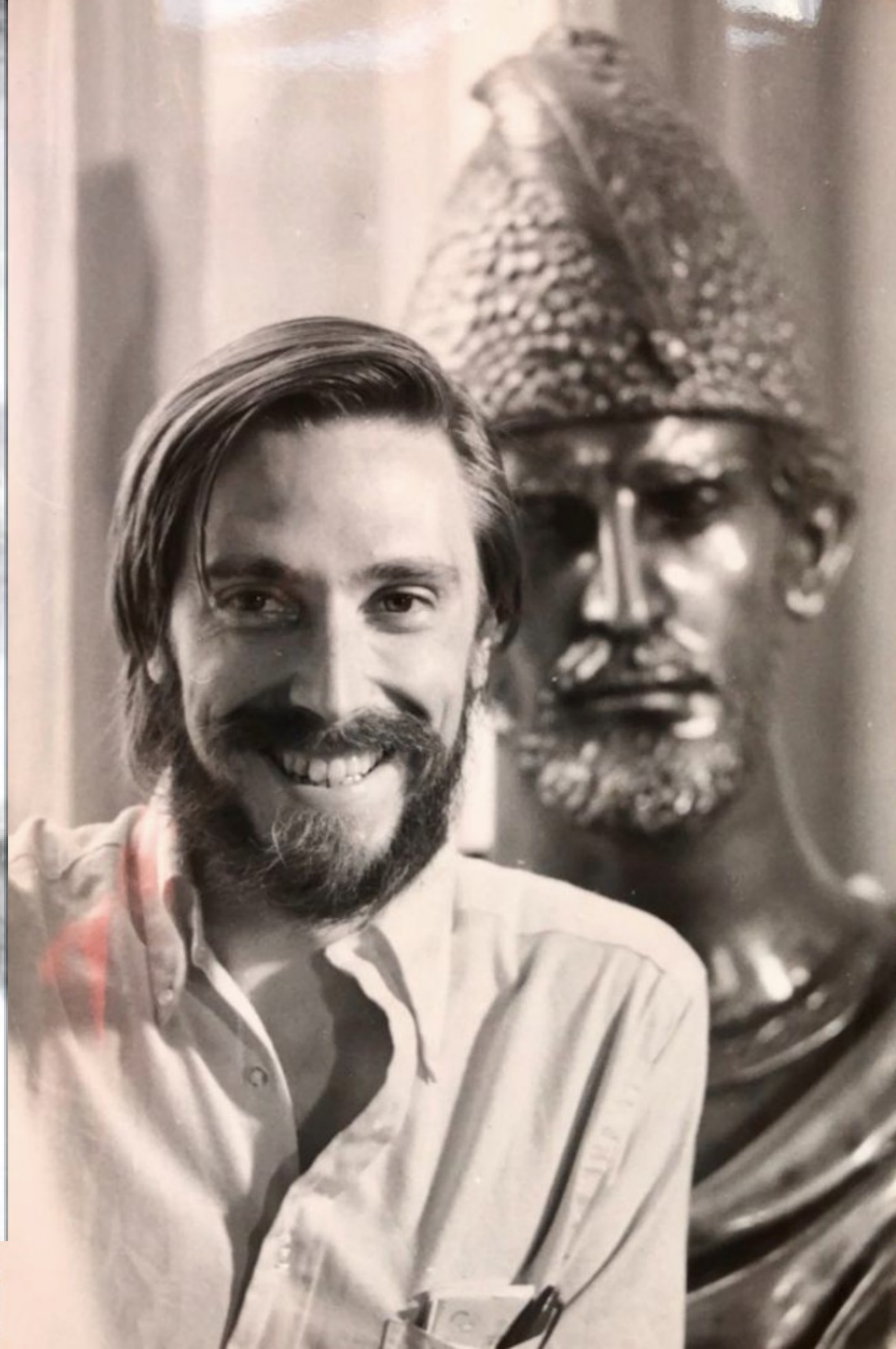
XVIII International Conference on High-Energy Physics, 1976

Organizing Committee

N.N.Bogolubov - Chairman
V.P.Dzhelepov - Vice-Chairman
A.N.Tavkhelidze - Vice-Chairman
V.G.Kadyshevsky - Scientific Secretary

N.S.Amaglobeli
E.L.Andronikashvili
A.Ts.Amatuni
A.M.Baldin
D.I.Blokhintsev
G.A.Chilashvili
O.I.Chkhikvishvili
I.V.Chuvilo
E.L.Feinberg
O.I.Kavtiashvili
V.N.Kachibaya
V.F.Kuleshov
M.A.Markov
E.M.Nikitin
B.M.Pontecorvo
R.G.Salukvadze
A.N.Skrinsky
L.D.Soloviev
O.I.Sumbaev
I.G.Timerbulatov
A.A.Vasiliev
V.A.Vasiliev
D.V.Volkov
V.A.Yarba
G.P.Zedginidze

Tbilisi 1976



შოთა რუსთაველი

ახალი
ნაწილაკების
თეორიული
საფუძველი

ТЕОРЕТИЧНАТА ОСНОВА НА НОВИТЕ ЧАСТИЦИ

FROM LONDON TO TBILISI [EXPERIMENTAL HEADLINES, RESUMÉ]

- THE NOVEMBER 74 REVOLUTION

RM. REV.

J/ψ (3.1)	ψ' (3.7)
BROOK - SLAC	SLAC

e^+e^- →

- DESY $\psi' \to \gamma P_c$ [3.5]
- SLAC $\psi' \to \gamma X$ [3.41, 3.45, 3.5, 3.55]
- DESY $\psi, \psi' \to \gamma X$ [2.8]
- SLAC JETS

ONIUM !!

CHARM -ONIUM ?

ν →

INDIRECT CHARM ?

- NEUTRAL CURRENT STRENGTH À LA WEINBERG-SALAM
- NEUTRAL CURRENTS "VIOLATE PARITY" C (MANY)
  ATOMIC PHYSICS
- $\nu \to \mu^+\mu^-$ (HPW, CALTECH, SERPUKHOV ...)
- $\nu \to \mu^- e^+ K$ (Ber, Cer, Haw, Wis), Others CGM)
- $\Delta S = -\Delta Q$ CANDIDATE (BROOKHAVEN)

e^+e^- →

CHARM!?

- $e^+e^- \to D^0 + m_R [\gtrsim m[D_0]]$ NARROW
  ↳ $K\pi$, $K\pi\pi\pi$
  1.865 ± .015 GeV
  $D^+ - D^0 = 4 \pm 4$ MeV
- Ke... $\to D^{+-} + m_R [\gtrsim m(D)]$
  ↳ $K\pi\pi$ 'EXOTIC'

HKEGB mechanism
Higgs Boson

THE HIGGS-KIBBLE-HAGEN-ENGLERT-BROUT BOSON :
LA BÊTE NOIRE OF SPONTANEOUSLY BROKEN GAUGE THS

NON-STRONGLY INTERACTING NEUTRAL SCALAR PARTICLE

COUPLING TO QUARKS AND LEPTONS ~ MASSES, WEIRD!

ELLIS-GAILLARD-NANOPOULOS:
- VERY HARD TO FIND IF $M_H \lesssim 1.5$ GeV
- VERY VERY MUCH HARDER $M_H \gtrsim 1.5$ GeV

LINDE
WEINBERG

STABILITY OF VACUUM
$\langle\phi\rangle \sim G_F^{-1} \sim 300$ GeV
GAUGE COUPLINGS $O(e)$
→ LOWER LIMIT ON M_H

M_H [W-S MODEL] > 3.72 GeV

GILDENER WEINBERG $M_H \sim 5$ to 10 GeV
[LIGHTEST HIGGS]

- WAYS TO LOOK FOR IT STILL THINKABLE

① $pp \to H + \cdots$
$\hookrightarrow \mu^+\mu^-, L^+L^-, c\bar{c}$
ELLIS-et al
VERY SMALL σ

② $\nu N \to \mu^- H + \cdots$
$\hookrightarrow \mu^+\mu^-$
VERY SMALL σ (LOSECCO)

MESSAGE : BETTER LOOK IN LOCH NESS
(i.e. FORGET IT)

PERL'S Li's
$H^+ \to H^0 + l + \nu$

PROVIDED HIGGS STRUCTURE NOT TOO

References !!

COLOR
TRIPLETS

COLOR
SINGLS.

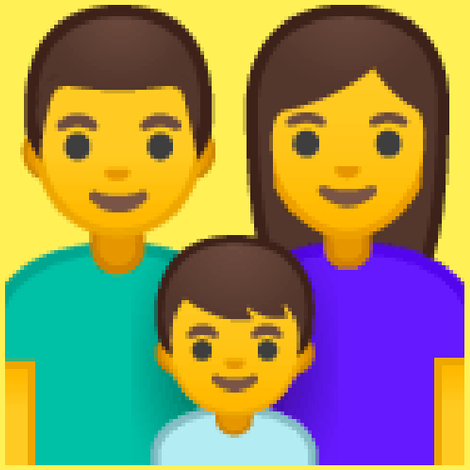
C_R	C_B	C_Y	ν_μ	
p_R	p_B	p_Y	ν_e	
n_R	n_B	n_Y	e	
λ_R	λ_B	λ_Y	μ	

WEAK

FLAVOR

STRONG

Tbilisi
1976



U

S

S

R


P(n)-QUARK UP
X МЕЖДУНАРОДНАЯ ШКОЛА ПО ФИЗИКЕ ВЫСОКИХ ЭНЕРГИЙ·БАКУ-76


P(n)-QUARK DOWN
X МЕЖДУНАРОДНАЯ ШКОЛА ПО ФИЗИКЕ ВЫСОКИХ ЭНЕРГИЙ·БАКУ-76


STRANGE QUARK
X МЕЖДУНАРОДНАЯ ШКОЛА ПО ФИЗИКЕ ВЫСОКИХ ЭНЕРГИЙ·БАКУ-76


CHARMED QUARK
X МЕЖДУНАРОДНАЯ ШКОЛА ПО ФИЗИКЕ ВЫСОКИХ ЭНЕРГИЙ·БАКУ-76

Цветные кварки, «открытые» АЛЬВАРО ДЕ РУХУЛА в его рапортерском докладе на XVIII Международной конференции по физике высоких энергий.

(Тбилиси, июль 1976 г.)

Who invented color?

Three identical quarks cannot form an antisymmetric S-state. In order to realize an antisymmetric orbital S-state, it is necessary for the quark to have an additional quantum number.
—B. V. Struminsky, JINR-Preprint P-1939, Dubna, Submitted on January 7, 1965

Boris Struminsky was a PhD student of Nikolay Bogolyubov. The problem considered in this preprint was suggested by Bogolyubov, who advised Boris Struminsky in this research.[15] In the beginning of 1965, Nikolay Bogolyubov, Boris Struminsky and Albert Tavkhelidze wrote a preprint with a more detailed discussion of the additional quark quantum degree of freedom.[16]

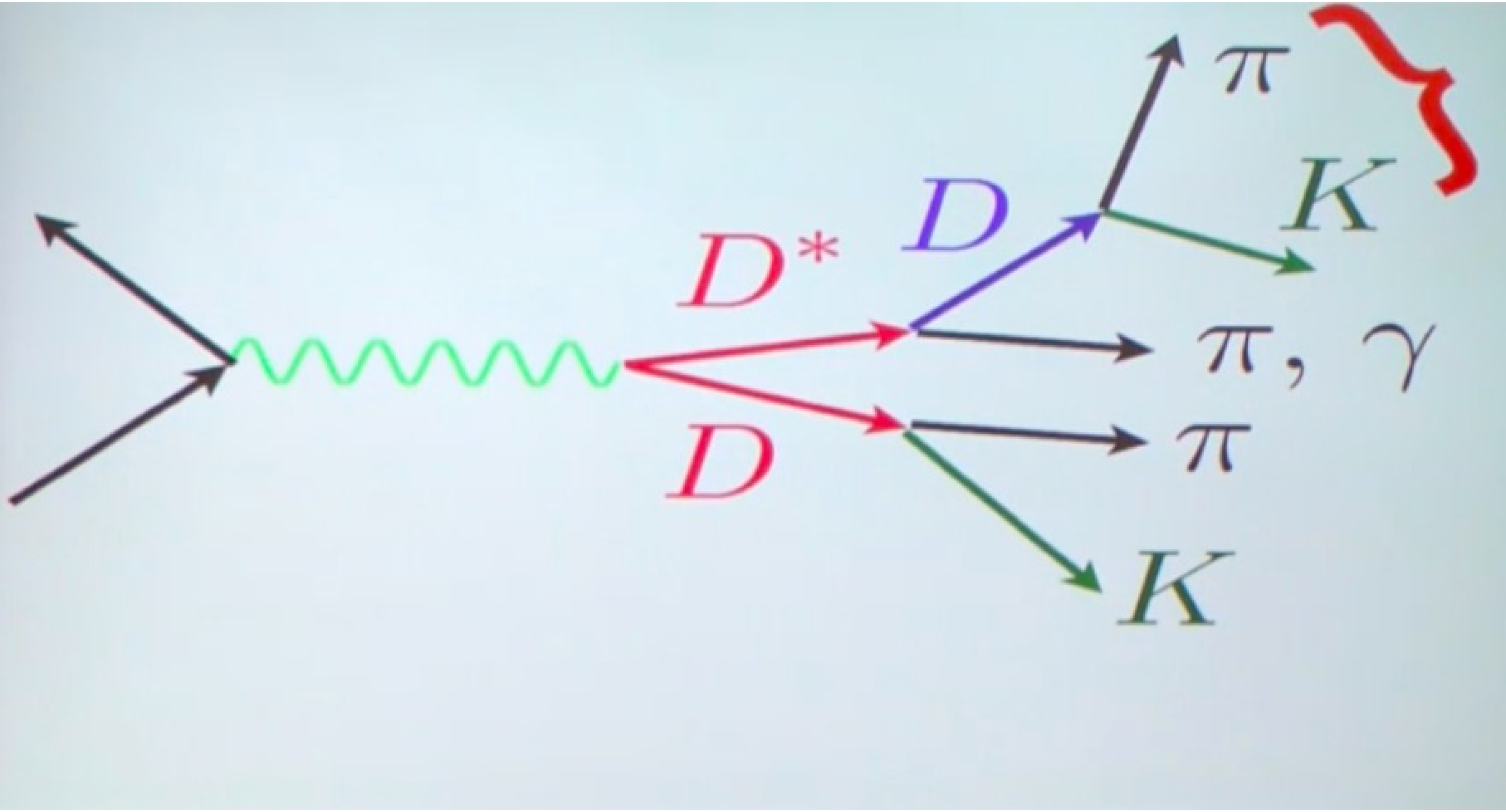
УДК 539.12.01

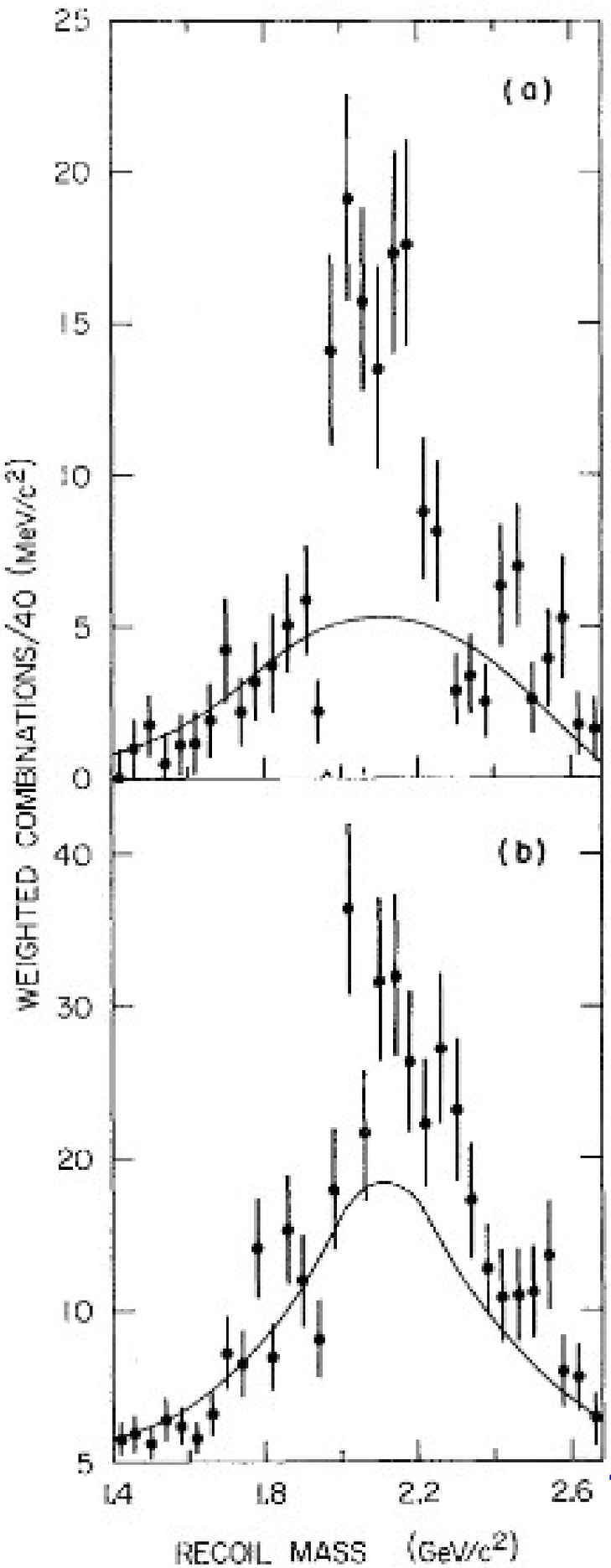
THE QUANTUM NUMBER *COLOR*, *COLORED QUARKS* AND QCD

(Dedicated to the 40th anniversary of the discovery of *color*)

V. A. Matveev, A. N. Tavkhelidze

Institute of Nuclear Research of the Russian Academy of Sciences, Moscow


π
K
D*
D
π , γ
π
D
K



$\mathbf{K\,\pi}$

$\mathbf{K\,3\pi}$

Roy Schwitters at Tbilisi

Goldhaber et al. Phys.Rev.Lett.37.255

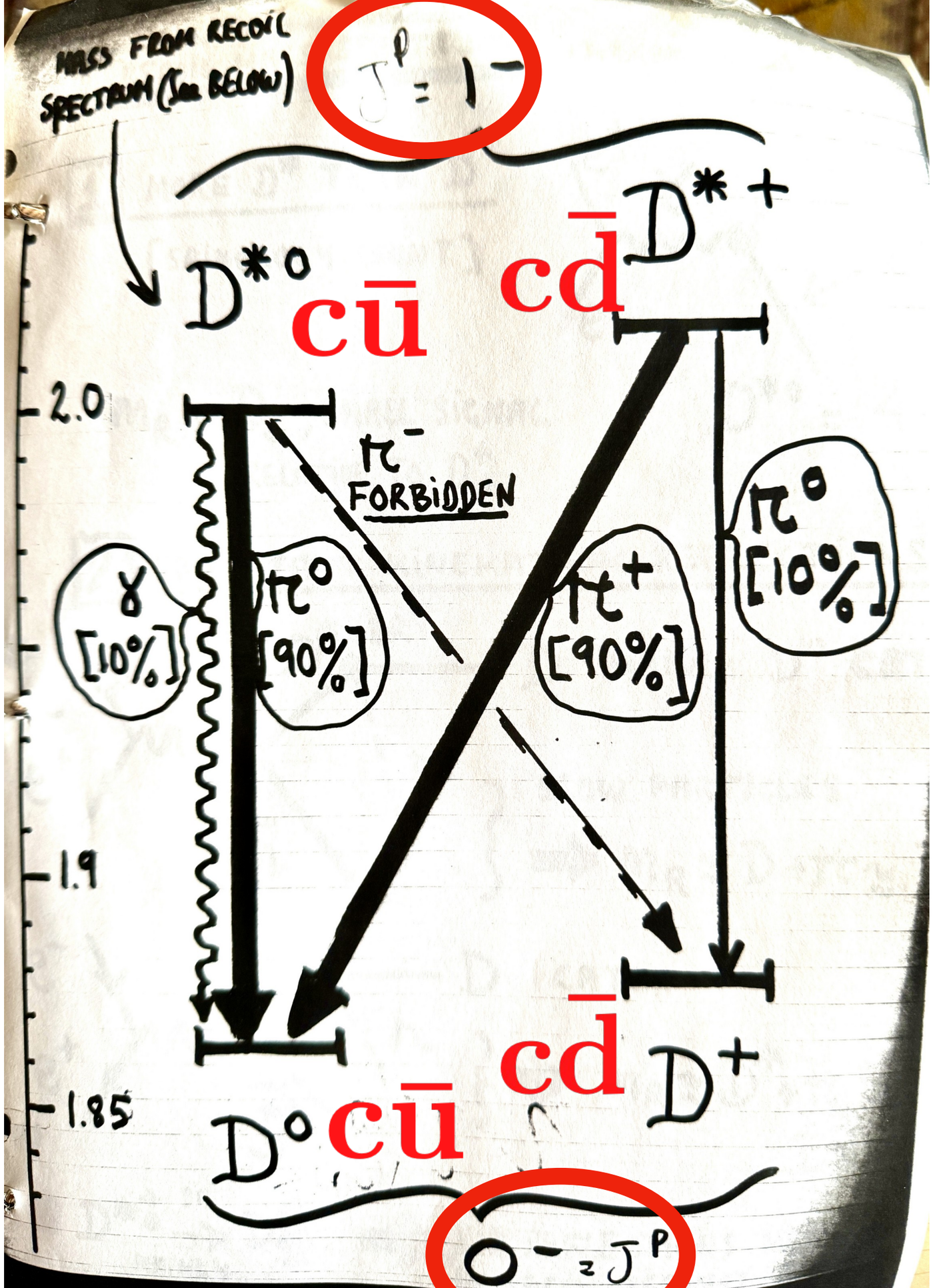
FIG. 2. Recoil-mass spectra for combinations in the $K\pi$ and $K3\pi$ peaks. Smooth curves are estimates of the background obtained from combinations whose invariant masses are on either side of the peak mass region. (a) $K^{\pm}\pi^{\mp}$, peak mass region of 1.84 to 1.90 GeV/c^2 and background mass regions of 1.70 to 1.82 GeV/c^2 and 1.92 to 2.04 GeV/c^2. (b) $K^{\pm}\pi^{\mp}\pi^{\pm}\pi^{\mp}$, peak mass region of 1.84 to 1.88 GeV/c^2 and background mass regions of 1.74 to 1.82 GeV/c^2 and 1.90 to 1.98 GeV/c^2.

They thought it may be the decays of charmed mesons but they did not understand their own data

DGG

Hadron masses in a gauge theory

Phys. Rev. D 12, 147 (1975)

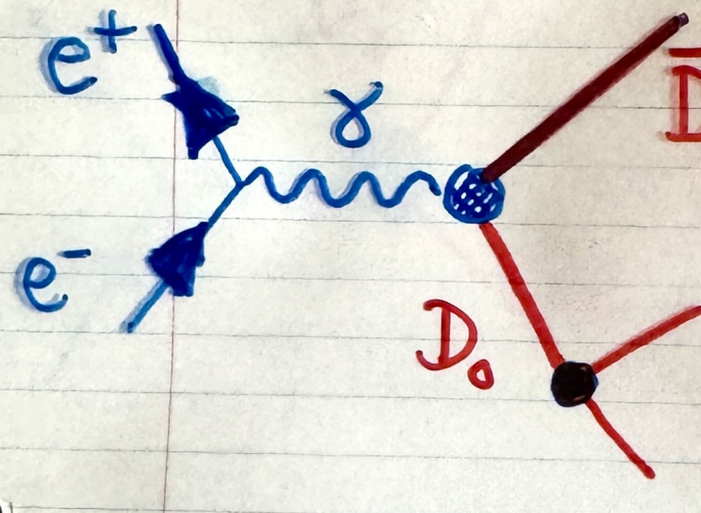

MASS FROM RECOIL SPECTRUM (See BELOW)
$J^P = 1^-$
D^{*0}
$c\bar{u}$
$c\bar{d}$
D^{*+}
2.0
π^-
FORBIDDEN
γ [10%]
π^0 [90%]
π^+ [90%]
π^0 [10%]
1.9
1.85
D^0
$c\bar{u}$
$c\bar{d}$
D^+
$0^- = J^P$

DGG

WHY D^+_s SOMEWHAT HARDER.

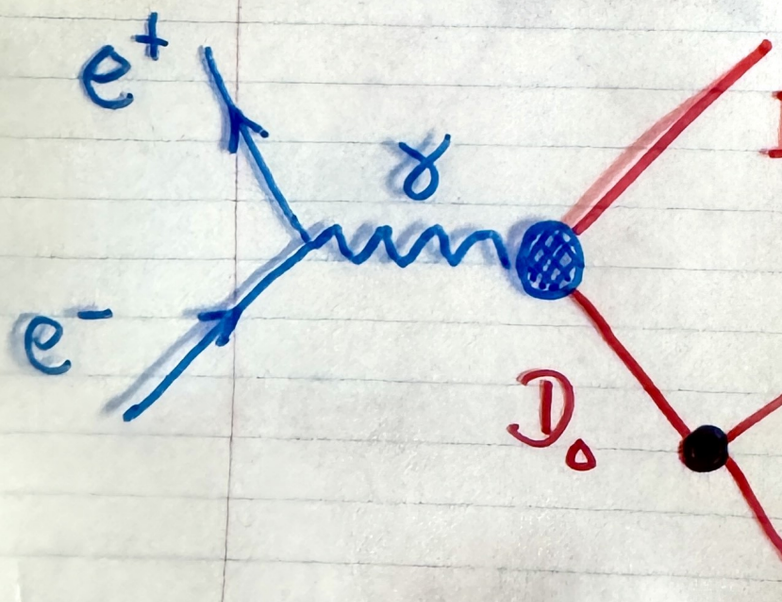
RECOIL SPECTRUM AGAINST D_0 (1.86) [$c\bar{c}$

① "TRUE" RECOIL PEAKS [IN MISSING MASS]



$m_R = D_0$ (1.86)

} CATCH ($K^-\pi^+\pi^+\pi^-$)



$m_R = D^0_*$ (~2.0)

≤ 1 MeV wide

} CATCH

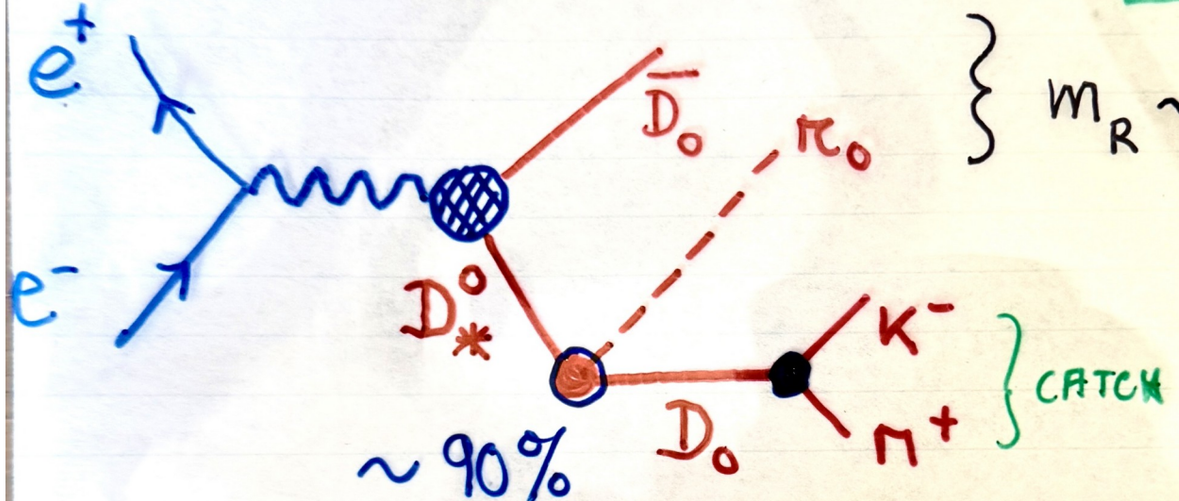
i BECAUSE $D^* - D \sim m_\pi$

② KINEMATICAL REFLECTIONS NEAR THRESHOLD

→ FALSE RECOIL PEAKS IN MISSING MASS

FALSE BUMPS FROM $D\bar{D}^*$

$E \approx E_{TH}$

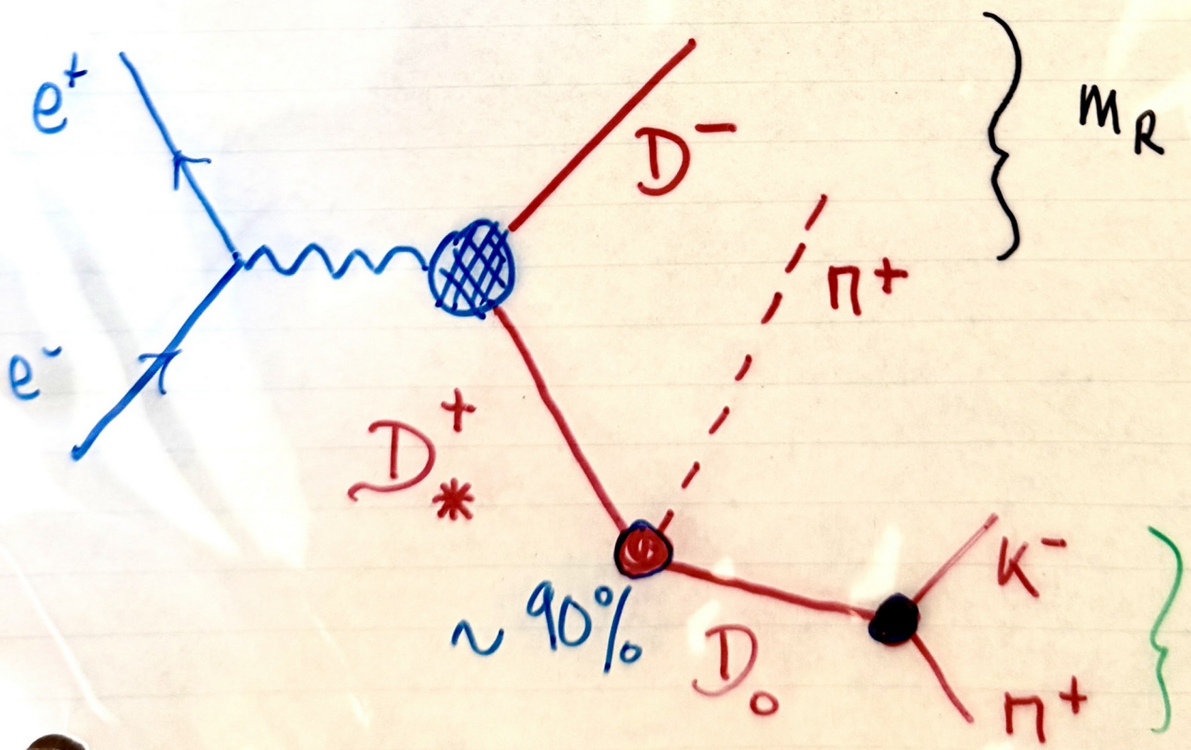


$$m_R \sim D_0 + \pi_0 \pm \epsilon\,[0, E - E_{TH}]$$

$\approx D_*$!!!

(~ 2.0 GeV)

ON TOP OF REAL D^*

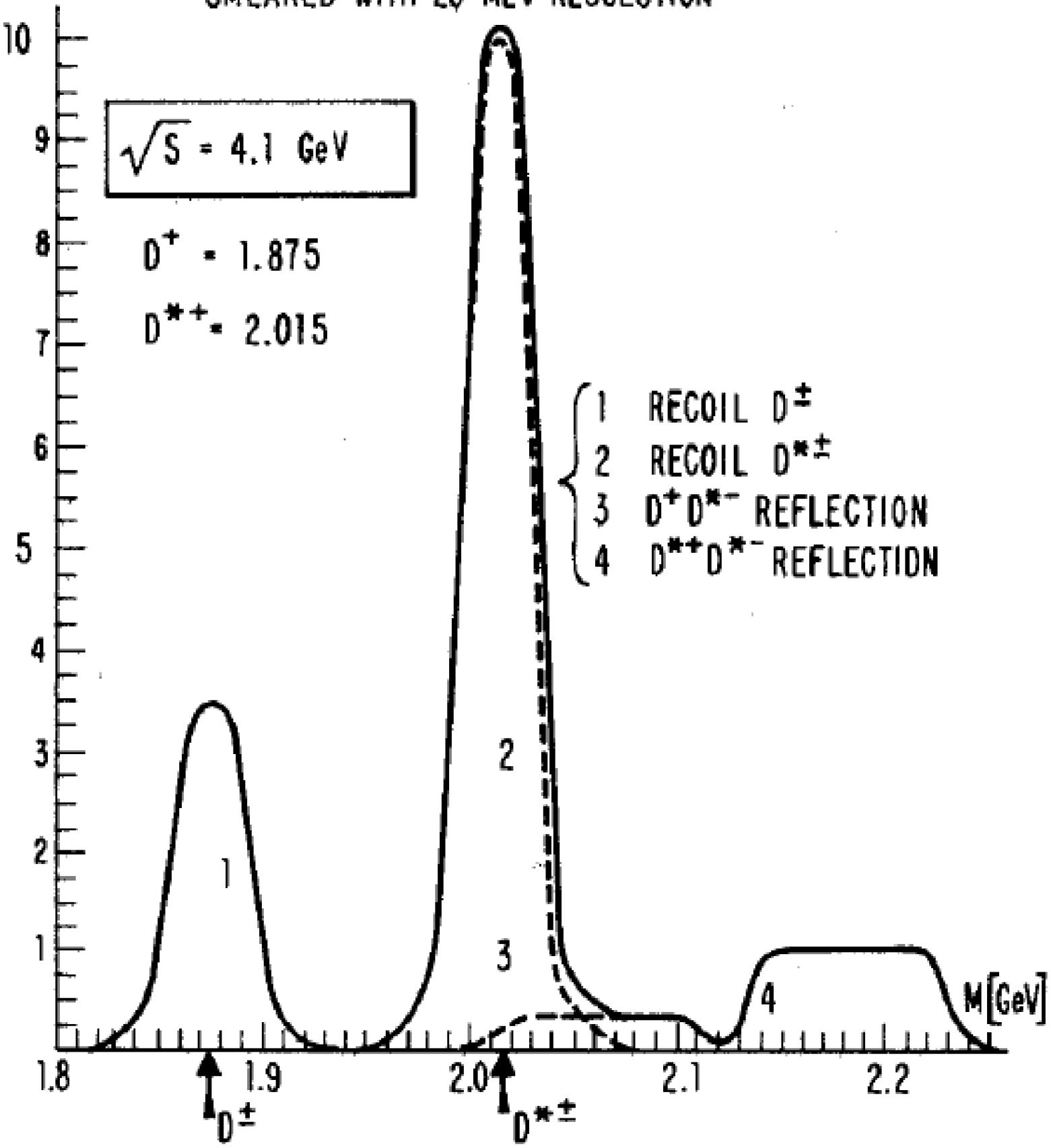


$$m_R \sim D_- + \pi_+ \pm \epsilon$$

$\approx D_*$!

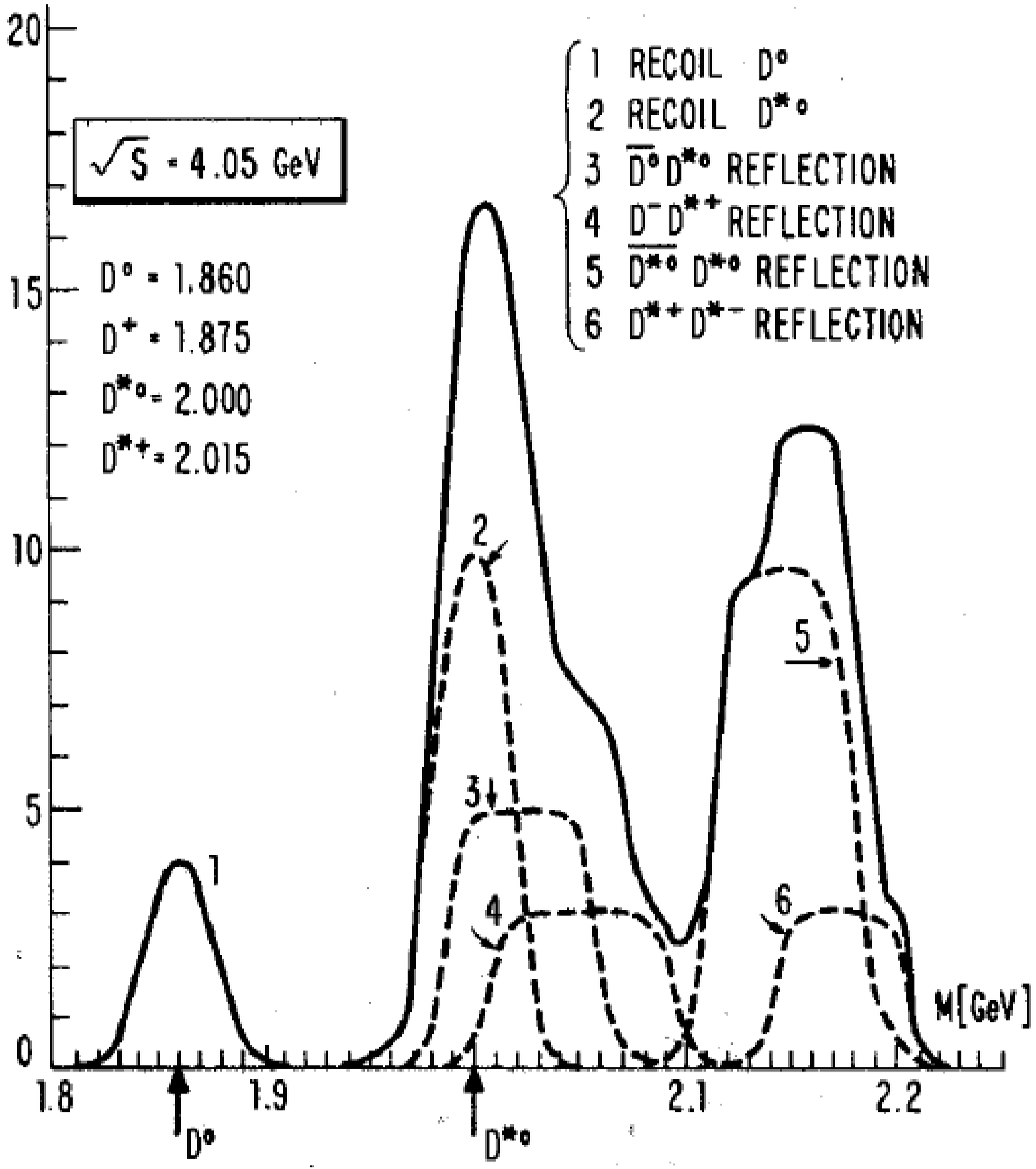
(b) RECOIL SPECTRUM AGAINST $D^{\pm}$

SMEARED WITH 20 MEV RESOLUTION



(a) RECOIL SPECTRUM AGAINST D^0

SMEARED WITH 20 MeV RESOLUTION



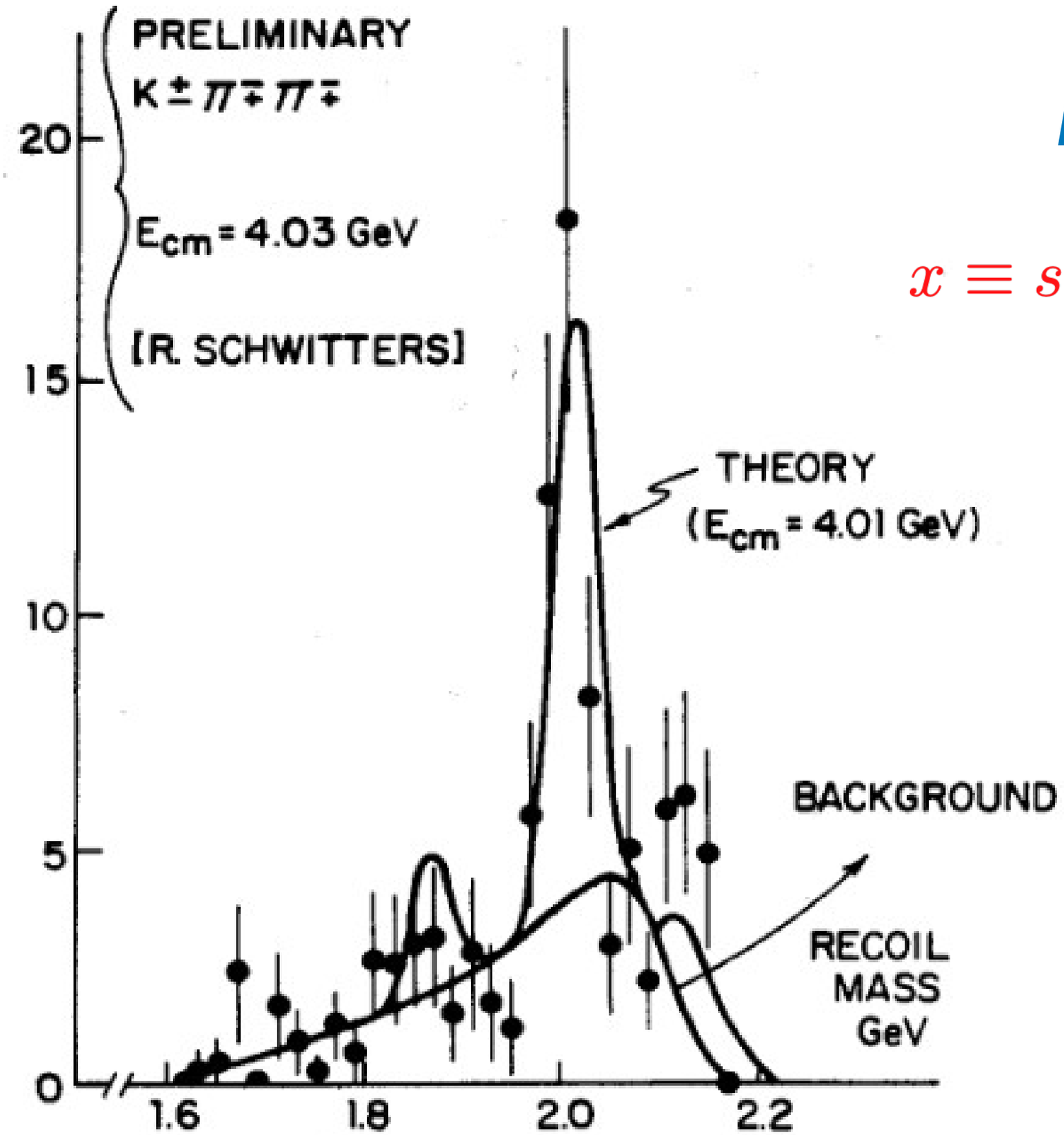


Fig. 6 Comparison of theory[7] and experiment[7] for the invariant mass spectrum recoiling against a detected D_+.

P-wave threshold

$$x \equiv s(e^+e^-) - (m_1 + m_2)^2$$

$$x^{3/2}\, Exp(-x/\Gamma)$$

Only fit parameter

$$\Gamma \sim 1\,\mathrm{GeV}^2$$

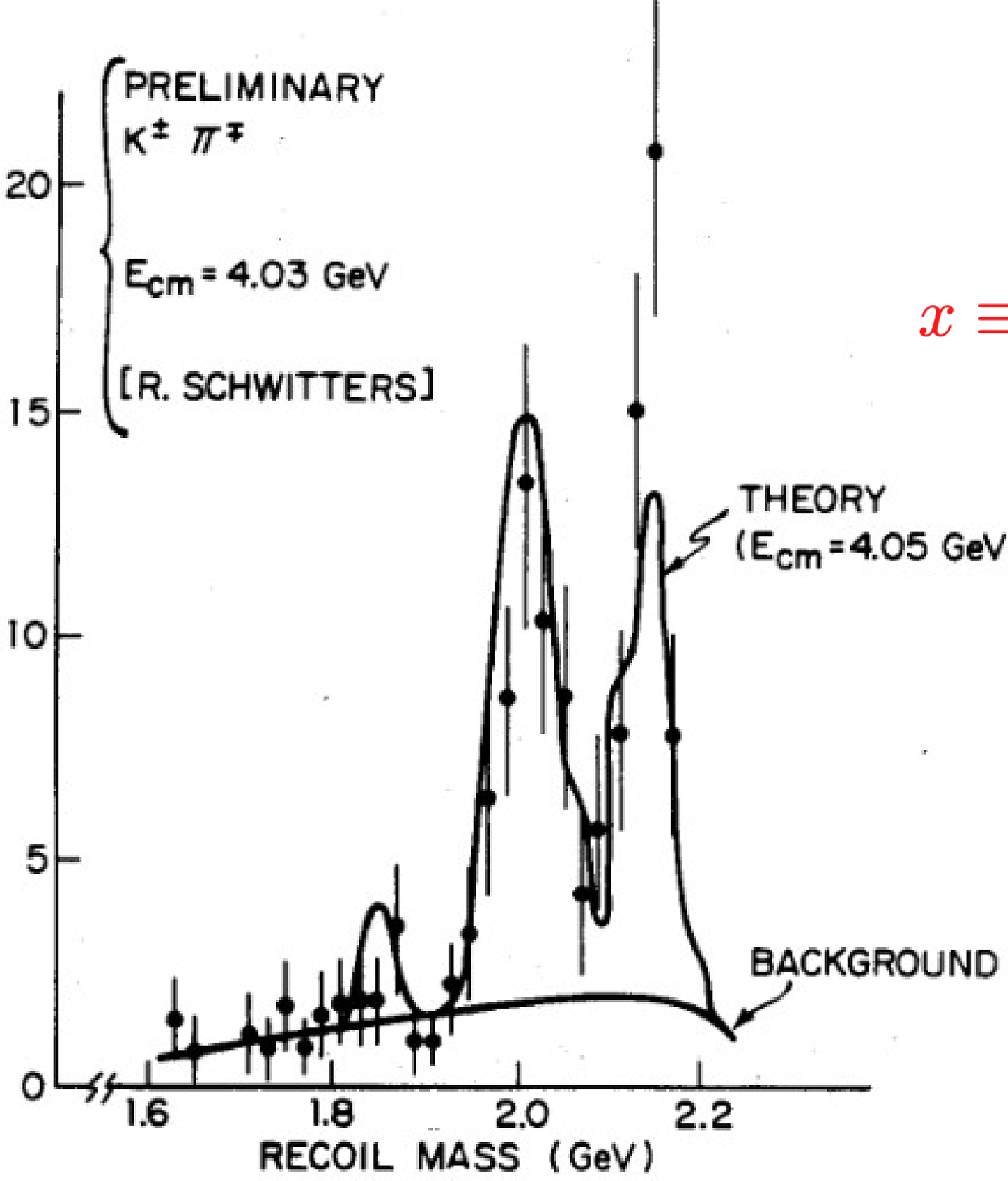


Fig. 5 Comparison of theory[a] and experiment[b] for the invariant mass spectrum recoiling against a detected D_s.

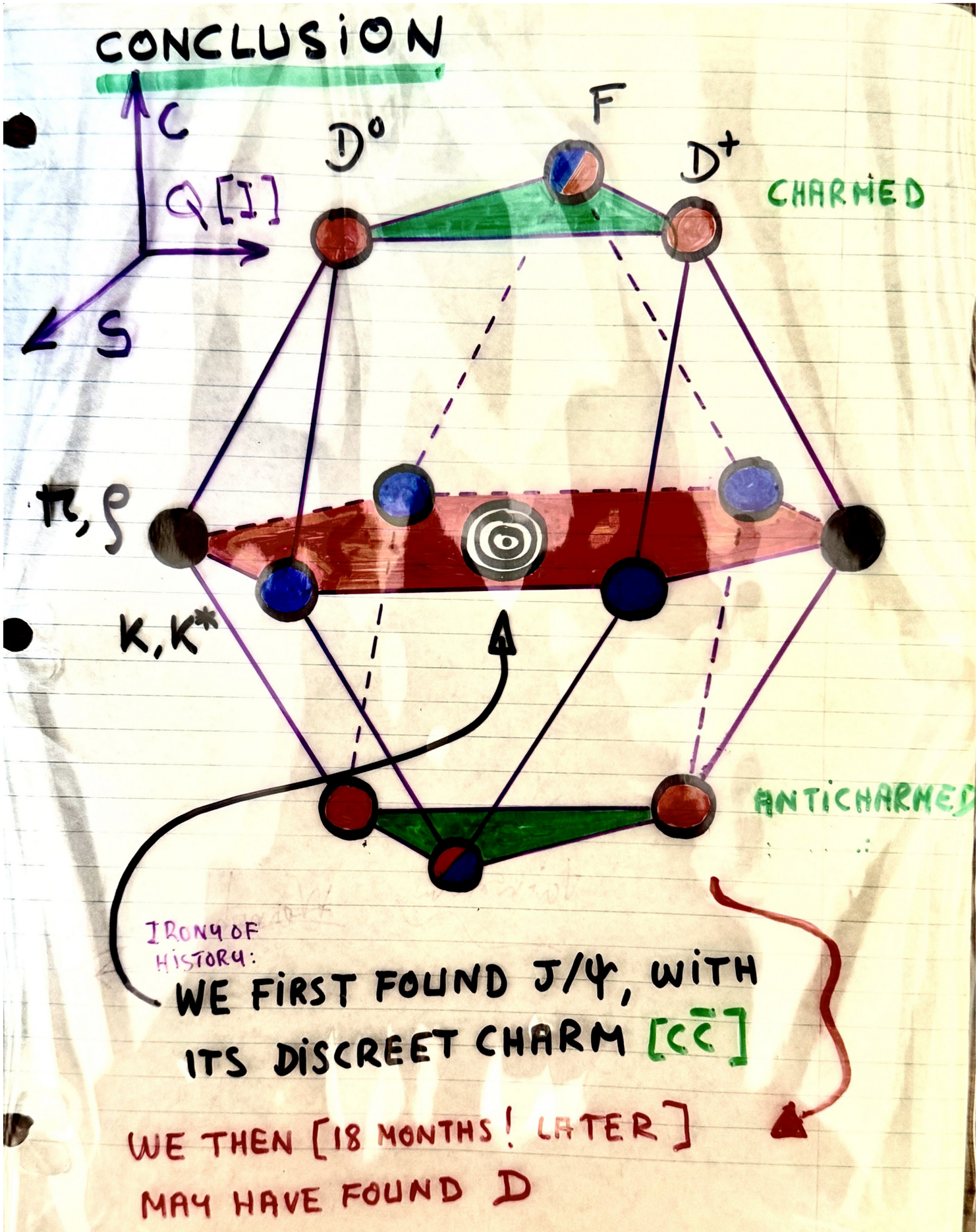
P-wave threshold

$$x \equiv s(e^+e^-) - (m_1 + m_2)^2$$

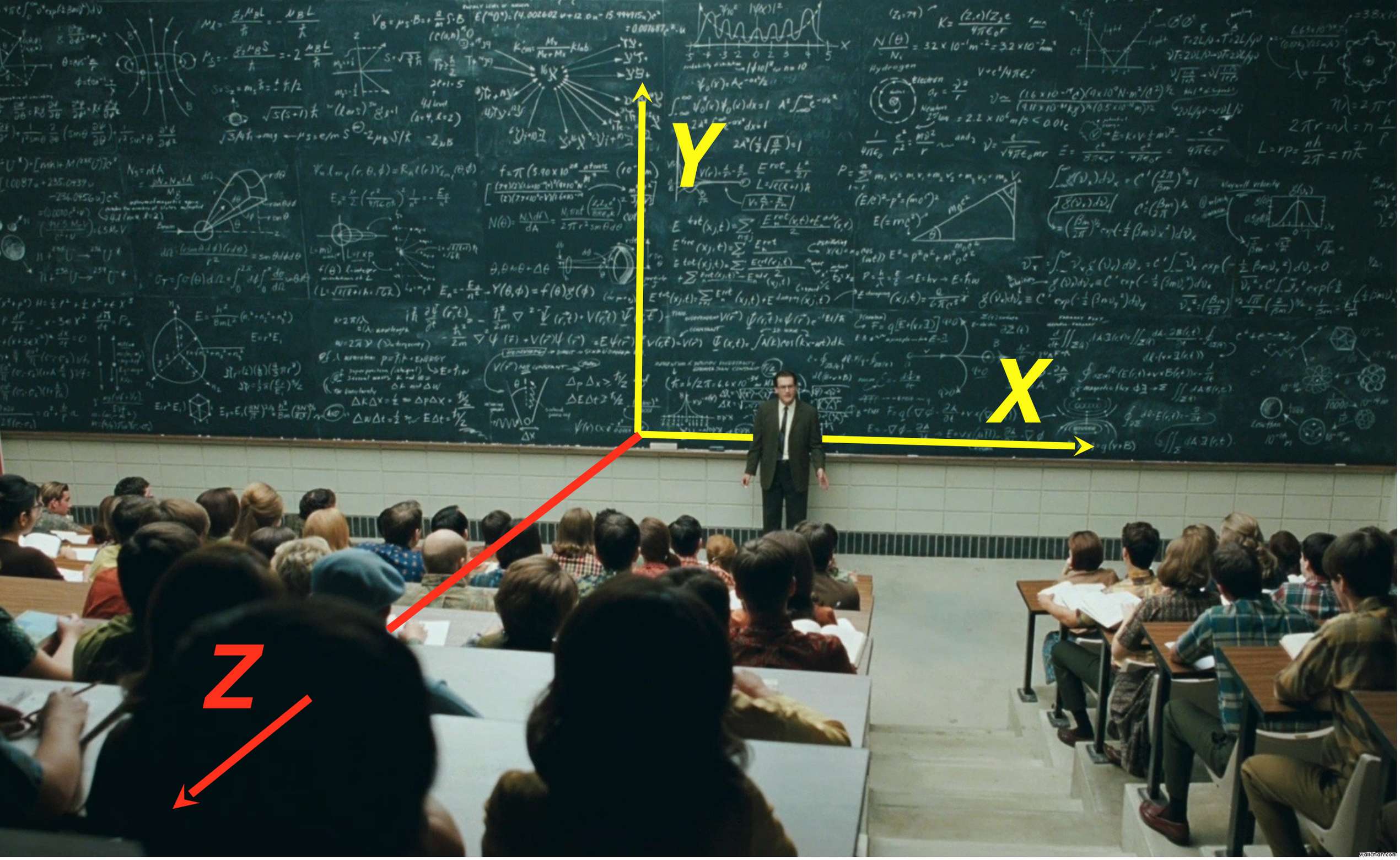
$$x^{3/2}\, Exp(-x/\Gamma)$$

Only fit parameter

$$\Gamma \sim 1\,\mathrm{GeV}^2$$


CONCLUSION
C
Q[I]
S
D°
F
D+
CHARMED
π, ρ
K, K*
ANTICHARMED
IRONY OF HISTORY:
WE FIRST FOUND J/ψ, WITH ITS DISCREET CHARM [cc̄]
WE THEN [18 MONTHS! LATER] MAY HAVE FOUND D

ERROR?


Y
X
Z

More on

Никола́й Никола́евич

Боголю́бов

?

Países para los cuales este pasaporte es válido
(Pays pour les quels ce passeport est valable)

TODOS LOS DEL MUNDO
(Excepto Rusia y Países satélites)

La validez de este pasaporte terminará
(Ce passeport expire)

21 DIC. 1966

a menos que sea renovado
(a moins de renouvellement)

Expedido en MADRID
(Délivré á)

fecha (date) 22 DIC. 1964