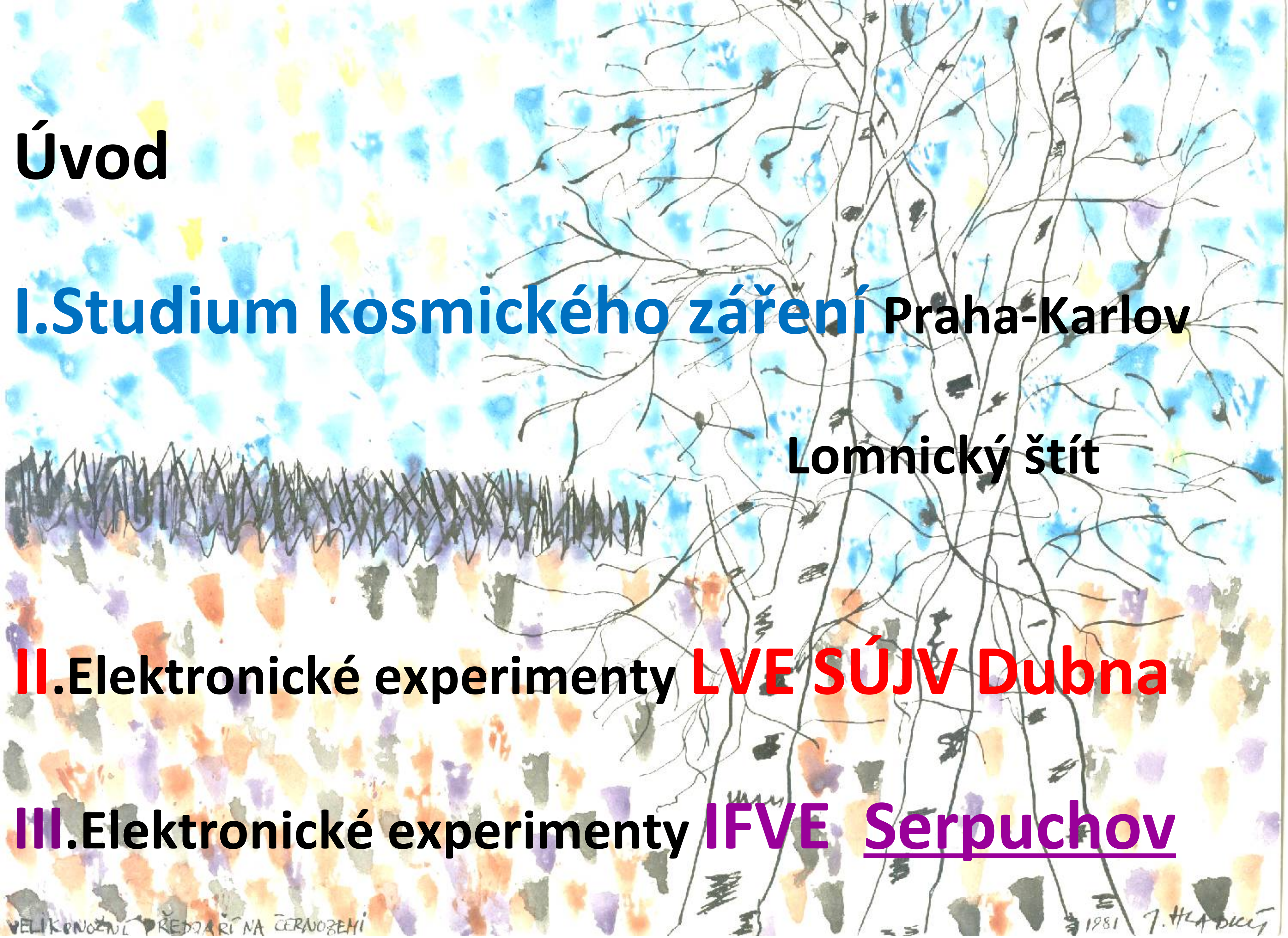
ČÁSTICOVÁ ZLATÁ LÉTA SEDMDESÁTÁ

(aneb **NAŠE ZAČÁTKY III.**)

elektronické experimenty v ÚFVE Serpuchov via LVE SÚJV Dubna.

Jan Hladký, FZÚ AV ČR v. v. i.

Erice, Sicilie



Úvod

I.Studium kosmického záření Praha-Karlov

Lomnický štít

II.Elektronické experimenty LVE SÚJV Dubna

III.Elektronické experimenty IFVE Serpuchov

~ 1965 **Ústav Fyziky Vysokých Energií**

Protvino u Serpuchova

Protonový synchrotron E = 70 GeV

pro experimenty od 1970

(pouze pro vybranou společnost !)

Od začátku roku1969 zájem některých fyziků z oddělení vysokých energií FÚ ČSAV v Praze o experiment v Serpuchově

ČESKOSLOVENSKÁ AKADEMIE VĚD
FYZIKÁLNÍ ÚSTAV
Praha 8, Na Slovance 2

1969

Oddělení vysokých energií

CO DĚLAT?

ЧЕХОСЛОВАЦКАЯ АКАДЕМИЯ НАУК
ФИЗИЧЕСКИЙ ИНСТИТУТ

CZECHOSLOVAK ACADEMY OF SCIENCES
INSTITUTE OF PHYSICS

PRAHA

1970

Definitivní schizma experimentu

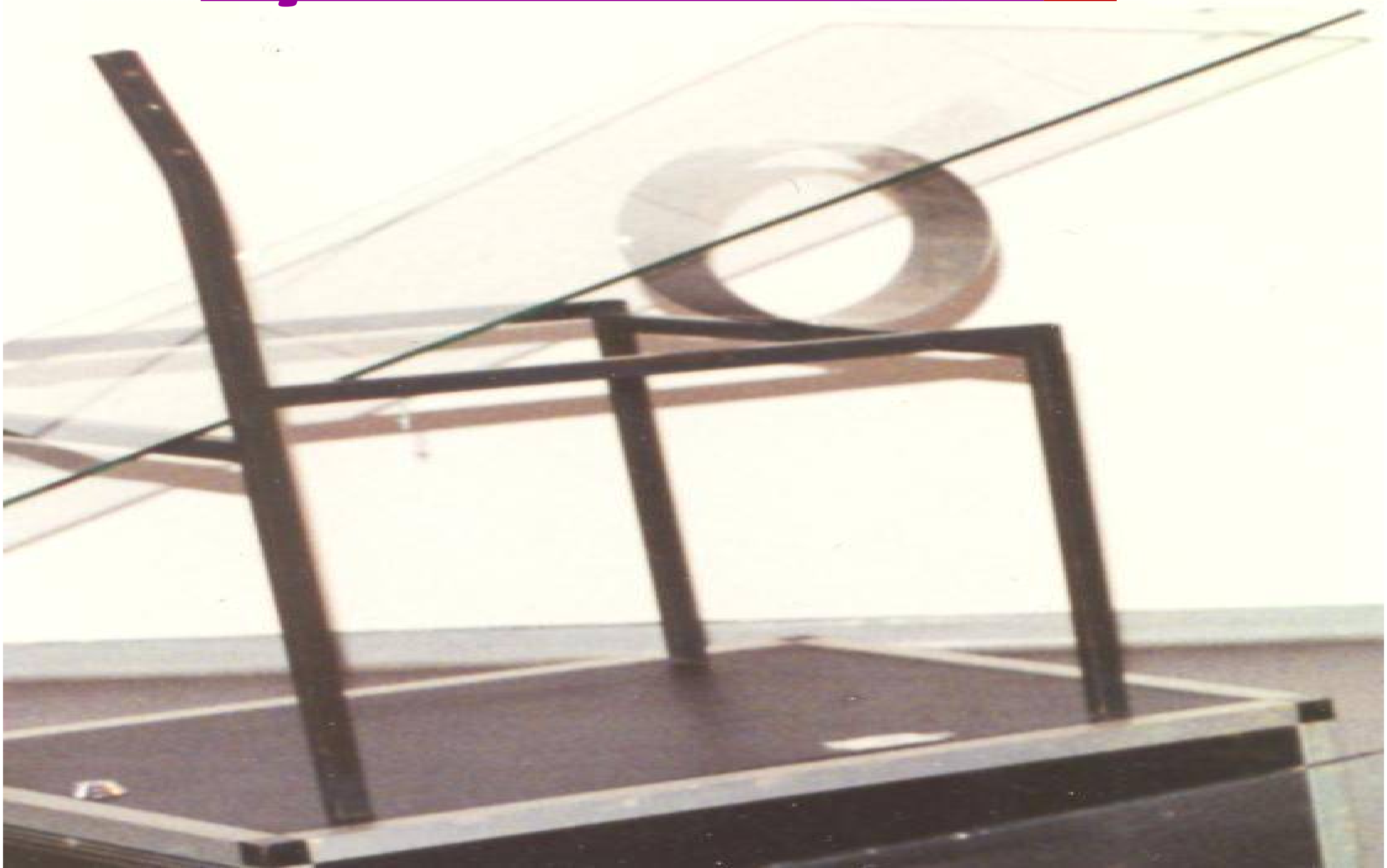
♦ Tradiční metoda - **bublinkové komory**
(všichni, kdo neemigrovali+laboratoř optiky)

♥ Progresivní metoda – **elektronický experiment**
(v oné době již opožděné)

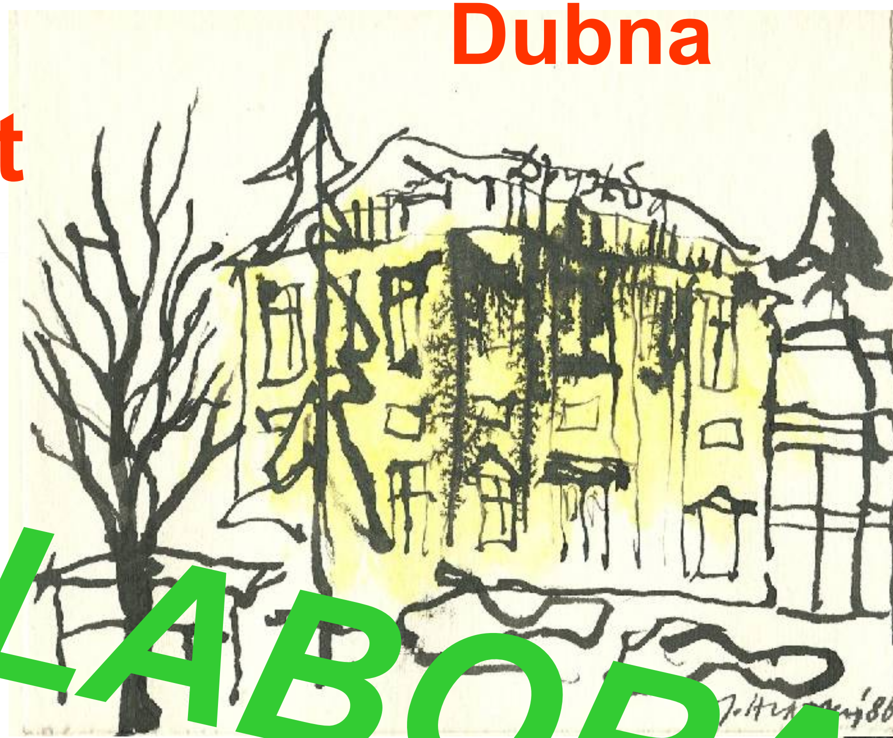
Budování infrastruktury:

* **CDC 3300 – Čs. úřad statistický Praha a Výzk.výpočt.stredisko Bratislava**
* **4 fyzici** – J.Hladký, M.Novák, A.Prokeš, J.Votruba

Fyzika mezonů K^0



Dubna

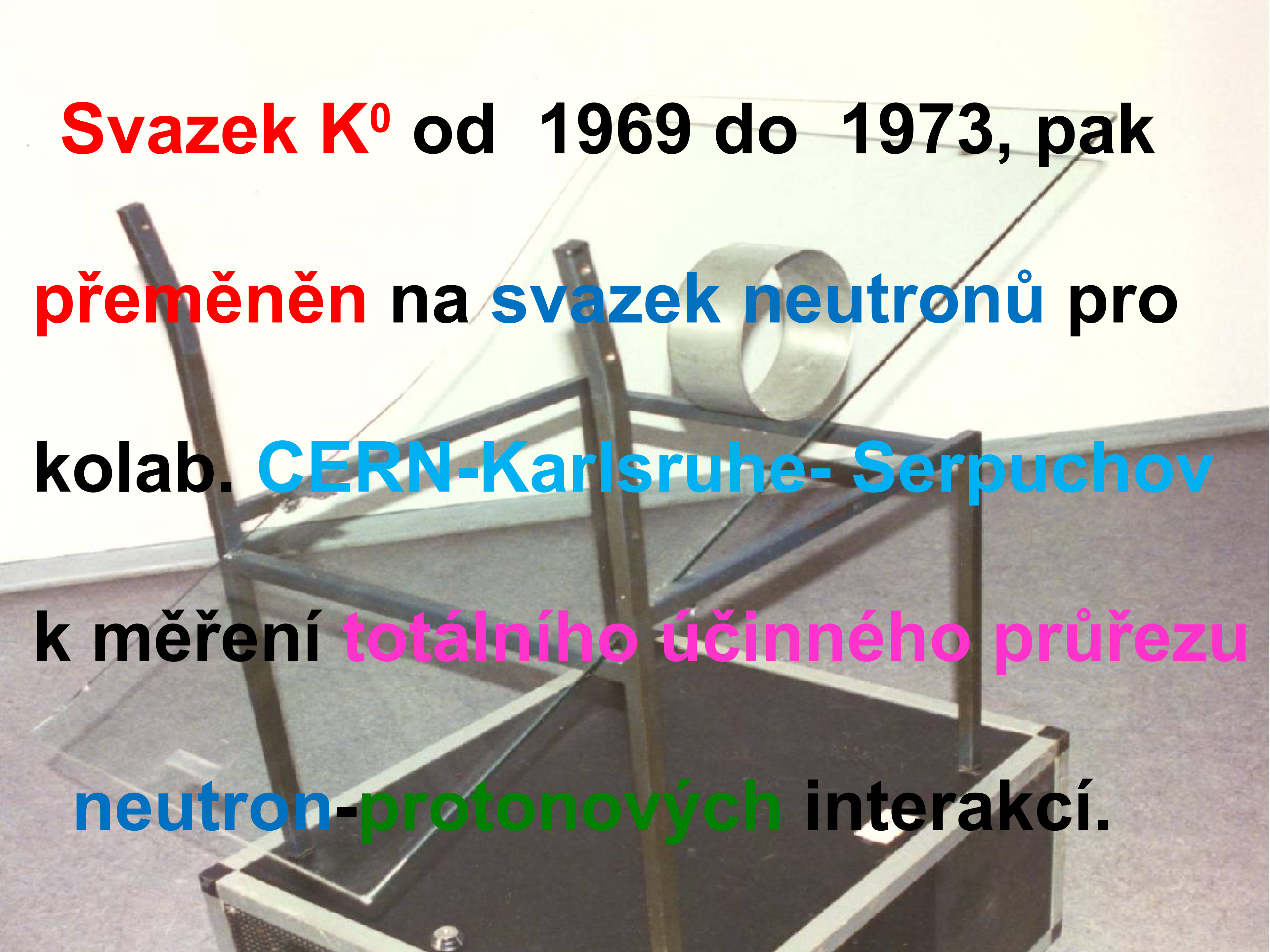


Budapest

Serpuchov

KOLABORACE

Praha



Svazek K^0 od 1969 do 1973, pak přeměněn na svazek neutronů pro kolab. CERN-Karlsruhe- Serpuchov k měření totálního účinného průřezu neutron-protonových interakcí.

Program LVE SÚJV v Serpuchově od 1969:

1* Regenerace mezonů $K^0_L \rightarrow K^0_S \rightarrow \pi^+ \pi^-$

na **H_2**, **D_2**, **C** regenerátorech,

2* Semileptonové rozpady $K^0_L \rightarrow \pi e\nu, \pi\mu\nu$,

3* Vzácné rozpady mezonu $K^0_L \rightarrow \mu^- \mu^+$, atd.

a další problémy....

kolaborace ***BIS*** (Bezfilmovij iskrovij spektrometr):

1* Regenerace mezonů K

(při energiích do 50 GeV)

Typy regenerace:

1* transmisní (koherentní)→dopředu- $<10^{-7}$ mrad

2* elastická (difrakční na různých jádrech)

3* neelastická→excitace neb rozbití jádra

1* Transmisní testuje:

♦ rozdíl $\Delta\sigma_T$ totálních účinných průřezů K a K(t.j. jsou to 2+2 experimenty v jednom→ syst.chyba)

♥* Pomerančukův teorém→asymptotika

$$\Delta\sigma_T = \sigma_T(K^0 p - K^0 p) = 4\pi/k(\mathrm{Im}(f^0 - f^0))$$

V. Telegdi
Chicago Univ.
Erice 1970

ERICE 1970 : VALENTINO TELEGDI :

K_L + matter → K_S reg.

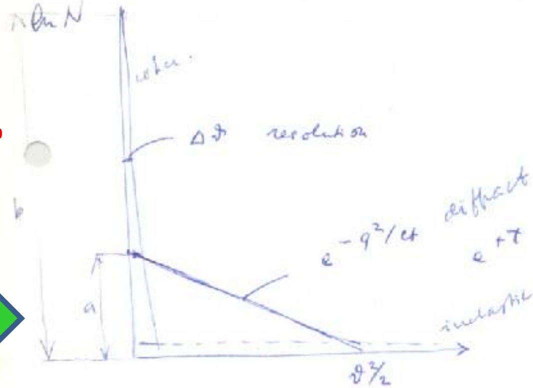
$K_S \simeq \rho K_L$ $\rho \sim \left(\frac{f - \bar{f}}{k}\right) N$

As $k \to \infty$ $\rho \to 0$. Pom. $f(0)$

$\boxed{K_L + p \to K_L + p \text{ (coherent)}}$

$\boxed{|\rho|^2 \ll 0.01}$

dá se regenerovat maximálně 1% na vzdálen



A) $\cancel{R}$ reg. on protons

B) reg. on nuclei

C

$\frac{b}{a}$ Ratio $\sim 1/k^2$ – beam inf.

protons $N_{coh} \sim \rho^2 = \frac{f_{21}^2 N^2}{k^2}$

N_{diff} $|f_A|^2 N \, d\Omega$

definice: $|f|^2 = \frac{d\sigma}{d\Omega}$

$e^{ikz} + f \frac{e^{ikr}}{r}$

η

ρ/η Cu 20–25

$|\rho/\eta|^2$ 400 !!

ρ/η C 15

B_4C = Carborunde

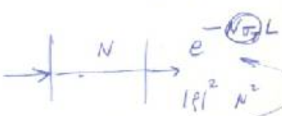
Boron carbide density:

Graphite $d \sim 1.7$ (H. ... 2.25)

B C Diamant $d \sim 3.2$

B_4C $d = 2.45$

B^{11} až (→ 2.7)



oslabení svazku při průchodu terčem

Experiment Fermilab

při $E_p \longrightarrow$ 120 GeV

Teorie : Pais,Piccioni (1955):

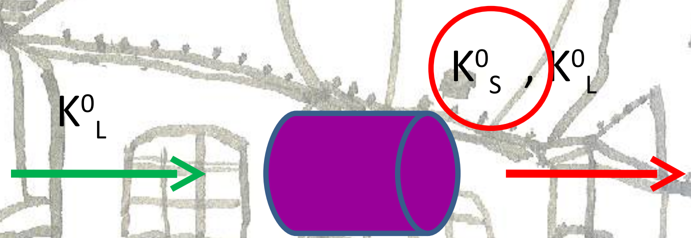
Neutral kaon regeneration

(K^0 and K^0 have different strangeness)

Linear combinations:

$|K^0_1\rangle = 1/\sqrt{(2)}\ (|K^0\rangle + \ K^0\rangle)$

$|K^0_2\rangle = 1/\sqrt{(2)}\ (|K^0\rangle - \ K^0\rangle)$



When scattering amplitudes are f^0 , f^0 ***where*** ($f^0 \neq f^0$)

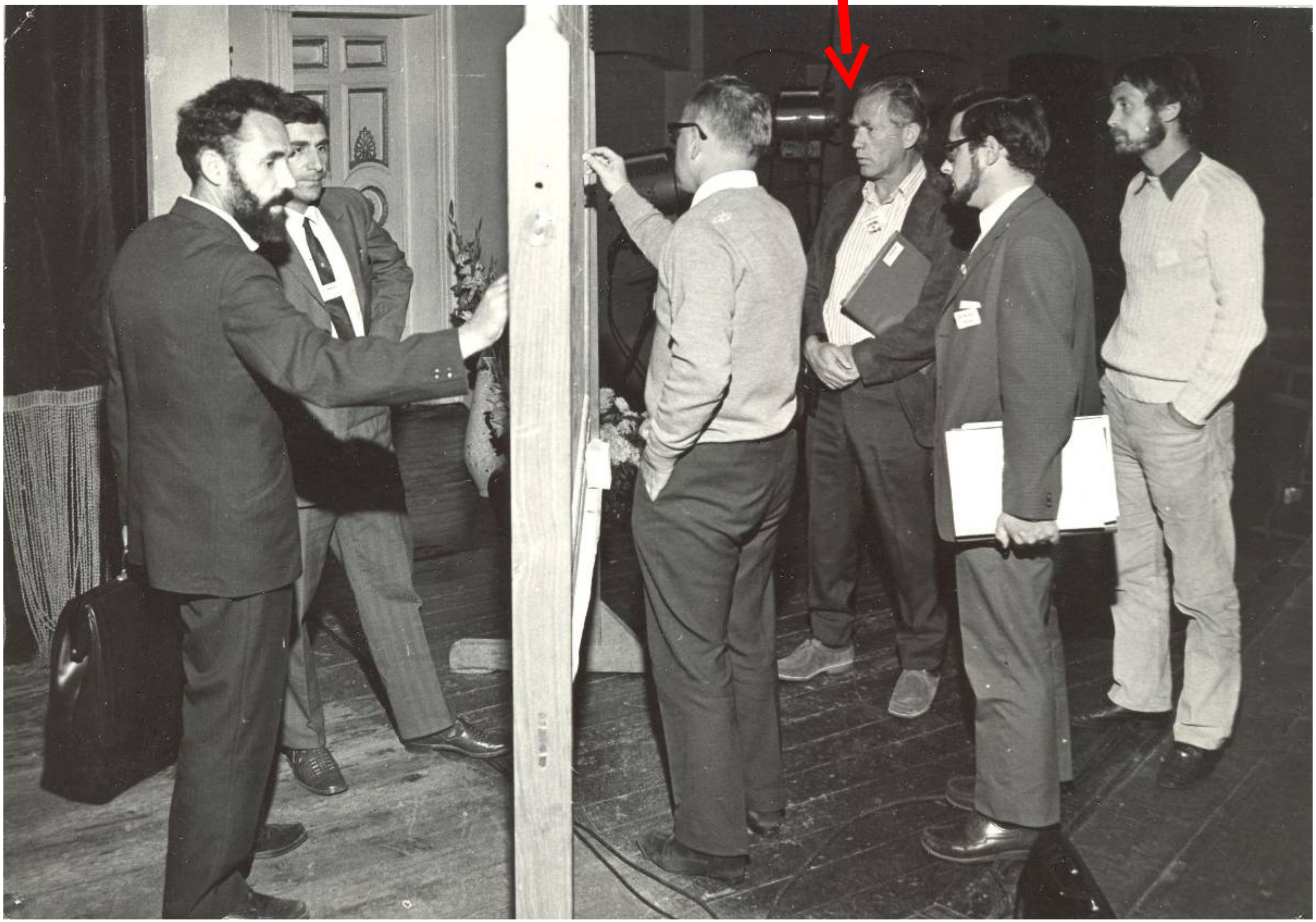
then the state behind the block is:

$$\tfrac{1}{2}(f^0 + f^0)\,|K^0_L\rangle + \tfrac{1}{2}(f^0 - f^0)\,|K^0_S\rangle$$

scattering term ***regeneration term***

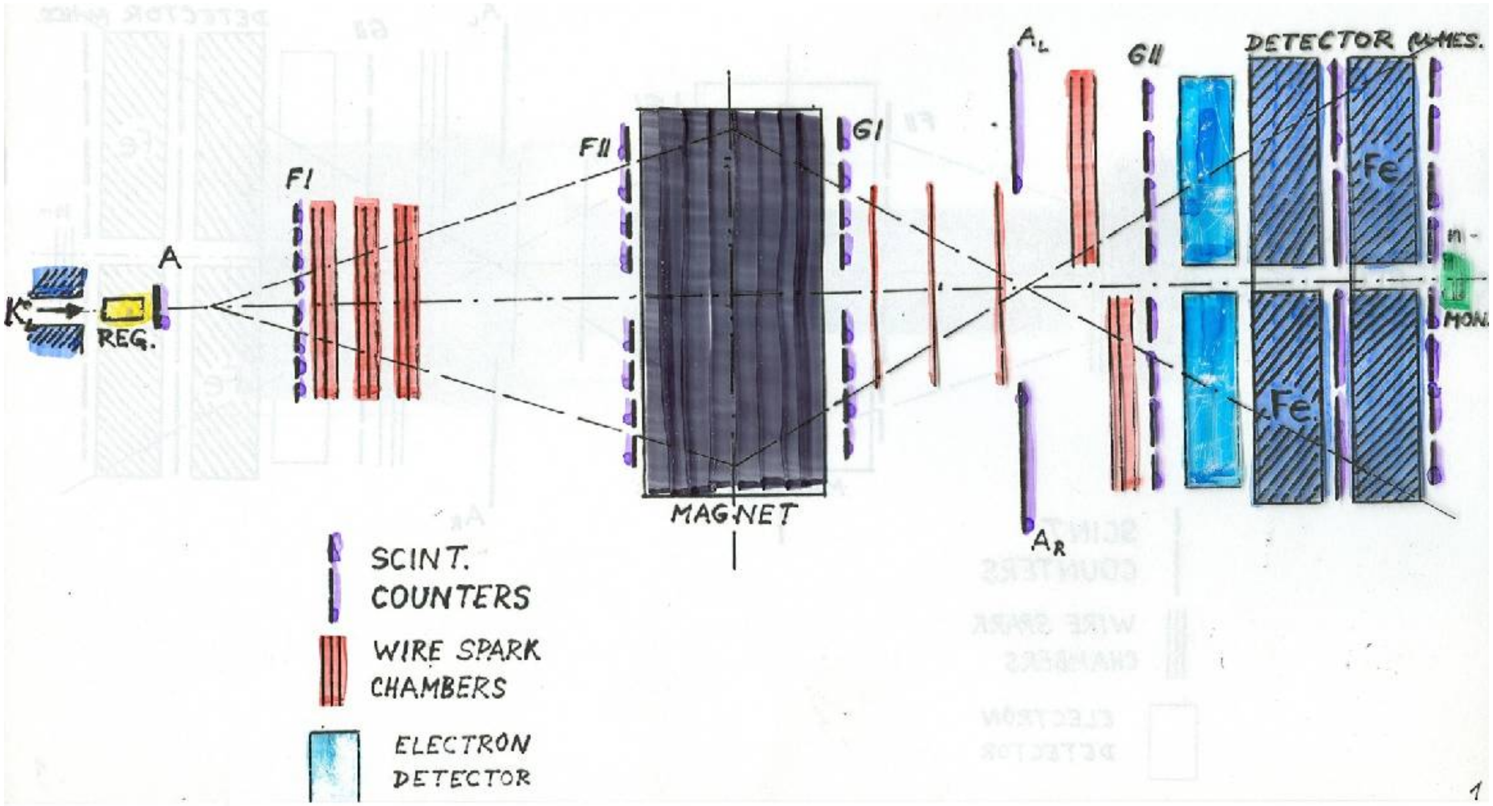
ICHEP Kiev 1970

V. Vovenko, P. Piccioni, XX ?, J.Hladký



M. Šafranov, XX ?

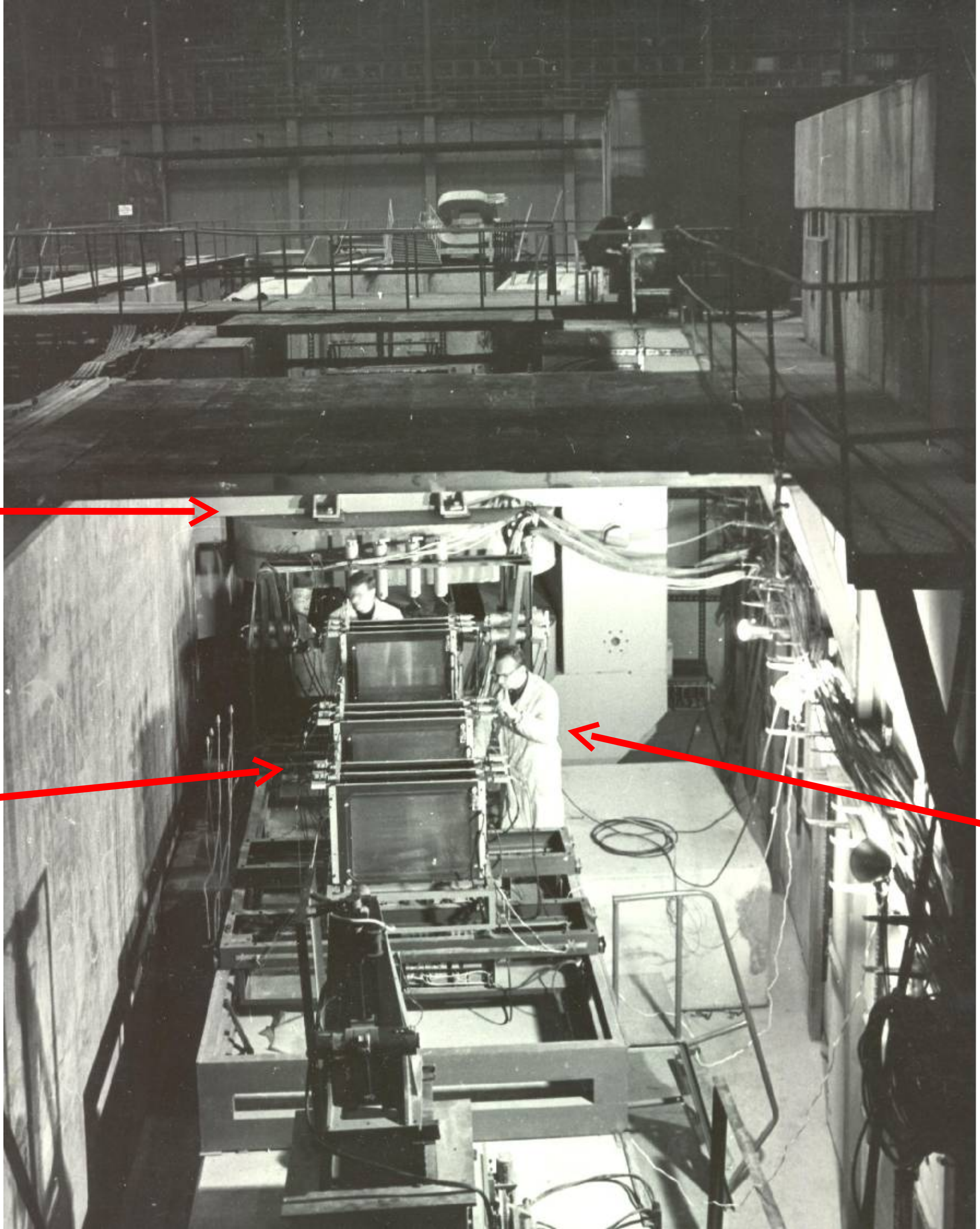
Budapest-Dubna-Prague-Serpukhov collaboration (from 1969)



Aparatura experimentu BIS - 1

BIS - 1

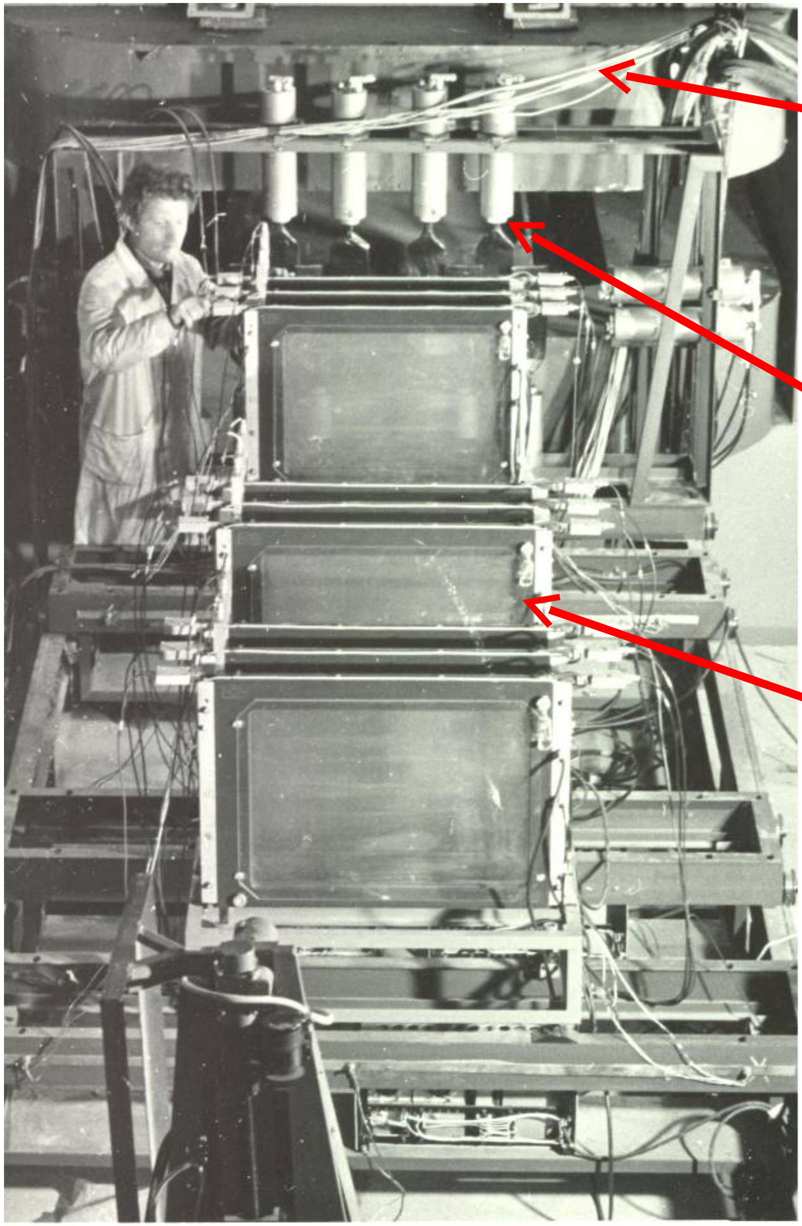
magnet



drátové
jiskrové
komory

I.A.Savin
mluvčí

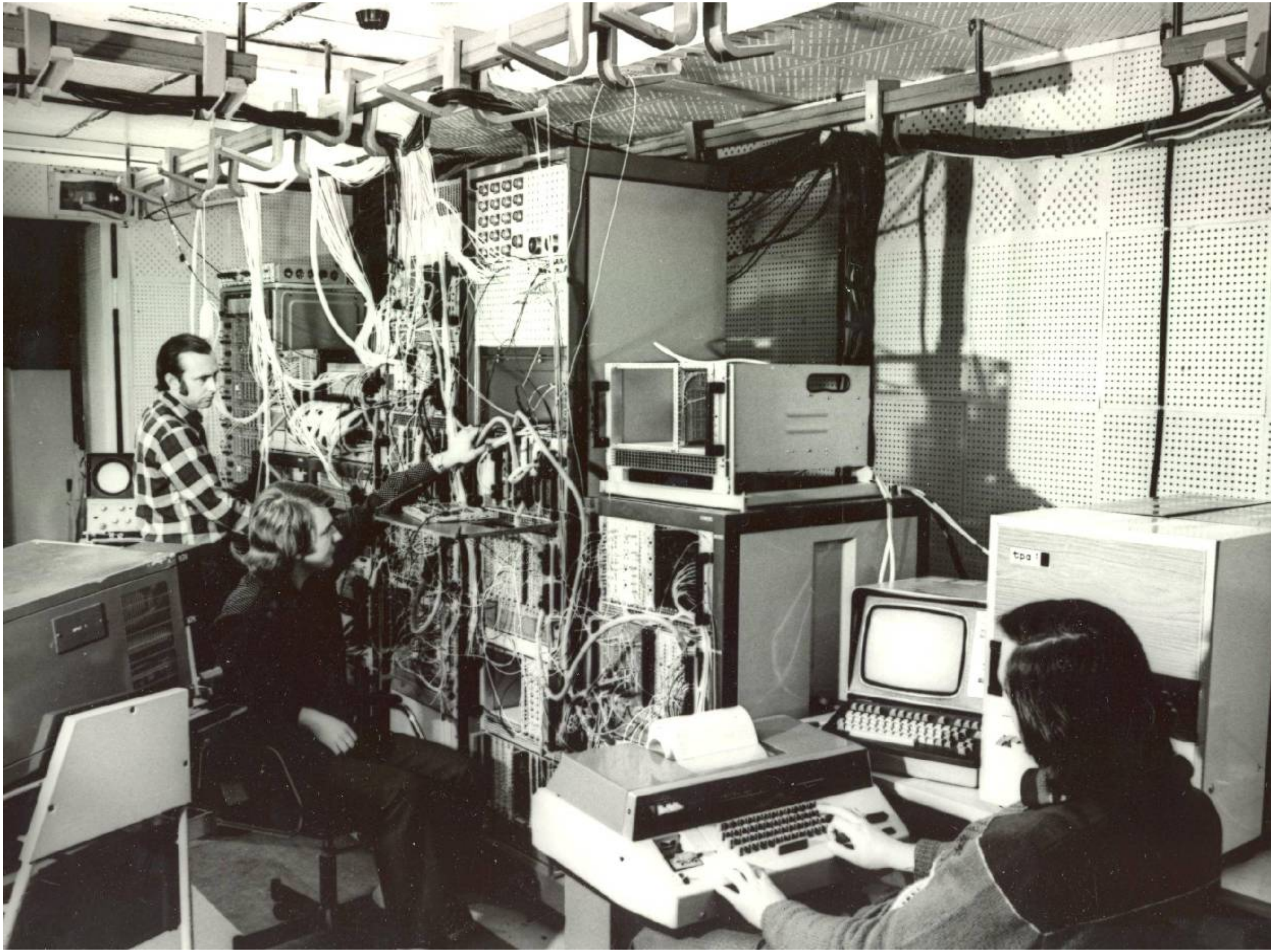
BIS - 1



magnet

scintilační
hodoskopy

drátové
jiskrové
komory



BIS-1 elektronika

I.Geškov

A.Meyer

V.D.Kekelidze

Dubna 1975

A.L.Ljubimov

L.Urbán

BIS – 1 kolaborace → BBDPSST

9.6.71.

BALDIN

Začátky pro nás velmi obtížné –

vybraná společnost….

(doma i v cizině)

А. Прокешу.

1. У нас с 20го по 24ое/X сеанс на Ужгороде.
Где будем эту информацию обрабатывать пока не знаем.
Мы должны сначала обработать все по Водораду до декабря. 10 TAPES

2. Здесь мы обрабатываем Ваш сеанс с конца и идем Вам навстречу. Обработали пока [illegible] (на 1. DST)
Желательно [illegible] есть ли у Вас [illegible] по обработке? ANO

3. Ждем приезда Новака М. и тебя на [illegible] и к нам для обсуждения [illegible] работ на 1972 г.

Novák [illegible]
пока нет контракта

4. Чертежи по пластинкам к счетчикам можем сделать только после октябрьского сеанса.

jaké připravujeme podmínky řešení
jaké plány se dělají na příští (jaro)

Привет и наилучшие пожелания от всех твоих знакомых. Привет Гладкому Я. и др.

14/X-71 [signature]

VYŘÍZENO ALICHAŘ TELEFONEM 25.10.71.

...ale brzy jsme se dobře chytli doma i venku a jelo to ...

Praha – činnost:

♥ geometrická rekonstrukce z magn. pásek

$145+700 \times 10^3$ případů na H_2 terči,

$48+200 \times 10^3$ případů „dummy“

♥ statistická a fyzikální analyza určitých rozpadových kanálů mezonů K^0_L, K^0_S

(př. program KSUMX, teorie, χ^0- mezon)

♥ doplňky různých částí aparatury

plastické scintilátory, skleněné světlovodiče pro hodoskopy atd.

Velmi důležitý BIS program

M. Novák
FÚ ČSAV
Na Slovance 2
Praha 8

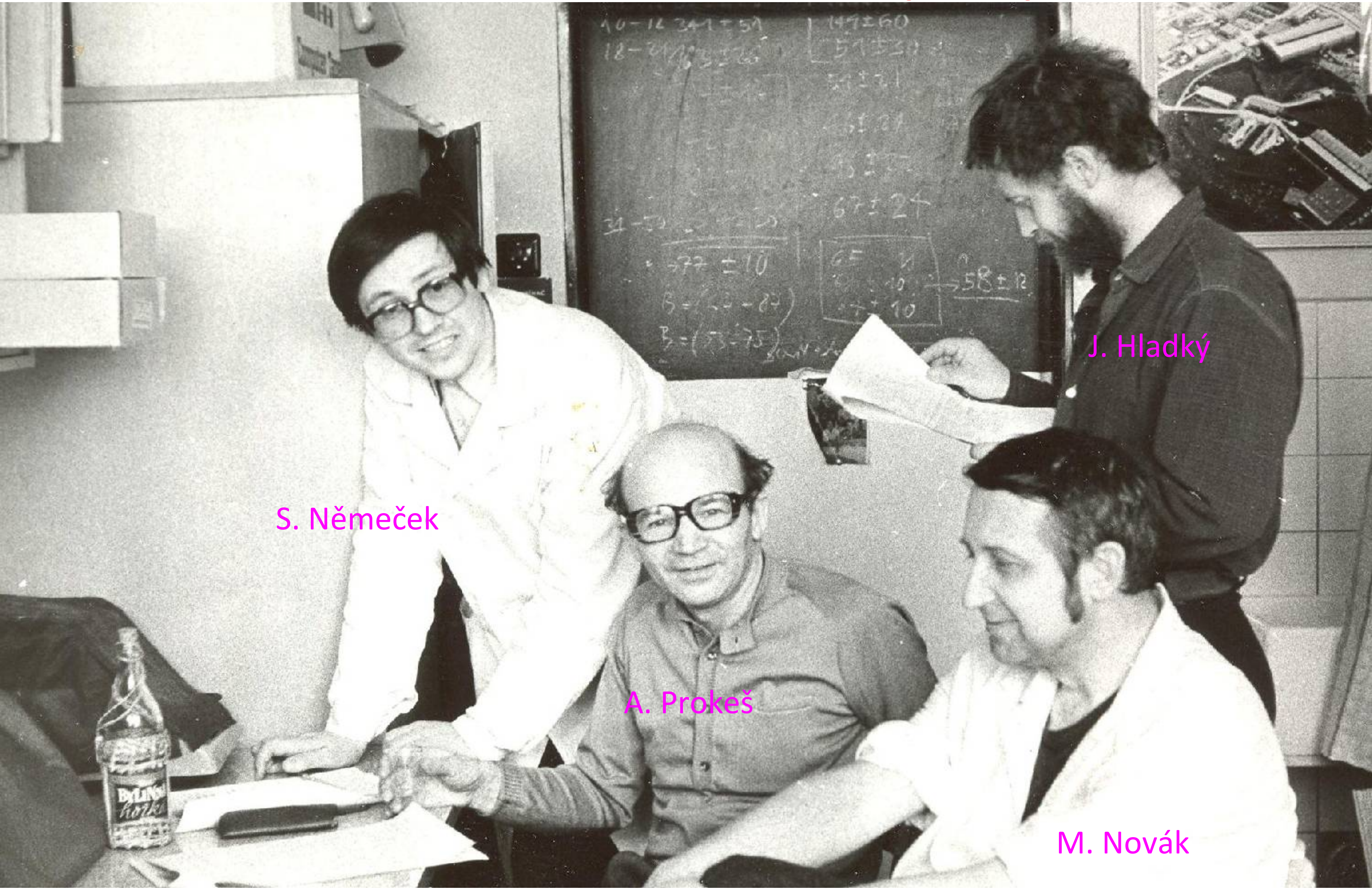
Апрель 1972 г.
~~Октябрь 1971 г.~~

П Р О Г Р А М М А K S U M X

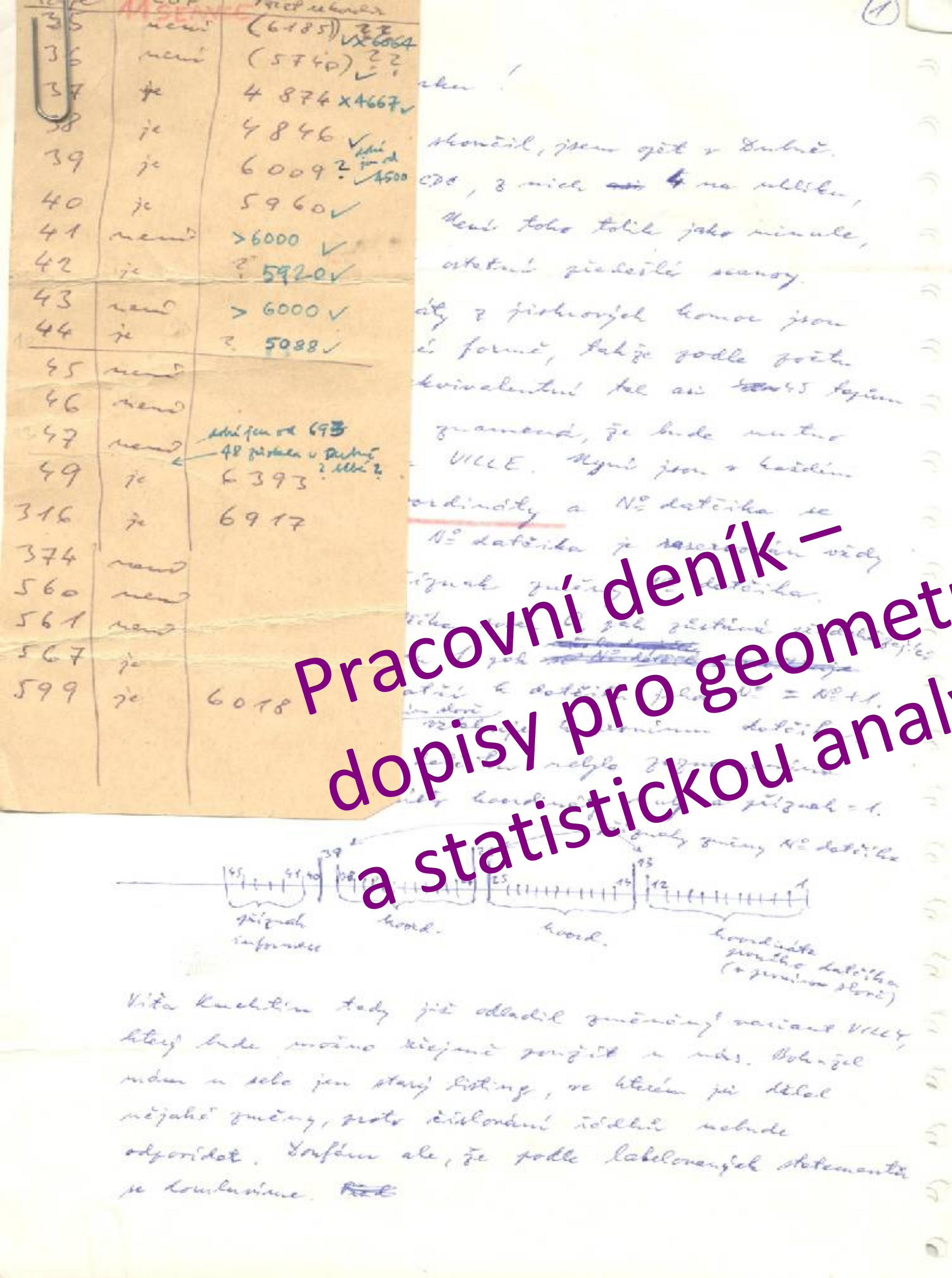
М. Новак
Физический институт ЧСАН, Прага

С о д е р ж а н и е

FÚ ČSAV Praha, místnost č. 223 (1977)



Pracovní deník – dopisy pro geometrickou rekonstrukci a statistickou analysu dat atd.



35	není	(6185) ?? x 6664
36	není	(5740) ??
37	je	4874 x 4667
38	je	4846
39	je	6009 ?
40	je	5960
41	není	>6000
42	je	? 5920
43	není	> 6000
44	je	? 5088
45	není	
46	není	
47	není	
49	je	6393
316	je	6917
374	není	
560	není	
561	není	
567	je	
599	je	6018

Víťa Kuchtín tedy již odladil změněný variant VILLY, který bude možno nejspíš použít u nás. Bohužel mám u sebe jen starý listing, ve kterém již dělal nějaké změny, proto číslování řádků nebude odpovídat. Doufám ale, že podle labelovaných statementů se domluvíme.

FÚ ČSAV Praha, místnost č. 223

проверять декодировку
на ленте
и словами

некот. из событий
найдут не порядку
идет тот же самый номер
событий – выбрасывать

```
      NEV = 0     на нач. програм
      NDEV = 0
    8 CONTINUE
C---
      IF(NEV-IB) 9, 10 ,9
    9 CONTINUE
      NEV = IB
      GO TO 11
   10 NDEV = NDEV+1          ← přeskočit celý event!
      GO TO 2
   11 CONTINUE
      NWORD= IAND(IB,NEWMASK(1))
      NWORD= NWORD/NEWMASK(2)
      I= I+NWORD-1
под над 777
      PRINT 776, NIEV
  776 FORMAT (//29H NUMBER OF IDENTICAL EVENTS =, I6)
```

① ~~Собак~~ (Bobe...) Кухтин

② ...

D. VILLY 333

DATA ISIFTX(I)

Y

DATA ISIFTY(I)

```
-14      1
-343     2
+603
-1480
-870
-1256
-2586
-2700
-2485
+1732
-155
-653
-1848
-1986
-1532
-800
-390     12
-265     18
12*0.
```

TELEFON 6.1.72

TONDA + LICHAČEV:

PRO 13 SEANCE:

(C-REGENER.)

```
29950
30450
30000
24400
24400
24000
15100
15150
0 → 15000
4450        10
2158        11
-1000
-341800     12
            13
-341500     14
-341500     15
+342100     16
341700      17
342500      18
```

Pracovní deník

1* Transmisní regenerace

Intensity of the **coherently** regenerated K^0_S on

protons →

regeneration ***coefficient*** $\rho(p) \sim 2/k[f^0(p) - f^0(p)] = 2/k\, f^0_{21}(p)$

regeneration ***phase*** $f^0_{21}(p) \sim \exp[\, i\, \varphi^0_{21}(p)\,]$

Nuclear Physics B115 (1976) 249–268
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Transmisní regenerace na vodíku

K^0_L-K^0_S TRANSMISSION REGENERATION ON HYDROGEN

V.K. BIRULEV, V. GENCHEV, N.N. GOVORUN, T.S. GRIGALASHVILI, B.N. GUS'KOV, J. HLADKY, I.M. IVANCHENKO, V.D. KEKELIDZE, D. KISS, V.G. KRIVOKHIZHIN, V.V. KUKHTIN, M.F. LIKHACHEV, E. NAGY, M. NOVAK, A. PROKES, Yu.I. SALOMATIN, I.A. SA..., L.V. SIL'VESTROV, V.E. SIMONOV, D.A. SMOLIN, G.G. TAKHTAMYSHEV, P. TODOROV, L. URBAN, A.S. VOV..., G. VESZTERGOMBI and J. VOTRUBA
Joint Institute for Nuclear Research, Dubna, USSR

Main **proton** **results**:

♥ the regeneration **phase** $\varphi^0_{21}(p) = -132° \pm 5°$ ***is energy independent in the region*** $10 \le p \le 50$ ***GeV/c for all regenerators used***

♥ the modulus of the regeneration **amplitude** for protons decreases with increasing momentum as:

$$2/k\,|f^0_{21}(p)| = (0.84 \pm 0.42)\,p^{-0.50 \pm 0.15}\ \text{mb}$$

♥ both results are in accordance width the prediction of the complex angular model for **ρ** and **ω** poles with the cuts

♥ the difference $\Delta\sigma_T = \sigma_T(K^0p) - \sigma_T(\bar{K}^0p)$ decreases as

$\Delta\sigma_T(p) = (7.3 \pm 3)\,p^{-(0.53) \pm (0.13)}$ - **agrees with other σ_T data measured in the K^+p and K^-p**

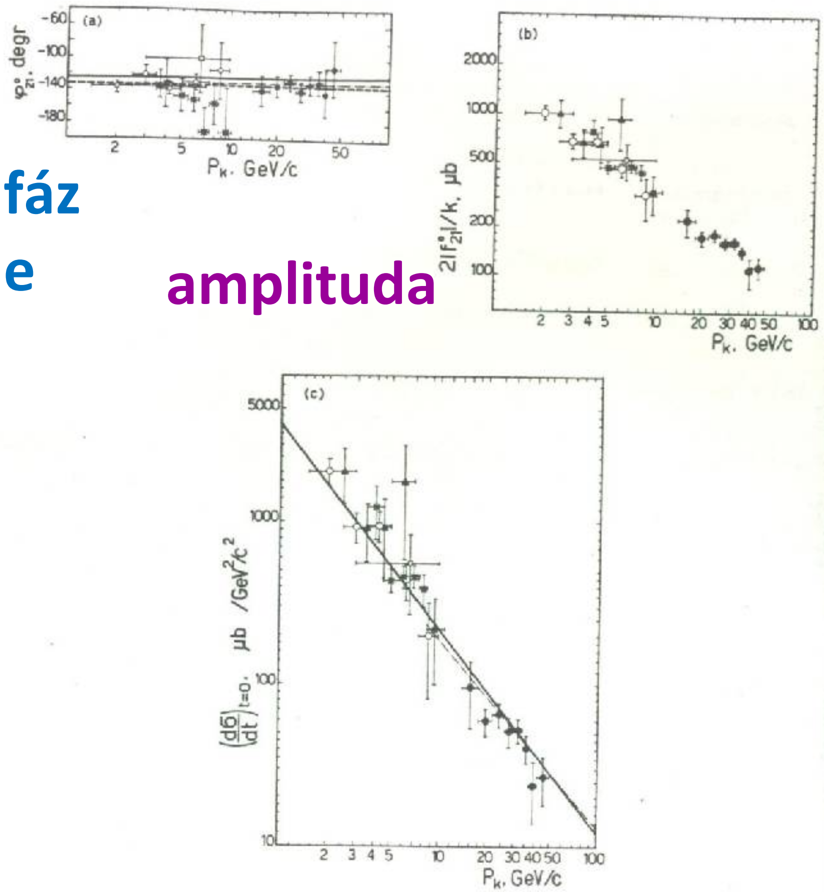

Fig. 6. Results of measurements of the phase (a) and the modulus (b) of the K_L^0-K_S^0 transmission regeneration amplitude on hydrogen and the differential regeneration cross sections at zero four-momentum transfer (c). Symbols (•) denote the results of this paper; (○) ref. [34]; (△) ref. [38]; (□) ref. [39]; (×) ref. [40]. The mean phase, $\bar{\varphi}^0_{21} = -133°$, is the broken line in fig. (a). The solid line is the calculation by the complex angular momentum model when $f^0_{21}(p)$ is determined by eq. (4) with the trajectory parameters taken from [41]; the chain dotted line is the same type of calculation but with the parameters of poles and cuts taken from [8].

The modified regeneration amplitude $2|f^0_{21}(p)|/k$ and the differential cross section at $t = 0$ $(d\sigma/dt)_{t=0}$ have been calculated for the weighted values of R as well as K^0p and $\bar{K}^0p$ total cross section differences using the formula

$$\Delta\sigma(p) = 4\pi|f^0_{21}(p)/k|\sin\varphi^0_{21}\ ,$$

where $\varphi^0_{21} = -132° \pm 5°$ is the observed average value of the regeneration phase. These values are shown in figs. 6 and 7 and listed in table 1.

We have investigated the dependence of the regeneration amplitude phase on a possible change of the parameters (18). It turns out that the possible change of the φ^0_{21} average value can be expressed by the formula:

$$\varphi^0_{21} = (-132° \pm 5°) + 70°\left[\frac{0.54\cdot 10^{10} - \Delta m}{0.54\cdot 10^{10}}\right] + 108°\left[\frac{\tau_S - 0.895\cdot 10^{-10}}{0.895\cdot 10^{-10}}\right] + (\Phi_{+-} - 42°)\ . \qquad (19)$$

The influence of other weak interaction parameters on the value of φ^0_{21} is negligible.

Possible systematic errors of φ^0_{21} and $2|f^0_{21}(p)|/k$ due to the procedures of event selection and background subtraction have been investigated as well. These errors are equal to about ±3° and ±8 μb, respectively.

Finally we have determined the energy dependence of $(d\sigma/dt)_{t=0}$, $2|f^0_{21}(p)|/k$ and $\Delta\sigma(p)$ fitting the values of table 1 with expressions of the type Ap^{-n}, where p is the kaon momentum, A and n are free parameters. The results obtained are given in table 2 and in figs. 6 and 7.

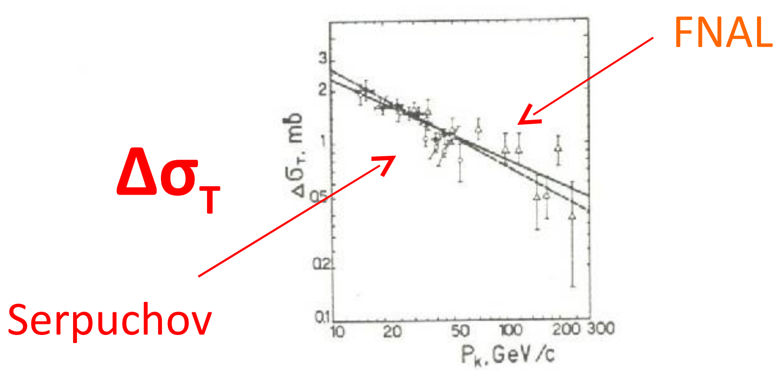

Fig. 7. The kaon-antikaon total cross section difference: (•) $\Delta\sigma_T = \sigma_T(\bar{K}^0p) - \sigma_T(K^0p)$, data of this paper; (○) and (△) $\Delta\sigma_T = \sigma_T(K^-n) - \sigma_T(K^+n)$ results of refs. [16] and [35], respectively. The solid line is the approximation of the Serpukhov and FNAL data by Ap^{-n} (see table 2); the broken line is the same for the results of this experiment.

Transmisní regenerace na deuteriu

Main deuteron results:

♥ the regeneration phase *$\varphi^0_{21}(d)$ **is energy independent** in the region* ***$18 \le p \le 50$ GeV/c*** and in accordance with the prediction of the complex angular model for **ω** pole exchange,

♥ the modulus of the modified regeneration **amplitude** decreases with increasing kaon momentum,

♥ the $K^\circ d$ and $K^\circ d$ total cross section difference **$\Delta\sigma_T$** decreases with increasing momentum of the incident kaons → independent confirmation of experiments with charge kaons (in p=15-65 GeV/c),

♥ **total cross section differences** in σ_T($K^\circ n - K^\circ n$) are **in agreement** with the results in σ_T ($K^- p - K^+ p$) **experiments.**

to be $\alpha(t) = (0.28\pm0.04)+(0.44\pm0.16)\,t$. Clearly there are some theoretical problems in reconciling the results of these three charge exchange reactions.

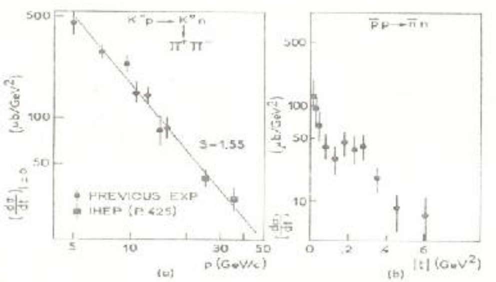

Fig.4.- (a) Forward differential cross-section for the reaction $K^-p \to \bar{K}^0 n$ [3].
(b) Differential cross-section of the reaction $\bar{p}+p \to \bar{n}+n$ at 35 GeV/c [4]. A maximum is clearly apparent around $|t| \simeq 2$ GeV^2 .

Figure 4b shows the angular distribution of reaction (4) obtained at 35 GeV/c [4]. The forward narrow peak is, as usually, attributed to pion exchange. Note however that at these high energies a clear secondary maximum appears. The energy dependence of the differential cross-section indicates that ρ and A_2 exchanges do not give large contributions.

For the first time polarization measurements in K^-p and $\bar{p}p$ charge exchange have been reported at this Conference. They are discussed in the report by W. Beusch.

2.2.- K^0 REGENERATION.- New preliminary data on $K^0_L - K^0_S$ regeneration in deuterium have been presented at this Conference by two groups. The University of Massachusetts-Mc Gill - Northwestern - Pittsburgh Collaboration working at the AGS has obtained results in the momentum range $4 < p < 10$ GeV/c [7]. At Serpukhov the Berlin-Budapest - Dubna - Prague - Serpukhov - Sofia Collaboration [8] has collected data in the momentum interval $20 < p < 50$ GeV/c . (These experiments are briefly described in the report by R. Diebold). In figure 5 some of the results of the two experiments are plotted together. The quantity $|f-\bar{f}|/k$ is the modulus of the regeneration amplitude divided by the momentum. The two experiments are in good agreement. The Serpukhov experiment gives a good determination of the phase of the regeneration amplitude, $\phi = -135^\circ \pm 4^\circ$, which turns out to be energy independent. Using the value $\phi = -135^\circ$ it is possible to relate, through the optical theorem, the quantity $|f-\bar{f}|/k$ to the difference

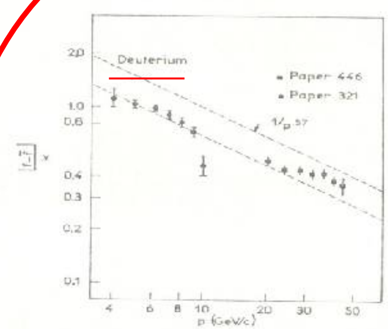

Fig.5.- Preliminary data presented at the Conference on $K^0_L \to K^0_S$ regeneration in deuterium. The lines are obtained from the difference of total cross-section $\sigma_t(K^-d) - \sigma_t(K^+d)$ as explained in the text.

of total cross-section $\sigma_t(\overline{K^0}d) - \sigma_t(K^0 d)$. Since the deuteron has isospin 0, isospin invariance allows one to write

$$\frac{|f-\bar{f}|}{k} = \frac{\sigma_t(K^-d) - \sigma_t(K^+d)}{4\pi\sin\phi} \quad . \qquad (5)$$

The dashed lines in the figure are computed using this equation and taking approximately into account the errors on the quantities appearing in the right-hand side. The agreement is good. In conclusion these preliminary data agree with the simple ω-pole exchange model, in both the phase and energy-dependence, as in the case of regeneration in hydrogen [10].

2.3.- ENERGY DEPENDENCE OF QUASI-TWO-BODY AND FEW-BODY PROCESSES.- Recent information on non-diffractive processes obtained with bubble chambers and with spectrometers are reviewed in the reports by G. Otter and R. Diebold respectively. The theoretical aspects are discussed by G.A. Ringland and by M. Aguilar-Benitez. In previous conferences a full rapporteur talk was devoted to the large field of reaction mechanism. Since this is not the case this year, in this section I shall limit myself to some considerations related to the energy dependence of quasi-two-body and few-body exclusive reactions referring to the accompanying reports for the detailed discussion.

Table I is a compilation of the results presented at the Conference. As usual, the cross-section of each process is parametrized in the form

$$\sigma \propto 1/p^n \qquad (6)$$

Aix en Provence 1973

II. Int.Elem.part.conf.

Raport. talk U. Amaldi

Transmisní regenerace na uhlíku

Main **carbon** results:

In the momentum range 16 ≤ p ≤ 40 GeV/c :

Phase of the carbon regeneration amplitude is independent of energy. Its value is -130° ± 17°

The phase and modulus of the carbon regeneration amplitude measured is in good agreement with the optical model predictions

(Pražská iniciativa)

The time distribution of the kaon decays behind the regenerator was fitted separately for five momentum intervals. Following quantities were fixed in the fit: $\Delta mc^2/\hbar = 0{\cdot}534 \times 10^{10}\ \mathrm{s}^{-1}$, $\tau_S = 0{\cdot}895 \times 10^{-10}$ s, $\tau_L = 5{\cdot}172 \times 10^{-8}$ s, $|\eta_{+-}| = 0{\cdot}00230$ and $\arg \eta_{+-} = 46°$. Supposing momentum independence of the regeneration phase $\varphi = \arg (f_0 - \bar{f}_0)/k$ we have obtained the value $\varphi = -126° \pm 14°$ and a set of $|(f_0 - \bar{f}_0)/k|$ plotted in Fig. 2. For comparison, the results of our first carbon regeneration experiment [3] are also plotted there.

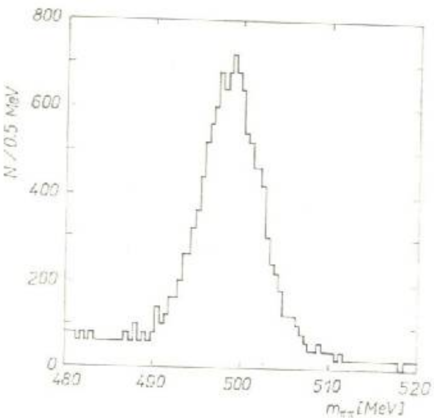

Fig. 1. The distribution of the V^0 invariant masses $m_{\pi\pi}$ calculated for the sample of 16 241 events under the assumption that both registrated charged particles are pions.

fáze regenerace

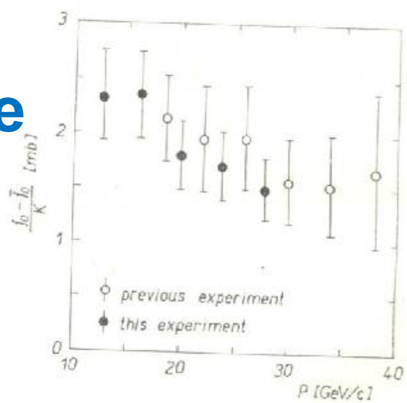

Fig. 2. The values of $|(f_0 - \bar{f}_0)/k|$ for different kaon momenta p obtained in the present experiment and also in our previous experiment [3]. The plotted error bars include besides the statistical errors also uncertainties of the regeneration phase φ.

One can see that the results of both our experiments performed with the carbon regenerator under different experimental and data analysis conditions are in good agreement:

1. the regeneration phase φ is equal to $-126° \pm 14°$ in the momentum range of $10 \leq p \leq 30$ GeV/c and to $-125° \pm 16°$ (after the correction to the same values of $\Delta mc^2/\hbar$, τ_S and $\arg \eta_{+-}$) in the range of $16 \leq p \leq 40$ GeV/c;

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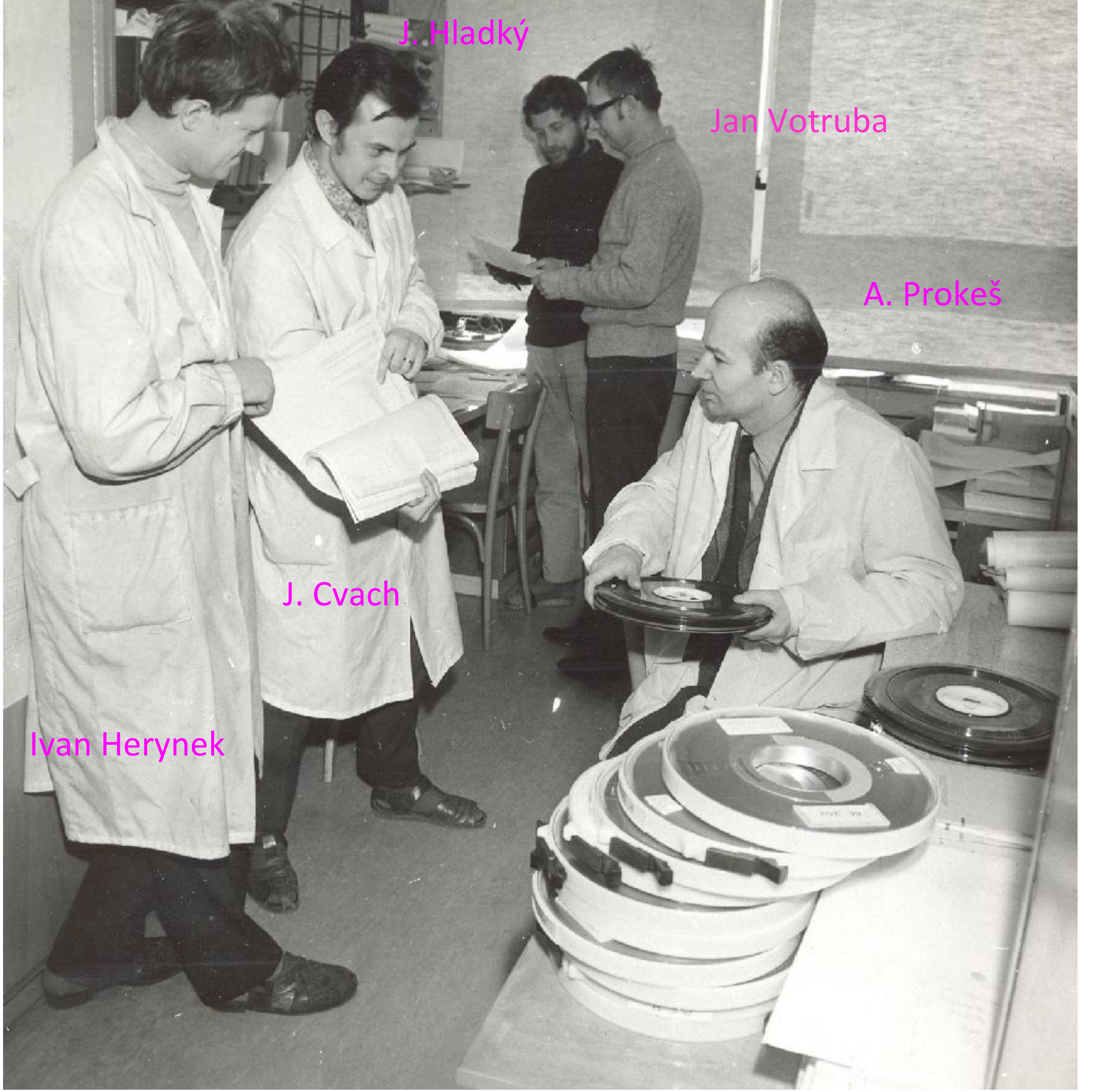
místnost č. 223



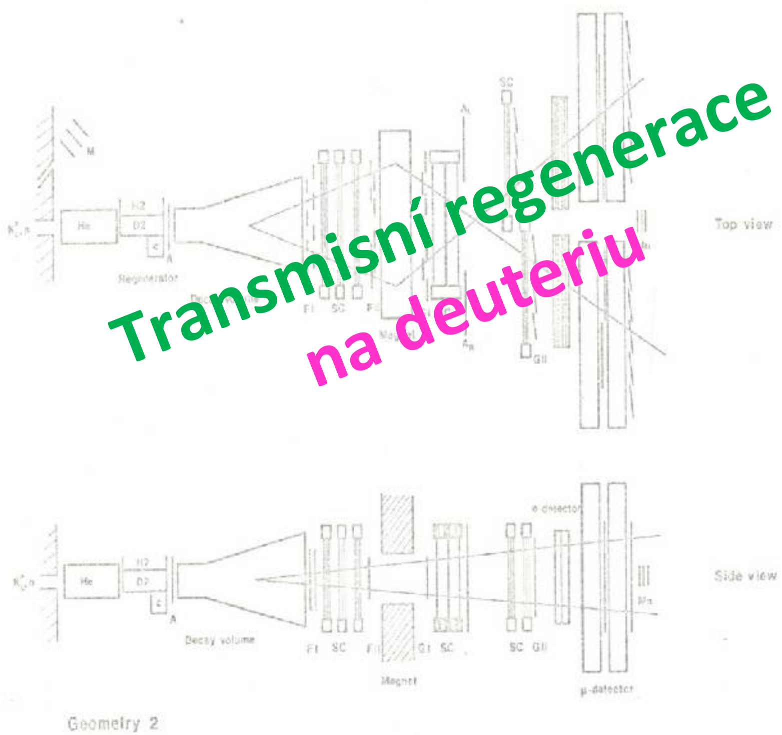
K_L^0-K_S^0 REGENERATION ON DEUTERIUM

BERLIN–BUDAPEST–DUBNA–PRAGUE–SERPUKHOV–SOFIA
COLLABORATION*

Received 26 November 1973

The K_L^0-K_S^0 regeneration on deuterium has been measured at the 70 GeV Serpukhov accelerator in a momentum region of 18–50 GeV/c. The measurements were performed by means of a 3 m long liquid deuterium target and an on-line spectrometer. The preliminary results on the energy dependence of the modulus and phase of the transmission regeneration amplitude are reported.

* K.-F. Albrecht, V.K. Birulev, F. Deak, N.N. Govorun, V. Genchev, L.B. Golovanov, T.S. Grigalashvili, B.N. Gus'kov, J. Hladky, I.M. Ivanchenko, H. Kaiser, V.D. Kekelidze, D. Kiss, V.G. Krivokhizhin, V.V. Kukhtin, M.F. Likhachev, A.L. Lyubimov, I. Manno, V.I. Mazursky, A. Meyer, E. Nagy, M. Novak, S. Nowak, A. Prokes, H.-E. Rysek, Yu.I. Salomatin, I.A. Savin, M.D. Shafranov, A.E. Senner, L.V. Sil'vestrov, V.E. Simonov, G.G. Takhtamyshev, P. Todorov, L. Urban, G. Vesztergombi, J. Votruba and A.S. Vovenko.



Transmisní regenerace na deuteriu

Fig. 1. Layout of the spectrometer.

Nuclear Physics B93 (1975) 237–241

NEUTRAL KAON REGENERATION ON CARBON IN A MOMENTUM REGION OF 16–40 GeV/c

Berlin – Budapest – Dubna – Prague – Serpukhov – Sofia – Collaboration

K.-F. ALBRECHT, V.K. BIRULEV, F. DEAK, V.I. GENCHEV, T.S. GRIGALASHVILI, B.N. GUS'KOV, J. HLADKY, I.M. IVANCHENKO, V.D. KEKELIDZE, D. KISS, V.G. KRIVOKHIZHIN, V.V. KUKHTIN, M.F. LIKHACHEV, A.L. LYUBIMOV, I. MANNO, A.MEYER, E. NAGY, M. NOVAK, A. PROKES, H.-E. RYSEK, YU.I. SALOMATIN, I.A. SAVIN, L.V. SIL'VESTROV, V.E. SIMONOV, G.G. TAKHTAMYSHEV, P.T. TODOROV, L. URBAN, G. VESZTERGOMBI, J. VOTRUBA and A.S. VOVENKO

Received 18 November 1974

The modulus and the phase of the K_L^0-K_S^0 regeneration amplitude on carbon have been measured. In a momentum range 16–40 GeV/c the phase is constant within experimental error bars and coincides with the regeneration phase on hydrogen. Both the modulus and the phase of the regeneration amplitude on carbon are in agreement with optical model predictions.

Transmisní regenerace na uhlíku

According to the investigation program of the $K_L^0 - K_S^0$ regeneration on different targets [1–4], measurements on carbon have been performed at the 70 GeV Serpukhov accelerator using an on-line spectrometer [5].

The spectrometer detected the $\pi^+\pi^-$ decays of incident K_L^0 and regenerated K_S^0 mesons, whose intensity behind a block of matter placed in the K_L^0 beam is described by the well-known formula

$$I(p,t) \sim |r(p)|^2 \exp(-t/\tau_S) + \exp(-t/\tau_L)$$
$$+ 2\,|r(p)|\exp\left[-\frac{1}{2}\left(\frac{1}{\tau_S}+\frac{1}{\tau_L}\right)\right]\cos\left[\frac{\Delta m}{\hbar}t + \phi'(p) - \phi(p)\right], \quad (1)$$

where

$$r(p) = \rho(p)/\eta_{+-}, \qquad \eta_{+-} = |\eta_{+-}|\exp(i\,\phi_{+-}),$$

$$\rho(p) = \pi N \Lambda_S\, \rho'(p)\, i\,[f^0(p) - \bar{f}^0(p)]/k, \quad (2)$$

Amplituda regenerace

XVII. ICHEP

London, 1974

Raport. talk A.N. Diddens

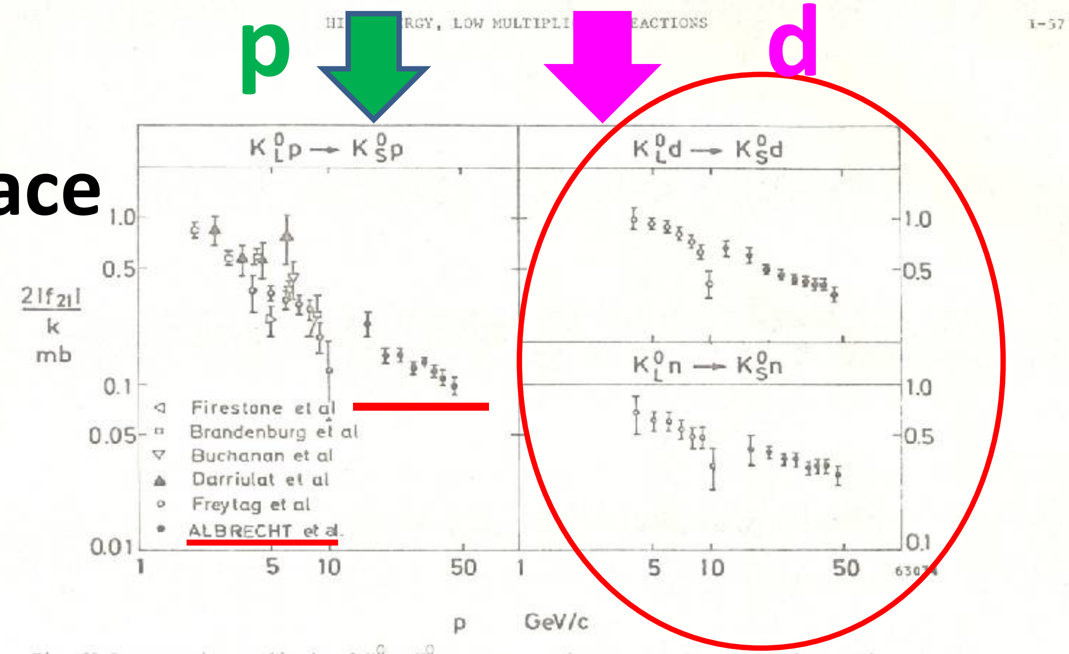


Fig. 29 Regeneration amplitude of $K_L^0 \to K_S^0$ on protons, deuterons and neutrons (Ref. 52).

Fáze regenerace

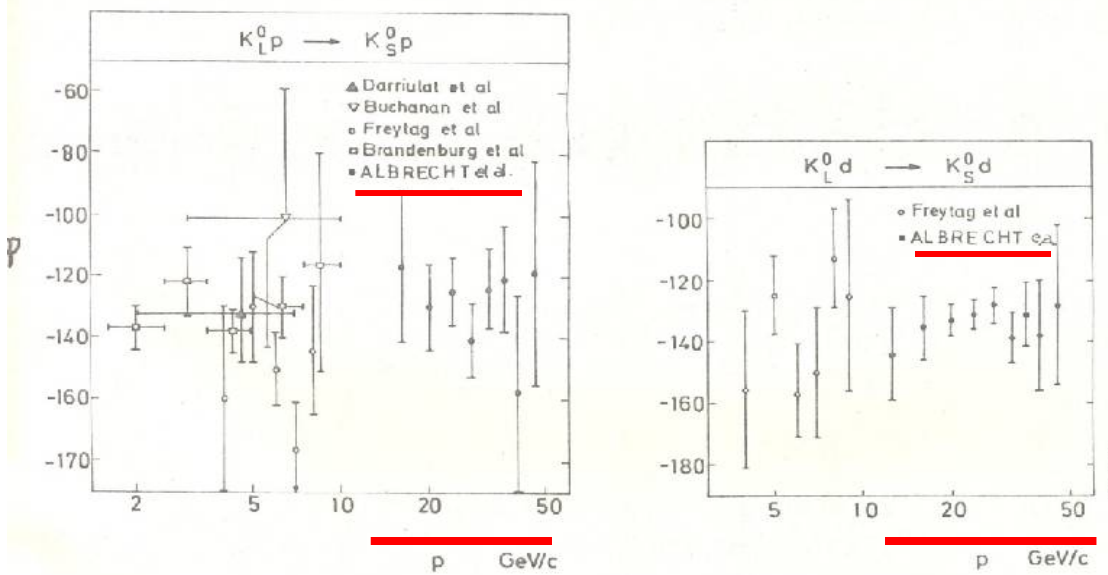


Fig. 30 The regeneration phase derived from transmission regeneration of $K_L^0 \to K_S^0$ (Ref. 52).

Δσ

XVII. ICHEP

London, 1974

Raport. talk

A.N. Diddens

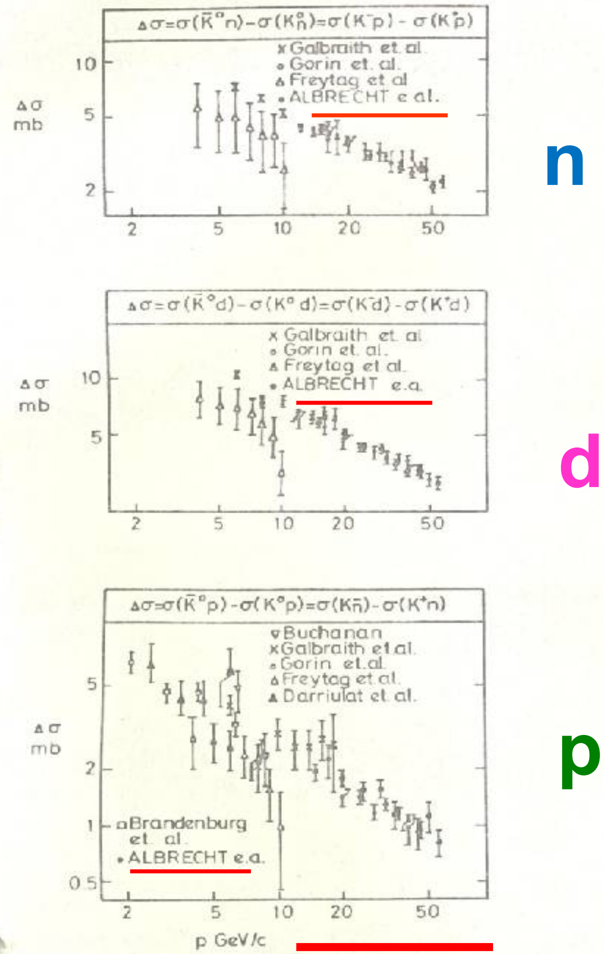


Fig. 31 The total cross section differences derived from transmission regeneration $K^o_L \to K^o_S$ compared to the actually measured differences (Ref. 52).

Fig. 32 shows preliminary data on regeneration on Carbon by a UCSD-Chicago-Wisconsin Collaboration(56), at 4 energies between 50 and 100 GeV/c. The data are in agreement with an optical model calculation and connect to a point at 4.5 GeV/c by a $1/\sqrt{p}$ momentum dependence.

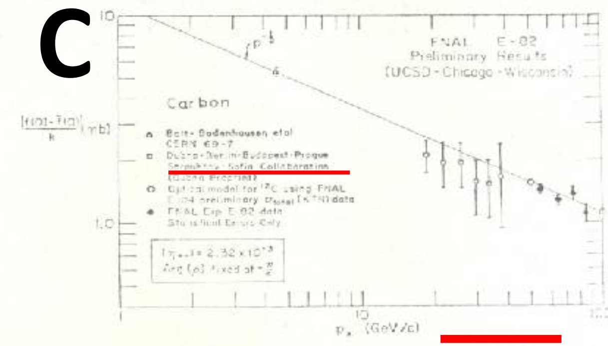


Fig. 32 Regeneration of K^o_S on Carbon (Ref. 56).

In conclusion, this large effort spent on non-diffractive processes seems fully justified, because it is one of the few branches in strong interaction physics where theoretical ideas(57) have withstood the attacks of experiments for more than a decade.

4. POLARIZATION

The Saclay-Serpukhov-Dubna-ITEP Collaboration(58) have performed measurements on the polarization, P, in K^-p and $\bar{p}p$ scattering at 40 GeV/c and pp scattering at 45 GeV/c. Data on 40 GeV/c π^-p scattering have been published previously(59). Fig. 33 shows the new results.

The behaviour of the pp polarization at this high energy seems to have changed somewhat, compared to energies in the 10 to 20 GeV region where it exhibited a double zero around $|t| \approx 0.9$ GeV^2. At 45 GeV/c the polarization has become negative, indicating that the zero's of the interfering amplitudes have moved apart. The energy dependence of the polarization in the region $0.1 \le |t| \le 0.3$ has been plotted in fig.34, showing a gradual decrease (in absolute value) with energy. It seems, however, that these energy dependences can be rather different for the six charged particles.

Transmis. regen. na deuteronu a neutronu

K^0_L-K^0_S TRANSMISSION REGENERATION ON DEUTERONS AND NEUTRONS IN A MOMENTUM RANGE OF 10-50 GeV/c

Main deuteron and neutron results:

Pro oblast 10 ≤ p ≤ 50 GeV/c:

the regeneration **phases** $\varphi^0_{21}\,d(p) = -130.9° \pm 2.7°$ ***and***

$\varphi^0_{21}\,n(p) = -132.3° \pm 1.7°$

are momentum independent in the region 10≤ p ≤ 50 GeV/c

the moduli of the transmission **amplitudes** depends as: $A_f p^{-c_j}$,

where

c_j=d, n and A_f are constants of the value:

A_d = 2.88 ± 0.04 mb, c_d = 0.546 ± 0.030

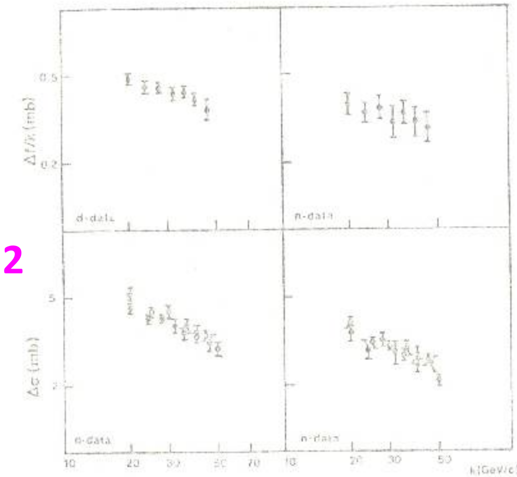
A_n = 1.97 ± 0.14 mb, c_n = 0.530 ± 0.019

the ratio $\Delta\sigma_T = \sigma_T(K^0 n) - \sigma_T(K^0 n) / \Delta\sigma_T = \sigma_T(K^0 p) - \sigma_T(K^0 p)$ done,

so as the values of ω and ρ trajectories intercept.

Δσ

D_2



n

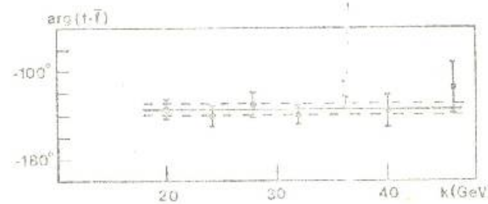


Fig. 3.

Regenerační **fáze**

Fig. 2. Results of the K_L^0-K_S^0 transmission regeneration measurement on deuterium and neutrons: • these data; ○ data of ref. [19].

The experimental study of the energy dependence of the K_L^0-K_S^0 transmission regeneration on deuterium is a natural continuation of the experiments previously done on hydrogen [1–4].

As is well known, the transmission regeneration amplitude is connected with the difference kaon-antikaon forward elastic scattering amplitudes on nuclei. Through the optical theorem the imaginary part of this difference is related to the total cross section difference of the same particles. Using the isospin invariance, one can connect the regeneration cross section on deuterium with the total cross section difference of $K^{\pm}$ d interactions because the deuteron isospin is equal to 0.

The investigation of the regeneration on both deuterium and on nucleons is very important for an experimental proof of the Pomeranchuk theorem conservation and different predictions based on complex angular momentum models [6], dispersion relations [7–9], quark models [10] etc.

This experiment has been performed at the 70 GeV Serpukhov accelerator with the help of a 3 m long liquid deuterium target [11] and an on-line spectrometer used for experiments on hydrogen [1–3].

Measurements were taken during two sets of accelerator runs. In each of them the position of the regenerator and the field in the spectrometer magnet were optimized for the momentum range of incoming K_L^0 10–30 GeV/c (geometry 1) and 18–50 GeV/c (geometry 2). In the geometry 1 and 2 runs 0.5 × 10^6 and 1.1 × 10^6 triggers were respectively recorded. Here we present the results for geometry 2.

The events written on magnetic tapes were processed with the help of the same programs and methods as in the case of the hydrogen regeneration [12–14].

The selection of the two pion decays detected behind the regenerator was performed according to the preceding experience [3]. There are a number of histograms illustrating the selection procedure [21].

The selected two pion decays of K_L^0 and K_S^0 (12 500) events) were used for determining the energy dependence of the modulus $|f^0(K^0d) - \bar{f}^0(\bar{K}^0d)|/k$ and the phase $\arg[f^0(K^0d) - \bar{f}^0(\bar{K}^0d)]$ of the regeneration amplitude on deuterium. This determination has been done by usual methods [3] fitting the experimental time distributions of two pion events by the known interference formula. The obtained values as well as those calculated for $\sigma_{tot}(K^0d) - \sigma_{tot}(\bar{K}^0d)$ and corresponding values for the regeneration on neutrons are shown in fig. 2.

The following weak interaction parameters have been put in the interference formula to fit the data: $\tau_s = 0.905 \times 10^{-10}$ sec, $\Delta m/\hbar = 0.560 \times 10^{10}$ sec^{-1}, $|\eta_{+-}| = 2.35 \times 10^{-3}$ [17], $\phi_{+-} = 42°$ which better fit our data than those of ref. [18].

Calculating the regeneration amplitude on neutrons we have used the data on hydrogen [3], present data and Glauber corrections taken from ref. [20].

From the results shown in fig. 2 one can see the following:

1) The phase of the regeneration amplitude on deuterium is independent of energy and its mean value for a momentum region of 18–[illegible] GeV/c is in agree-

2* Difrakční regenerace

měřena v intervalu $0 \le t \le 0.03\ (\mathrm{GeV}/c)^2$

♥ **Výsledky:**

deuterium:

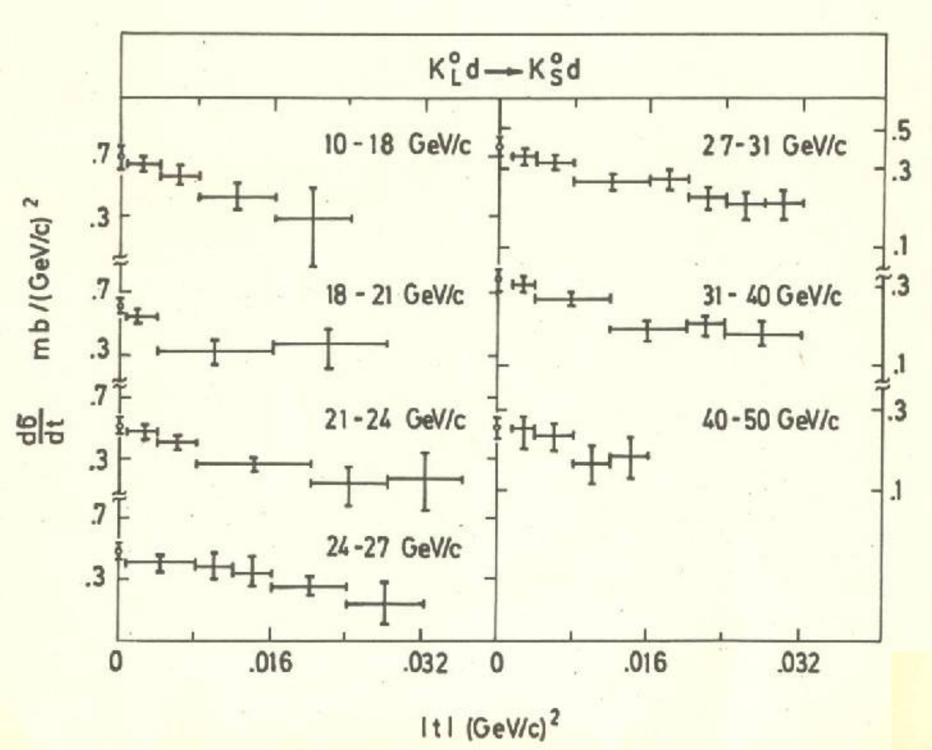
♥ v intervalu **$10 \le p \le 50$ GeV/c** není *dσ/dt* ***slope*** **b** závislý na *p* a má hodnotu **$31\ \mathrm{mb}/(\mathrm{GeV}/c)^2$**

→ souhlas s teorií

♥ pro trajektorii **ω** je intercept **$\alpha_\omega(0) \sim 0.46$**

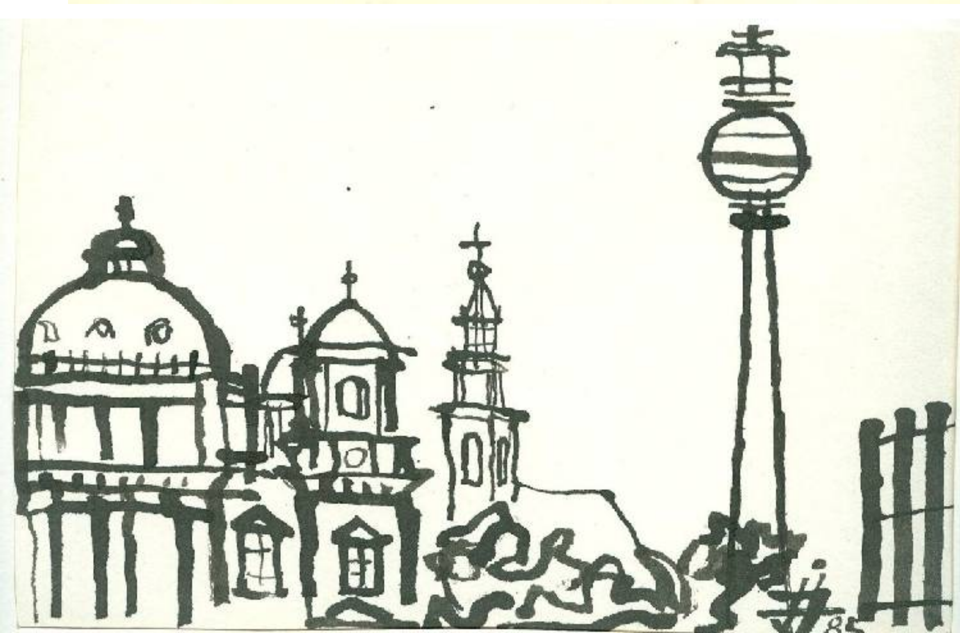
→ souhlas s experimenty

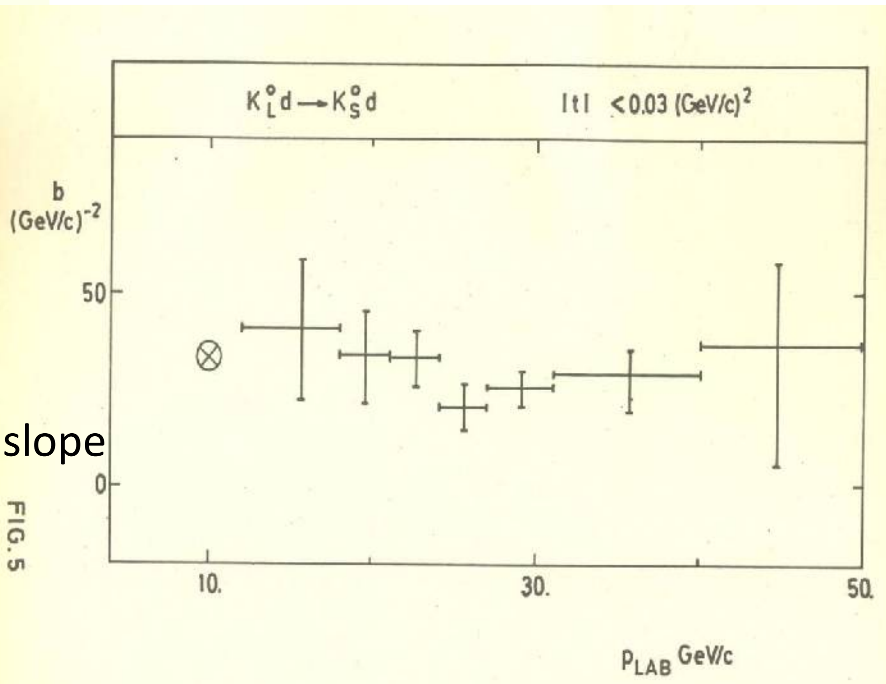
Difrakční regenerace



deuterium

(Berlínská iniciativa)





slope

FIG. 5

Volume 48B, number 4 PHYSICS LETTERS 18 February 1974

A STUDY OF THE FORMFACTORS IN THE $K^0_{\mu 3}$ DECAYS

K.-F. ALBRECHT, F. DEAK, V. GENCHEV, T.S. GRIGALASHVILI, B.N. GUS'KOV, J. HLADKY
I.M. IVANCHENKO, V.D. KEKELIDZE, D. KISS, V.G. KRIVOKHIZHIN, V.V. KUHTIN,
M.F. LIKHACHEV, P. MAJOR, A. MEYER, E. NAGY, M. NOVAK, A. PROKES, H.-E. RYSEK,
Yu.I. SALOMATIN, I.A. SAVIN, L.V. SIL'VESTROV, V.E. SIMONOV, G.G. TAKHTAMYSHEV,
P. TODOROV, L. URBAN, G. VESZTERGOMBI, S. VO...

Formfaktory v rozpadech K^0_L na $K\mu_3$

Received 22 January 1974

The analysis of 82386 selected $K_{\mu 3}$ decays has been performed. Two solutions both for the vector and scalar formfactors have been obtained, and for each solution the validity of linear approximation is shown. One of the solutions which agrees with the μ–e universality hypothesis, gives the following values for the linear expansion parameters: $\lambda_+ = 0.046 \pm 0.008$, $\lambda_0 = 0.024 \pm 0.011$.

V rámci **V – A** varianty **teorie** slabých interakcí bylo pro skalární a **vektorové f_+, f_0** **formfaktory hadronového proudu** obdrženo dvojí řešení za předpokladu lineární aproximace.

Získané vyjádření hodnot parametrů $\lambda_+ = 0.046 \pm 0.008$

a $\lambda_0 = 0.024 \pm 0.011$

vyhovuje tomu řešení, které **neodporuje μ – e univerzalitě**.

V experimentu bylo použito pro analyzu ~ 84 000 rozpadů $K\mu_3$.

II. Int. Elem. Particle conf. Aix en Provence 1973

reportérský referát: B. Stech - Heidelberg

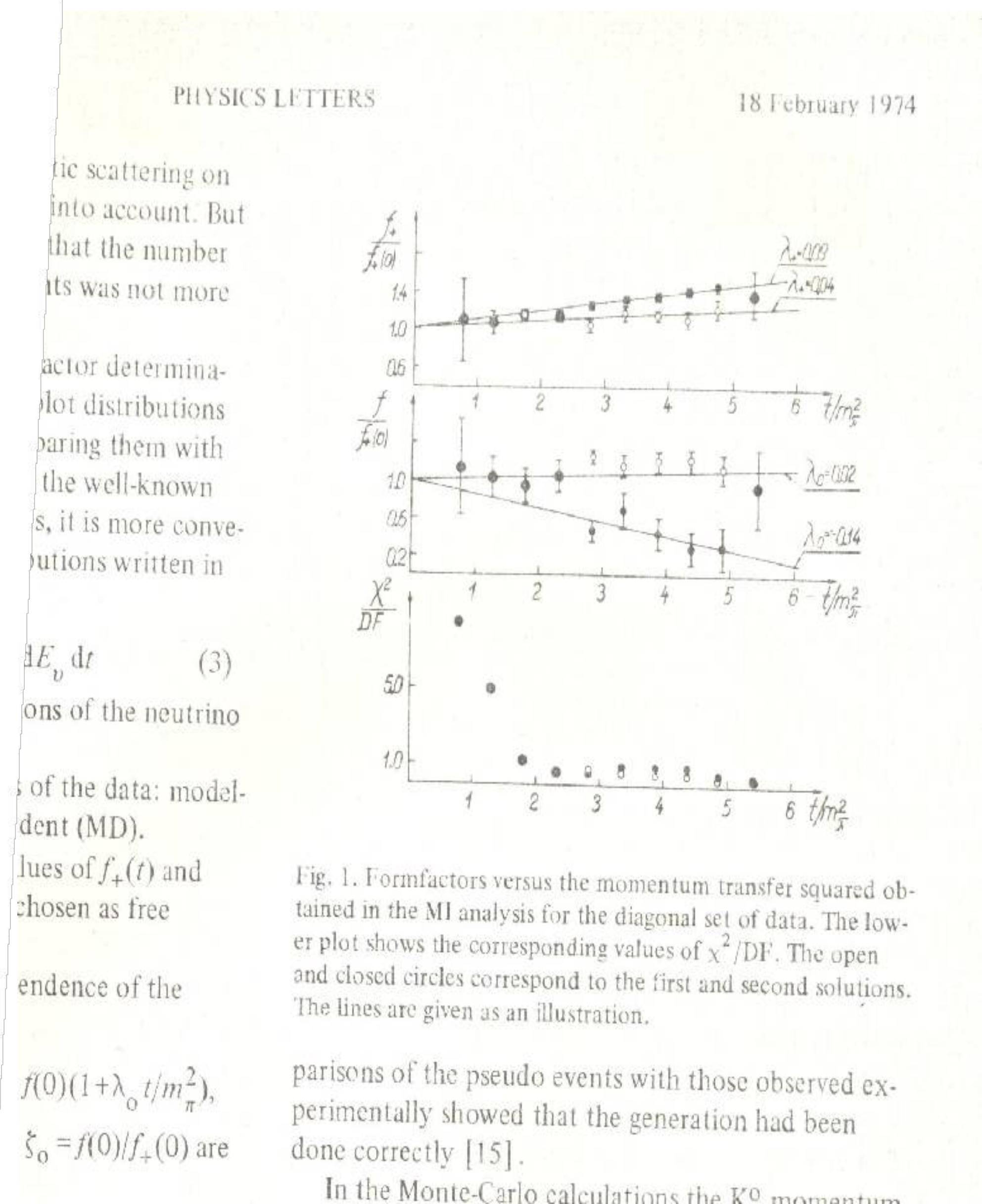
TABLE I

Process	Events	λ_+	λ_o	Group
K^+_{e3}	2827	$.027 \pm .008$		Aachen [13] Bari Brussels CERN
$K^+_{\mu3}$	1897	$.025 \pm .017$	$-.007 \pm .02$	
K^o_{e3}	4.6×10^5	$.031 \pm .0025$	-	CERN-Heidelberg [14]
K^o_{e3}	2.6×10^4	$.044 \pm .006$	-	John Hopkins [15] SLAC UCLA
$K^o_{\mu3}$	3.2×10^4	$(.044 \pm .012)$ input	$.032 \pm .01$	
$K^o_{\mu3}$	1.6×10^6	$.030 \pm .003$	$.019 \pm .004$	SLAC [16] Santa Cruz
$K^o_{\mu3}$	8.2×10^4	$.046 \pm .008$	$.024 \pm .011$	Dubna [17] Budapest Berlin Sofia Prague Serpukhov
$K^o_{\mu3}/K^o_{e3}$	1×10^4	(.03 input)	$.018 \pm .024$	Brookhaven [18] Yale

r in striking contrast to earlier findings [19].

Formfaktory $K\mu_3$

Budapeštská iniciativa



PHYSICS LETTERS 18 February 1974

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$dE_{\nu}\,dt$ (3)

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of the data: model-
dent (MD).
lues of $f_+(t)$ and
chosen as free

endence of the

$f(0)(1+\lambda_0\, t/m_\pi^2)$,
$\xi_0 = f(0)/f_+(0)$ are

Fig. 1. Formfactors versus the momentum transfer squared obtained in the MI analysis for the diagonal set of data. The lower plot shows the corresponding values of χ^2/DF. The open and closed circles correspond to the first and second solutions. The lines are given as an illustration.

parisons of the pseudo events with those observed experimentally showed that the generation had been done correctly [15].

In the Monte-Carlo calculations the K^0 momentum

Ранг публикаций Объединенного института ядерных

Studium maticových elementů rozpadu $K^\circ_L \to Ke_3$

P1 - 9539

Hlavní výsledky:

Skalární f_S a tensorové formfaktory f_T přispívající do maticových elementů

$|f_S/f_+| < 0.07$ a

$|f_T/f_+| < 0.34$.

Závislost **vektorového formfaktoru** $f_+(t)$ byla v **rámci V-A** studována v oblasti $t = (0 - 0.1)\ (GeV/c)^2$ – (t je předaný čtyřimpuls leptonům rozpadu).

Slope $\lambda_+ = 0.03 \pm 0.0042$ pro případ lineární aproximace $f_+(t)$.

(Jiné aproximace byly rovněž uvažovány.)

Preprint of the Joint Institute for Nuclear Research

Dubna 1976

В.К.Бирулев, Г.Вестергомби, А.С.Вовенко, Я.Вотруба, В.И.Генчев, Т.С.Григалашвили, Б.Н.Гуськов, Я.Гладки, В.П.Джорджадзе, И.М.Иванченко, В.Д.Кекелидзе, Д.Киш, В.Г.Кривохижин, В.В.Кухтин, М.Ф.Лихачев, М.Новак, Э.Надь, А.Прокеш, Ю.И.Саломатин, И.А.Савин, Л.В.Сильвестров, В.Е.Симонов, Д.А.Смолин, Г.Г.Тахтамышев, П.Т.Тодоров, Л.Урбан

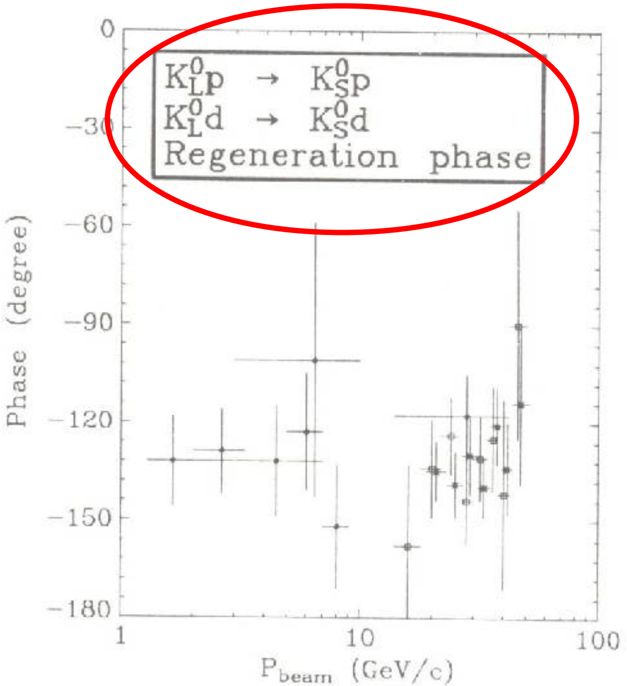
ИЗУЧЕНИЕ МАТРИЧНОГО ЭЛЕМЕНТА В РАСПАДАХ $K^0_L \to \pi^\pm + e^\mp + \nu$

Направлено в ЯФ

Kolaborace BDPS

Review of particle properties - PDG 1974

Vlad. Chaloupka et al. - CERN



Phases of forward amplitudes for $K_L^0 p \rightarrow K_S^0 p$ and $K_L^0 d \rightarrow K_S^0 d$. The deuterium data are shifted 1 GeV/c higher to avoid overlap with the proton data. ○-p, compiled by Particle Data Group, LBL-55; □-p, V. Birulev et al. JINR-E1-6551 (1972); ×-d, K.-F. Albrecht et al., Phys. Lett. 48B, 257 (1974).

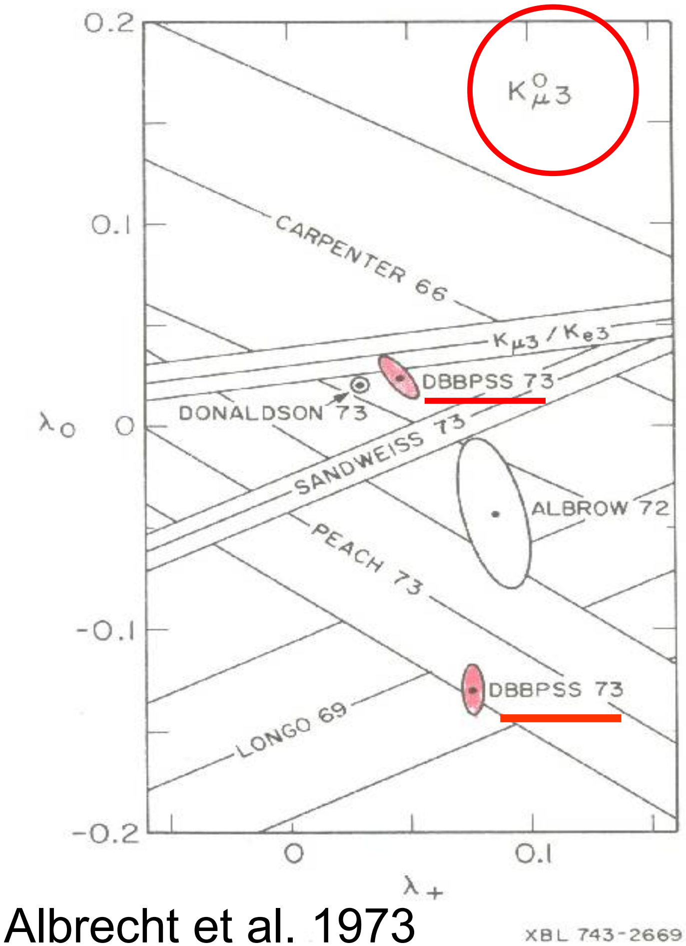


Fig. 2. One-standard-deviation ($e^{-1/2}$) likelihood contours in the (λ_+, λ_0) plane for $K^0_{\mu 3}$.

V.Birulev et al. 1972 - p
K.-F.Albrecht et al. 1974 - d

K.-F.Albrecht et al. 1973

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN $K_{\mu3}$ DECAY)

See also the corresponding entries and notes in section "$\xi_A = f_-/f_+$" above and section "λ_0 (LINEAR ENERGY DEPENDENCE OF f_0 IN $K_{\mu3}$ DECAY)" below. For radiative correction of $K_{\mu3}$ Dalitz plot see GINSBERG 70 and BECHERRAWY 70.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.034 ±0.005 OUR EVALUATION		From a fit discussed in note on $K_{\ell3}$ form factors in 1982 edition, PL 111B (April 1982).			
0.0427±0.0044	150k	BIRULEV	81	SPEC	DP
[illegible]	74k	CHO	80	HBC	DP
0.020 ±0.011	16k	HILL	79	STRC	DP
0.046 ±0.030	32k	BUCHANAN	75	SPEC	DP
0.030 ±0.003	1.6M	DONALDSON	74B	SPEC	DP
0.085 ±0.015	9086	ALBROW	72	ASPK	DP

• • • We do not use the following data for averages, fits, limits, etc. • • •

[illegible]	[illegible]	DZHORD...	77	SPEC	Repl. by BIRULEV 81
0.046 ±0.008	82k	ALBRECHT	74	WIRE	Repl. by BIRULEV 81
[illegible]	[illegible]	DALLY	72	ASPK	DP
0.07 ±0.02	16k	CHIEN	70	ASPK	Repl. by DALLY 72

λ_0 (LINEAR ENERGY DEPENDENCE OF f_0 IN $K_{\mu3}$ DECAY)

Wherever possible, we have converted the above values of $\xi(0)$ into values of λ_0 using the associated λ^{μ}_{+} and $d\xi(0)/d\lambda_+$.

VALUE	$d\lambda_0/d\lambda_+$	EVTS	DOCUMENT ID		TECN	COMMENT
0.025 ±0.006 OUR EVALUATION			From a fit discussed in note on $K_{\ell3}$ form factors in 1982 edition, PL 111B (April 1982).			
0.0341±0.0067	unknown	150k	[64] BIRULEV	81	SPEC	DP
+0.050 ±0.008	[illegible]	[illegible]	[illegible]			
−0.039 ±0.010	0.67	16k	HILL	79	STRC	DP
−0.047 ±0.009	1.06	207k	[65] CLARK	77	SPEC	POL
−0.025 ±0.019	+0.5	32k	[66] BUCHANAN	75	SPEC	DP
+0.019 ±0.004	−0.47	1.6M	[67] DONALDSON	74B	SPEC	DP
0.060 ±0.030	−0.71	1385	[68] PEACH	73	HLBC	DP
0.018 ±0.009	+0.49	2.2M	[65] SANDWEISS	73	CNTR	POL
−0.043 ±0.052	−1.39	9086	[69] ALBROW	72	ASPK	DP
$-0.140\ ^{+0.043}_{-0.022}$	−0.49		[65] LONGO	69	CNTR	POL
+0.08 ±0.07	−0.54	1371	[65] CARPENTER	66	OSPK	DP

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.041 ±0.008		14k	[70] CHO	80	HBC	BR. $\lambda_+ = 0.028$
[illegible]		47k	DZHORD...	77	SPEC	In BIRULEV 81
[illegible]		82k	ALBRECHT	74	WIRE	In BIRULEV 81
−0.05 ±0.03		6700	[71] BRANDENB...	73	HBC	BR. $\lambda_+ = 0.019 \pm 0.013$
−0.067 ±0.227	unknown	16k	[72] DALLY	72	ASPK	DP
−0.333 ±0.034	+1.	3140	[73] BASILE	70	OSPK	DP

[64] BIRULEV 81 gives $d\lambda_0/d\lambda_+ = -1.5$, giving an unreasonably narrow error ellipse which dominates all other results. We use $d\lambda_0/d\lambda_+ = 0$.
[65] λ_0 value is for $\lambda_+ = 0.03$ calculated by us from $\xi(0)$ and $d\xi(0)/d\lambda_+$.
[66] BUCHANAN 75 value is from their appendix A and uses only $K_{\mu3}$ data. $d\lambda_0/d\lambda_+$ was obtained by private communication, C.Buchanan, 1976.
[67] DONALDSON 74B $d\lambda_0/d\lambda_+$ obtained from figure 18.
[68] PEACH 73 assumes $\lambda_+ = 0.025$. Calculated by us from $\xi(0)$ and $d\xi(0)/d\lambda_+$.
[69] ALBROW 72 λ_0 is calculated by us from ξ_A, λ_+ and $d\xi(0)/d\lambda_+$. They give $\lambda_0 = -0.043 \pm 0.039$ for $\lambda_- = 0$. We use our larger calculated error.
[70] CHO 80 BR result not independent of their Dalitz plot result.
[71] Fit for λ_0 does not include this value but instead includes the $K_{\mu3}/K_{e3}$ result from this experiment.
[72] DALLY 72 gives $f_0 = 1.20 \pm 0.35$, $\lambda_0 = -0.080 \pm 0.272$, $\lambda_0' = -0.006 \pm 0.045$, but with a different definition of λ_0. Our quoted λ_0 is his λ_0/f_0. We cannot calculate true λ_0 error without his (λ_0, f_0) correlations. See also note on DALLY 72 in section ξ_A.
[73] BASILE 70 λ_0 is for $\lambda_+ = 0$. Calculated by us from ξ_A with $d\xi(0)/d\lambda_+ = 0$. BASILE 70 is incompatible with all other results. Authors suggest that [illegible] estimates might be responsible.

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN K_{e3} DECAY)

For radiative correction of K_{e3} DP, see GINSBERG 67 and BECHERRAWY 70.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0300±0.0016 OUR AVERAGE		Error includes scale factor of 1.2.			
0.0306±0.0034	74k	BIRULEV	81	SPEC	DP
[illegible]	[illegible]	[74] ENGLER	78B	HBC	DP
0.0348±0.0044	18k	HILL	78	STRC	DP
0.0312±0.0025	500k	GJESDAL	76	SPEC	DP
0.0270±0.0028	25k	BLUMENTHAL	75	SPEC	DP
0.044 ±0.006	24k	BUCHANAN	75	SPEC	DP
0.040 ±0.012	2171	WANG	74	OSPK	DP
0.045 ±0.014	5600	ALBROW	73	ASPK	DP
0.019 ±0.013	1871	BRANDENB...	73	HBC	PI transv.
0.022 ±0.014	1910	NEUHOFER	72	ASPK	PI
0.023 ±0.005	42k	BISI	71	ASPK	DP
0.05 ±0.01	16k	CHIEN	71	ASPK	DP, no RC
0.02 ±0.013	1000	ARONSON	68	OSPK	PI
+0.023 ±0.012	4300	BASILE	68	OSPK	DP, no RC
−0.01 ±0.02	762	FIRESTONE	67	HBC	DP, no RC
+0.01 ±0.015	531	KADYK	67	HBC	e,PI, no RC
$+0.08\ ^{+0.10}_{-0.08}$	240	LOWYS	67	FBC	PI
+0.15 ±0.08	577	FISHER	65	OSPK	DP, no RC
+0.07 ±0.06	153	LUERS	64	HBC	DP, no RC

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.029 ±0.005	15k	[74] CHO	80	HBC	DP
0.0286±0.0049	25k	BIRULEV	79	SPEC	Repl. by BIRULEV 81
0.032 ±0.0042	48k	BIRULEV	76	SPEC	Repl. by BIRULEV 81

[74] ENGLER [illegible] K_{e3} subset of CHO [illegible] systematic effects.

$|f_S/f_+|$ FOR K_{e3} DECAY

Ratio of scalar to f_+ couplings.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.04	68	25k	BLUMENTHAL	75	SPEC	

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.095	95	18k	HILL	78	STRC	
<0.07	68	48k	BIRULEV	76	SPEC	See also BIRULEV 81
[illegible]	95	5600	ALBROW	73	ASPK	
[illegible]	68		KULYUKINA	67	CC	

$|f_T/f_+|$ FOR K_{e3} DECAY

Ratio of tensor to f_+ couplings.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.23	68	25k	BLUMENTHAL	75	SPEC	

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.40	95	18k	HILL	78	STRC	
<0.34	68	48k	BIRULEV	76	SPEC	See also BIRULEV 81
[illegible]	95	5600	ALBROW	73	ASPK	
<1.0	68		KULYUKINA	67	CC	

$|f_T/f_+|$ FOR $K_{\mu3}$ DECAY

Ratio of tensor to f_+ couplings.

VALUE	DOCUMENT ID		TECN
0.12±0.12	BIRULEV	81	SPEC

NOTE ON CP VIOLATION IN K^0_L DECAY

(by L. Wolfenstein, Carnegie-Mellon University and T. Trippe, LBL)

Experimentally Measured Parameters

CP violation has been observed in the semi-leptonic decays $K^0_L \to \pi^{\mp}\ell^{\pm}\nu$ and in the nonleptonic decay $K^0_L \to 2\pi$. The experimental numbers that have been measured are[1]

$$\delta = \frac{\Gamma(K^0_L \to \pi^-\ell^+\nu) - \Gamma(K^0_L \to \pi^+\ell^-\nu)}{\Gamma(K^0_L \to \pi^-\ell^+\nu) + \Gamma(K^0_L \to \pi^+\ell^-\nu)} \qquad (1)$$

$$\eta_{+-} = A(K^0_L \to \pi^+\pi^-)/A(K^0_S \to \pi^+\pi^-) = |\eta_{+-}|\, e^{i\phi_{+-}} \qquad (1b)$$

$$\eta_{00} = A(K^0_L \to \pi^0\pi^0)/A(K^0_S \to \pi^0\pi^0) = |\eta_{00}|\, e^{i\phi_{00}} \qquad (1c)$$

Thus there are five real numbers, three magnitudes and two phases. We list $\delta(\mu)$ for $K^0_L \to \pi\mu\nu$ and $\delta(e)$ for $K^0_L \to \pi e\nu$ separately and a weighted average δ. Experimentally for the $K^0_L \to \pi^0\pi^0$ decay the quantities directly measured (and also of greatest theoretical interest) are $|\eta_{00}/\eta_{+-}|$ and $\phi_{00} - \phi_{+-}$.

Analysis Based on CPT Invariance[2]

CP violation can occur either in the $K^0 - \overline{K}^0$ mixing or in the decay amplitudes. The mixing is described by:

$$|K^0_L\rangle = \left[(1+\epsilon)\,|K^0\rangle - (1-\epsilon)\,|\overline{K}^0\rangle\right] / \left[2(1+|\epsilon|^2)\right]^{1/2} \qquad (2a)$$

$$|K^0_S\rangle = \left[(1+\epsilon)\,|K^0\rangle + (1-\epsilon)\,|\overline{K}^0\rangle\right] / \left[2(1+|\epsilon|^2)\right]^{1/2} \qquad (2b)$$

Particle Data

(od 1994 – 2010)

citováno:

$K^{\circ}_{L} \to K\mu_3$ a Ke_3 rozpady

[75] Quadratic coefficients h and k required by some experiments. (See section on "QUADRATIC COEFFICIENT k" below.) Correlations prevent us from averaging results of fits not including g, h, and k terms.

QUADRATIC COEFFICIENT k FOR $K^0_L \to \pi^+\pi^-\pi^0$

VALUE	EVTS	DOCUMENT ID		TECN
0.0099±0.0015 OUR AVERAGE				
0.0104±0.0017±0.0024	500k	ANGELOPO...	98C	CPLR
0.024 ±0.010	6499	CHO	77	HBC
−0.008 ±0.012	4709	PEACH	77	HBC
0.0097±0.0018	509k	MESSNER	74	ASPK

LINEAR COEFFICIENT j FOR $K^0_L \to \pi^+\pi^-\pi^0$ (CP-VIOLATING TERM)

Listed in CP-violation section below.

QUADRATIC COEFFICIENT f FOR $K^0_L \to \pi^+\pi^-\pi^0$ (CP-VIOLATING TERM)

Listed in CP-violation section below.

QUADRATIC COEFFICIENT h FOR $K^0_L \to \pi^0\pi^0\pi^0$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN
−5.0±1.4 OUR AVERAGE Error includes scale factor of 1.7.				
−6.1±0.9±0.5	14.7M	LAI	01B	NA48
−3.3±1.1±0.7	5M	[76] SOMALWAR	92	E731

[76] SOMALWAR 92 chose m_{π^+} as normalization to make it compatible with the Particle Data Group $K^0_L \to \pi^+\pi^-\pi^0$ definitions.

K^0_L FORM FACTORS

For discussion, see note on form factors in the $K^\pm$ section of the Particle Listings above.

In the form factor comments, the following symbols are used.

f_+ and f_- are form factors for the vector matrix element.

f_S and f_T refer to the scalar and tensor term.

$f_0(t) = f_+(t) + f_-(t)\, t/(m^2_{K^0} - m^2_{\pi^+})$.

t = momentum transfer to the π.

λ_+ and λ_0 are the linear expansion coefficients of f_+ and f_0:

$f_+(t) = f_+(0)\,(1 + \lambda_+ t/m^2_{\pi^+})$

For quadratic expansion

$f_+(t) = f_+(0)\,(1 + \lambda'_+ t/m^2_{\pi^+} + \frac{\lambda''_+}{2} t^2/m^4_{\pi^+})$

as used by KTeV. If there is a non-vanishing quadratic term, then λ_+ represents an average slope, which is then different from λ'_+.

NA48 (K_{e3}) and ISTRA quadratic expansion coefficients are converted with

$\lambda'_+{}^{PDG} = \lambda_+{}^{NA48}$ and $\lambda''_+{}^{PDG} = 2\lambda'_+{}^{NA48}$

$\lambda'_+{}^{PDG} = (\frac{m_{\pi^+}}{m_{\pi^0}})^2 \lambda'_+{}^{ISTRA}$ and

$\lambda''_+{}^{PDG} = 2(\frac{m_{\pi^+}}{m_{\pi^0}})^4 \lambda''_+{}^{ISTRA}$

ISTRA linear expansion coefficients are converted with

$\lambda_+{}^{PDG} = (\frac{m_{\pi^+}}{m_{\pi^0}})^2 \lambda_+{}^{ISTRA}$ and $\lambda_0{}^{PDG} = (\frac{m_{\pi^+}}{m_{\pi^0}})^2 \lambda_0{}^{ISTRA}$

The pole parametrization is

$f_+(t) = f_+(0)\,(\frac{M_V^2}{M_V^2 - t})$

$f_0(t) = f_0(0)\,(\frac{M_S^2}{M_S^2 - t})$

where M_V and M_S are the vector and scalar pole masses.

The dispersive parametrization is

$f_+(t) = f_+(0)\exp[\frac{t}{m^2_\pi}(\Lambda_+ + H(t))]$;

$f_0(t) = f_+(0)\exp[\frac{t}{m^2_K - m^2_\pi}(\ln[C] - G(t))]$,

where Λ_+ is the slope parameter and $\ln[C] = \ln[f_0(m^2_K - m^2_\pi)]$ is the logarithm of the scalar form factor at the Callan-Treiman point. $H(t)$ and $G(t)$ are dispersive integrals.

The following abbreviations are used:

DP = Dalitz plot analysis.

PI = π spectrum analysis.

MU = μ spectrum analysis.

POL= μ polarization analysis.

BR = $K^0_{\mu3}/K^0_{e3}$ branching ratio analysis.

E = positron or electron spectrum analysis.

RC = radiative corrections.

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN K^0_{e3} DECAY)

For radiative correction of K^0_{e3} DP, see GINSBERG 67, BECHERRAWY 70, CIRIGLIANO 02, CIRIGLIANO 04, and ANDRE 04. Results labeled OUR FIT are discussed in the review "$K^\pm_{\ell3}$ and $K^0_{\ell3}$ Form Factors" in the $K^\pm$ Listings. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.82 ±0.04 OUR FIT Error includes scale factor of 1.1. Assuming μ-e universality					
2.85 ±0.04 OUR AVERAGE					
2.86 ±0.05 ±0.04	2M	AMBROSINO	06D	KLOE	
2.832±0.037±0.043	1.9M	ALEXOPOU...	04A	KTEV	PI, no $\mu = e$
2.88 ±0.04 ±0.11	5.6M	[77] LAI	04C	NA48	DP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.84 ±0.07 ±0.13	5.6M	[78] LAI	04C	NA48	DP
2.45 ±0.12 ±0.22	366k	APOSTOLA...	00	CPLR	DP
3.06 ±0.34	74k	BIRULEV	81	SPEC	DP
[illegible]				SPEC	DP
2.70 ±0.28	25k	BLUMENTHAL	75	SPEC	DP

[77] Results from linear fit and assuming only vector and axial couplings.
[78] Results from linear fit with $|f_S/f_+|$ and $|f_T/f_+|$ free.

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN $K^0_{\mu3}$ DECAY)

Results labeled OUR FIT are discussed in the review "$K^\pm_{\ell3}$ and $K^0_{\ell3}$ Form Factors" in the $K^\pm$ Listings. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.82 ±0.04 OUR FIT Error includes scale factor of 1.1. Assuming μ-e universality					
2.71 ±0.10 OUR FIT Error includes scale factor of 1.4. Not assuming μ-e universality					
2.67 ±0.06 ±0.08	2.3M	[79] LAI	07A	NA48	DP
2.745±0.088±0.063	1.5M	ALEXOPOU...	04A	KTEV	DP, no $\mu = e$
2.813±0.051	3.4M	ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$
3.0 ±0.3	1.6M	DONALDSON	74B	SPEC	DP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.27 ±0.44	150k	BIRULEV	81	SPEC	DP

[79] LAI 07A gives a correlation −0.40 between their λ_0 and λ_+ measurements.

λ_0 (LINEAR ENERGY DEPENDENCE OF f_0 IN $K^0_{\mu3}$ DECAY)

Wherever possible, we have converted the above values of $\xi(0)$ into values of λ_0 using the associated λ^μ_+ and $d\xi(0)/d\lambda_+$. Results labeled OUR FIT are discussed in the review "$K^\pm_{\ell3}$ and $K^0_{\ell3}$ Form Factors" in the $K^\pm$ Listings. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

VALUE (units 10^{-2})	$d\lambda_0/d\lambda_+$	EVTS	DOCUMENT ID		TECN	COMMENT
1.38 ±0.18 OUR FIT Error includes scale factor of 2.2. Assuming μ-e universality						
1.42 ±0.23 OUR FIT Error includes scale factor of 2.5. Not assuming μ-e universality						
1.17 ±0.07 ±0.10		2.3M	[80] LAI	07A	NA48	DP
1.657±0.125	−0.44	1.5M	[81] ALEXOPOU...	04A	KTEV	DP, no $\mu = e$
1.635±0.121	0.85	3.4M	[82] ALEXOPOU...	04A	KTEV	PI, DP, $\mu = e$
+1.9 ±0.4	−0.47	1.6M	[83] DONALDSON	74B	SPEC	DP
• • • We do not use the following data for averages, fits, limits, etc. • • •						
[illegible]	unknown	150k	[84] BIRULEV	81	SPEC	DP

[80] LAI 07A gives a correlation −0.40 between their λ_0 and λ_+ measurements.
[81] ALEXOPOULOS 04A gives a correlation −0.38 between their λ_0 and λ_+ measurements.
[82] ALEXOPOULOS 04A gives a correlation −0.35 between their λ_0 and λ_+ measurements.
[83] DONALDSON 74B $d\lambda_0/d\lambda_+$ obtained from figure 18.
[84] BIRULEV 81 gives $d\lambda_0/d\lambda_+ = -1.5$, giving an unreasonably narrow error ellipse which dominates all other results. We use $d\lambda_0/d\lambda_+ = 0$.

λ'_+ (LINEAR K^0_{e3} FORM FACTOR FROM QUADRATIC FIT)

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.40 ±0.12 OUR FIT Error includes scale factor of 1.2. Assuming μ-e universality					
2.49 ±0.13 OUR FIT Error includes scale factor of 1.1. Not assuming μ-e universality					
2.48 ±0.17 OUR AVERAGE Error includes scale factor of 1.5. See the ideogram below.					
2.55 ±0.15 ±0.10	2M	[85] AMBROSINO	06D	KLOE	
2.167±0.137±0.143	1.9M	[86] ALEXOPOU...	04A	KTEV	PI, no $\mu = e$
2.00 ±0.19 ±0.15	5.5M	[87] LAI	04C	NA48	DP

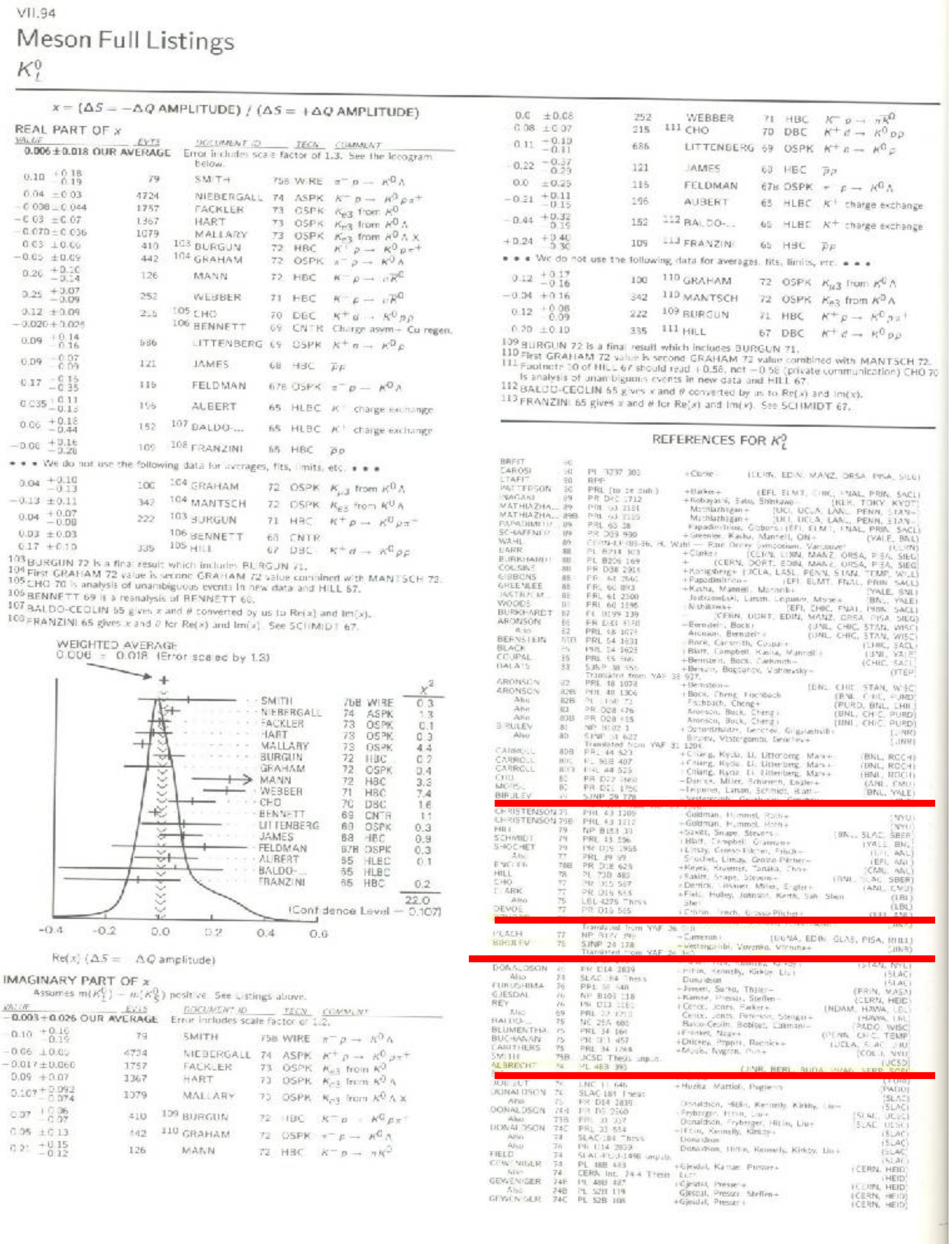
[85] We use AMBROSINO 06D result in the fit not assuming μ−e universality. This result enters the fit assuming μ−e universality via AMBROSINO 07C measurement of λ'_+ in $K_{\mu3}$ decays. AMBROSINO 06D gives a correlation −0.95 between their λ'_+ and λ''_+.
[86] ALEXOPOULOS 04A gives a correlation −0.97 between their λ'_+ and λ''_+.
[87] For LAI 04C we calculate a correlation −0.88 between their λ'_+ and λ''_+.

Particle Data

citováno:

$K^\circ_L \to K\mu_3$ a Ke_3

rozpady



Particle Data

citováno:

$K^\circ_L \rightarrow K\mu_3$ a Ke_3

rozpady

Hledání vektorového mezonu $\chi^{\circ} \rightarrow \mu^{+}\mu^{-}$

LETTERE AL NUOVO CIMENTO VOL. 8, N. 6 6 Ottobre 1973

A Search for the χ^0-Meson in the Dimuon Decays of K^0_L.

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(ricevuto il 25 Giugno 1973)

„**Hádanka**" rozpadu K°_{L} → **dimiony** mohla být vysvětlena v **modelu Alles-Patti** existencí dosud neznámého neutrálního vektorového mezonu χ°, který se rozpadá mj. i na dileptony.

According to (2), the χ^0-meson should have quantum numbers $I^G(J^P)^C = 0^-(1^-)^-$, a width of about 0.1 MeV and an invariant mass somewhere in the interval $350 < M_{\chi^0} <$ ... suppression of the $K^0_L \to \mu^+\mu^-$ decay mode (1), the model of ALLES and PATTI estimates the following branching ratio:

$$\text{(1a)} \qquad \frac{\Gamma(K^0_L \to \chi^0\gamma)}{\Gamma(K^0_L \to \text{all})} > 1.2 \cdot 10^{-2},$$

where $\chi^0 \to \pi^0\gamma$, e^+e^-, $\mu^+\mu^-$ or $\pi^+\pi^-$. The $\chi^0 \to \mu^+\mu^-$ decay mode should have a branching ratio $> 5\%$, *i.e.*

$$\text{(1b)} \qquad \frac{\Gamma(K_L \to \chi^0\gamma \to \mu^+\mu^-\gamma)}{\Gamma(K^0_L \to \text{all})} > 6 \cdot 10^{-4}.$$

This condition has been checked experimentally. In ref. (3) only $\chi^0 \to \pi^0\gamma$ and e^+e^- decay modes have been searched with a negative result. Our preliminary data on the

(1) H. STERN and M. K. GAILLARD: CERN DPh-T/72-14 (1972); A. D. DOLGOV, L. B. OKUN and V. I. ... *Conference 1972* (Balatonfüred, 1972), p. 281.
(2) ... *Nuovo Cimento*, **10** A, 325 (1972).
(3) V. V. BARMIN, G. V. DAVIDENKO, V. S. DEMIDOV, A. G. MIROSIDI, T. A. CHISTJAKOVA and I. V. CHUVILO: *Sov. Journ. Nucl. Phys.*, **15**, 1142 (1972).

(Pražská iniciativa)

Osnova pro článek o mezonu χ^0 do Lett. al Nuovo Cimento

χ^0 - meson

Úvod - theorie, důvod měření Alles-Path [illegible]

experimentální aparatura

registrace - [illegible] z terčíku i z válce

vyhodnocení - řezy [illegible], ΔY, χ^2, 5 cm μ-det.

As we have previously announced [ ] the results of the search ~~of a χ^0 meson~~ for the existence of χ^0 heavy meson are preliminary

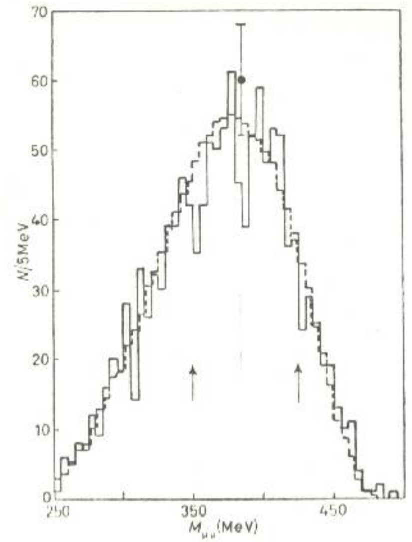
pro $K_S \to 2\pi \to 2\mu$ +

vysoké energie zanedbají rozpad $\pi \to \mu\nu$ v letu

zeptují identifikaci μ

Nalezena horní hranice rozpadu

culations have proved that the detection efficiencies for the $K_L^0 \to \chi^0\gamma \to \mu^+\mu^-\gamma$ decays in a given interval of $M_{\mu^+\mu^-}$ are equal.



$M_{\mu^+\mu^-}$ effective-mass distribution. The solid line represents the distribution of $M_{\mu^+\mu^-}$ for vents, the dashed line shows the same distribution for $K_{\mu 3}$ decays. The ranges of a possible mass, *i.e.* (350 ÷ 425) MeV, respectively (350 ÷ 370) MeV, are denoted by arrows.

for $\Gamma(\chi^0 \to \mu^+\mu^-) < 10$ MeV the worst case in the interval $350 < M_{\mu^+\mu^-} < 425$ MeV nge $405 < M_{\mu^+\mu^-} < 415$ MeV containing a dimuon signal of 18 events (see Fig. 2). ses the ratio $\Gamma(K_L^0 \to \pi\mu\nu)/\Gamma(K_L^0 \to \text{all}) = 0.27$ (8), the upper limit is

$$\boxed{\frac{\Gamma(K_L^0 \to \chi^0\gamma \to \mu^+\mu^-\gamma)}{\Gamma(K_L^0 \to \text{all})} < 8\cdot 10^{-6} (90\%\ \text{c.l.})\,.}$$

experimental upper limit (2) lies by a factor of 8 below the theoretical lower). This result is of the same order of magnitude as for the dielectron decay of neson (3,5) and is in accordance with the conclusion of ref. (3) that the partial $\Gamma(K_L^0 \to \chi^0\gamma)$ is by a factor 50 below the theoretical lower limit (1*a*).

* * *

authors would like to thank Drs. M. Bednar, A. L. Lyubimov, J. Cvach and er for helpful discussions and all members of Berlin-Budapest-Dubna-Prague-llaboration for making available experimental regeneration information.

icle Data Group: *Phys. Lett.*, **39** B, 1 (1972).

II. Mezinárodní sympozium Fyziky vysokých energií a elementárních částic

Štrbské pleso 9.10.1972

Příklady našich vystoupení na konferencích

ТОНКИЕ ИНТЕРФЕРЕНЦИОННЫЕ ЯВЛЕНИЯ В НЕЛЕПТОННЫХ РАСПАДАХ K^0-МЕЗОНОВ

Я.Вотруба , Я.Гладки , М.Новак , А.Прокеш

Физический институт ЧСАН , Прага

Введение

В настоящей работе изучается проблема экспериментального определения соотношения между комплексными коэффициентами смешивания ε_S и ε_L , которые определяют структуру [illegible] K_S и K_L /1/ :

$$|K_S\rangle=[2(1+|\varepsilon_S|^2)]^{-\frac{1}{2}}(|K_1\rangle+\varepsilon_S|K_2\rangle), \quad |K_L\rangle=[2(1+|\varepsilon_S|^2)]^{-\frac{1}{2}}(|K_2\rangle+\varepsilon_L|K_1\rangle) \qquad (1)$$

Здесь $|K_1\rangle = 2^{-1/2}(|K\rangle + |\bar{K}\rangle)$, $|K_2\rangle = 2^{-1/2}(|K\rangle - |\bar{K}\rangle)$. Феноменологический анализ [illegible] показывает, что если вместе с симметрией CP нарушается также и симметрия T /но CPT сохраняется/, то

$$\varepsilon_S = \varepsilon_L , \qquad (2)$$

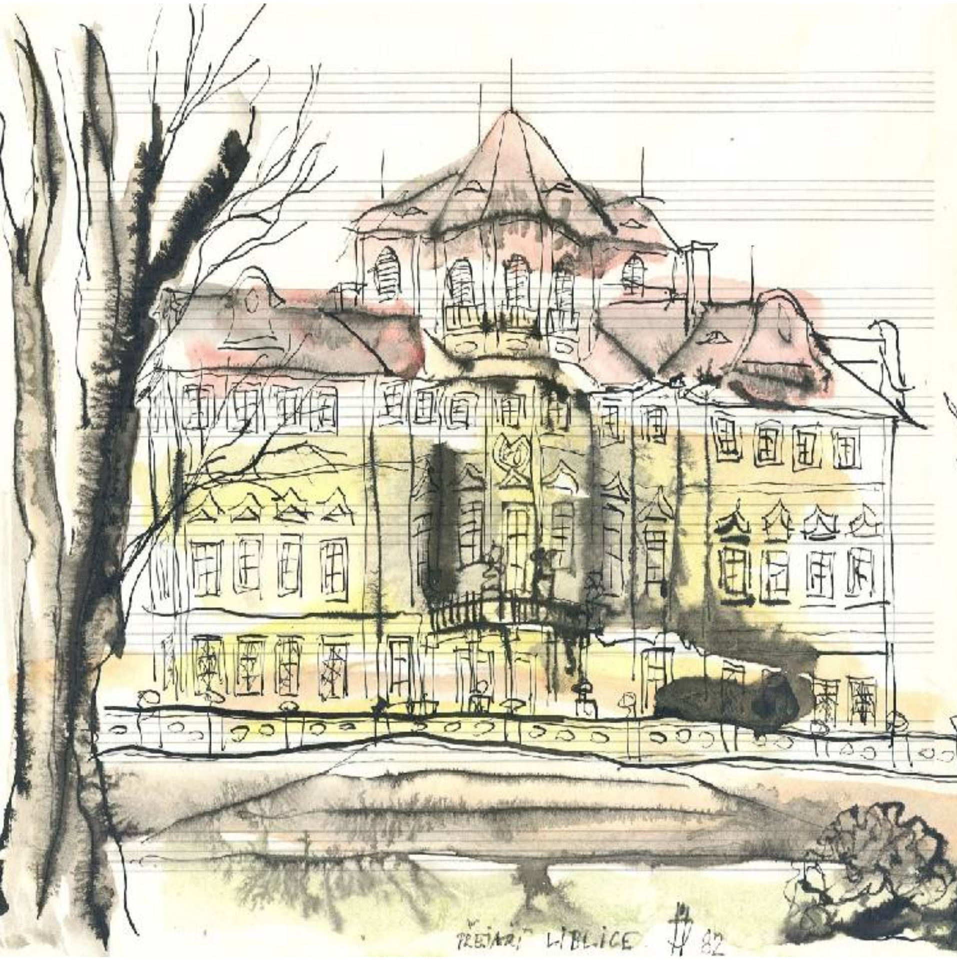
и если нарушается CP и CPT /и T сохраняется/, то

$$\varepsilon_S = -\varepsilon_L . \qquad (3)$$

Обсуждение существующих экспериментальных данных, основанное на соотношении Белла и Штейнбергера /2/, приводит к заключению, [illegible] соотношение (2) /3/. Однако до сих пор измерено только значение ε_L и существует модель /4/, которая на основе соотношения (3) согласуется с экспериментом не хуже чем модель Вольфенштейна.

Прямое определение коэффициентов ε_S и ε_L, не пользуясь соотношением Белла и Штейнбергера, можно в принципе сделать, измеряя временную зависимость интенсивности распадов K^0-мезонов

Příklady našich vystoupení na konferencích



RESULTS FROM NEUTRAL KAON REGENERATION AT HIGH ENERGIES*)

J. HLADKÝ

*Institute of Physics, Czechosl. Acad. Sci., Prague***)

The experimental neutral kaon regenerations results at Serpukhov energies up to 50 GeV are presented, including the coherent regeneration on hydrogen, deuterium and carbon regenerators and elastic regeneration on deuterium and preliminary carbon regenerators.

I should like to report you here some results, that have been obtained in the recent few years by our collaboration[1]).

The main aim of the experiment has been the study of the neutral kaon regeneration at high energies, that can give a very interesting answer about the behaviour of the total cross sections difference of the kaons and antikaons at high energies up to 50 GeV, and by this way a test of a validity of the Pomeranchuk theorem. The neutral beam of the proton–synchrotron at Serpukhov has been used.

Let me remember in a few words the effect of the neutral kaon regeneration. It has been introduced by PAIS and PICCIONI [2]. It follows from the two different linear combinations of the K^0 and $\bar{K}^0$: $|K_1^0\rangle = 1/\sqrt{(2)}\,(|K^0\rangle + |\bar{K}^0\rangle)$ and $|K_2^0\rangle = 1/\sqrt{(2)}\,(|K^0\rangle - |\bar{K}^0\rangle)$ owing to a different strangeness of K^0 and $\bar{K}^0$. Then, in a case of a K_L^0 beam traversing a block of a matter, conserving the strangeness in strong interactions, the K_S^0 are generated, because the total cross sections on the nucleons p, n are for the $\bar{K}^0$ bigger, than the corresponding ones of K^0. The same rule is also valid for any nucleus A. So, behind the block we have the state: $(\frac{1}{2}(f^0 + \bar{f}^0) \,.\, |K_L^0\rangle + \frac{1}{2}(f^0 - \bar{f}^0)\,|K_S^0\rangle$ – (f^0 resp. $\bar{f}^0$ are K^0 resp. $\bar{K}^0$ forward scattering amplitudes). Here, the first part represents the scattering term and the second one the regeneration term; $f^0 \neq \bar{f}^0$.

On can distinguish three types of the regeneration:

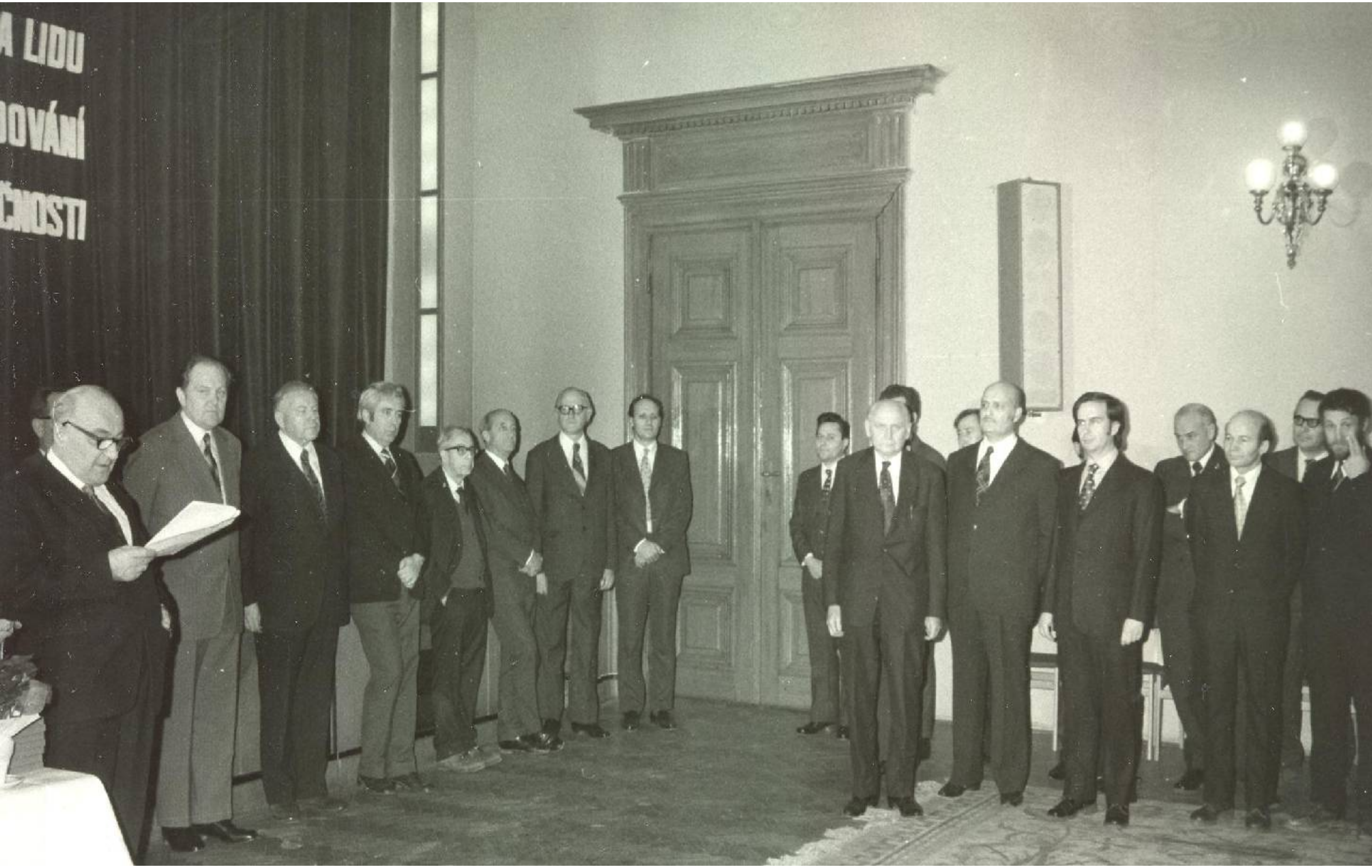
a) Transmission or coherent regeneration in the forward direction (angle $\gtrsim 10^{-7}$ mrad), that consists of coherent addition of the amplitudes from an extended part of the matter,

b) elastic from different nuclei of the diffractive type. The contributions of the different scattering centers do not add coherently,

c) inelastic regeneration — an excitation or a break of the nucleus.

*) Presented at the Symposium on Hadron–Hadron Scattering at High Energies, Liblice, Czechoslovakia, June 16—21, 1975.

**) *Na Slovance 2, 180 10 Praha 8, Czechoslovakia.*



Cena ČSAV předávaná na prezidiu ČSAV, Praha, Národní 3

Akademik Kožešník

Antonín Prokeš   Jan Hladký   Miroslav Novák

NAŠE CENY atd.

Liblice 1974 Hadron structure

Vedoucí sekce I a jeho zástupce

Ředitel FZÚ AV ČR v.v.i.

Léta sedmdesátá v Liblicích

Ředitel Laboratoře vysokých energií SÚJV Dubna

Liblice 1976 → Ludmila a BIS – 1 kolaborace

Večery po práci v Liblicích –
exkluzivní houslové koncerty mistrů
A. Prokeše a V. Šimáka (28.6.1974)

Šimákův host - Kalogeropoulos
Syracuse univ. ♂ ne ♀ !

Tak to začínalo….

.... a tak to končilo → diskuze, kritika, debaty atd. do noci.

Liblice 1976

Fyzika půvabných částic

Hledání půvabných částic – návrh experimentu

ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

СМ 1 - 1481

Служебный материал
Экз. № 000061

Поиск очарованных частиц

(Предложение эксперимента на ускорителе ИФВЭ ГКИАЭ)

Сотрудничество: Берлин-Будапешт-Дубна-Москва-Прага-Серпухов-София-Тбилиси

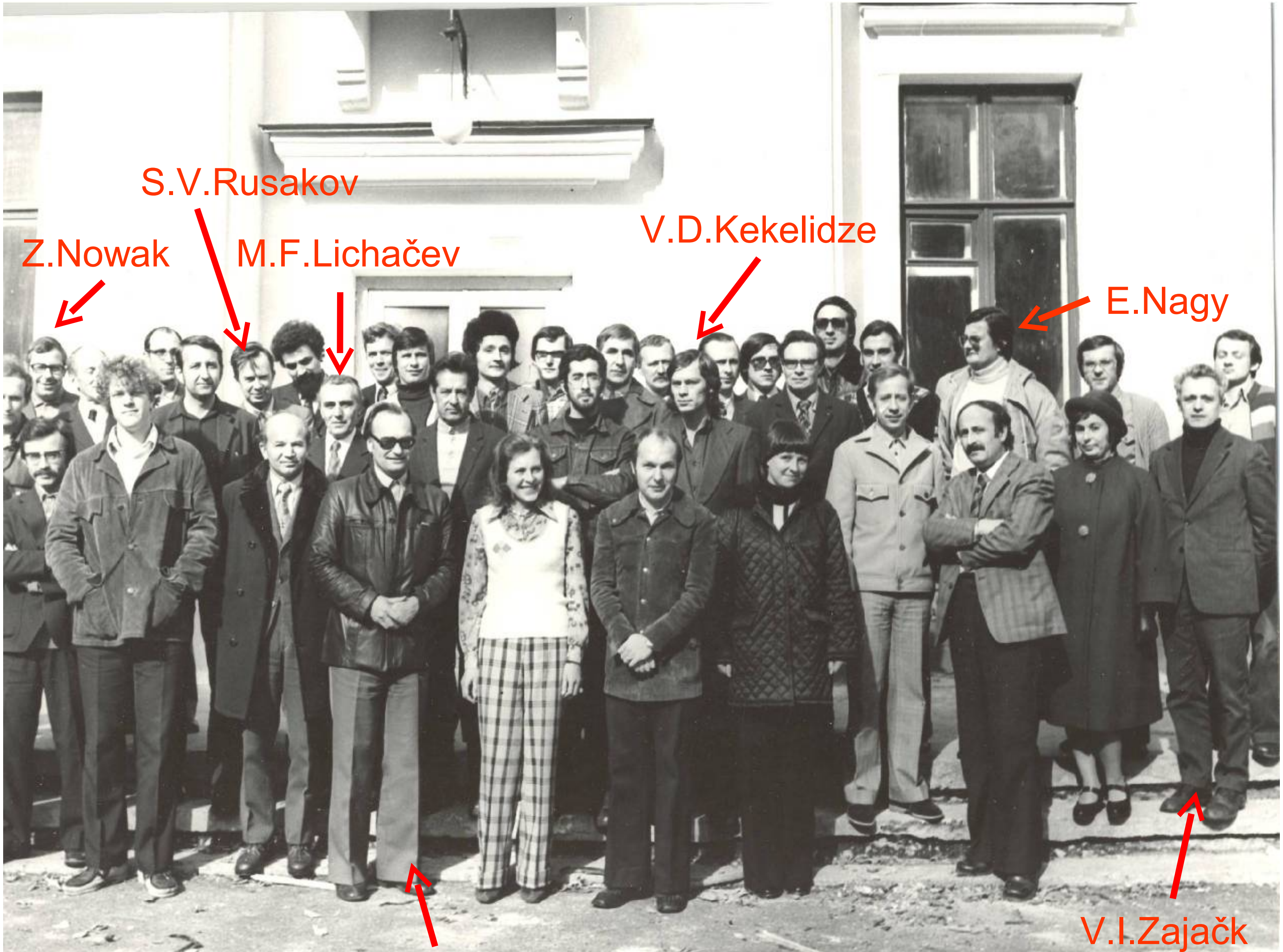
СЛУЖЕБНЫЕ МАТЕРИАЛЫ

Рассылаются только в научные учреждения стран-участниц ОИЯИ. Ссылки в публикациях на служебные материалы не допускаются.

Рукопись поступила в издательский отдел 18 августа 1975 г.

Дубна 1975

J. Hladký



BIS – 2 kolaborace

Dubna 1977

IFVE Serpuchov 1975

Svazek neutronů E_{max} ~ 60 GeV

Aparatura:

C (později i Al a Cu) terč

proporcionální komory

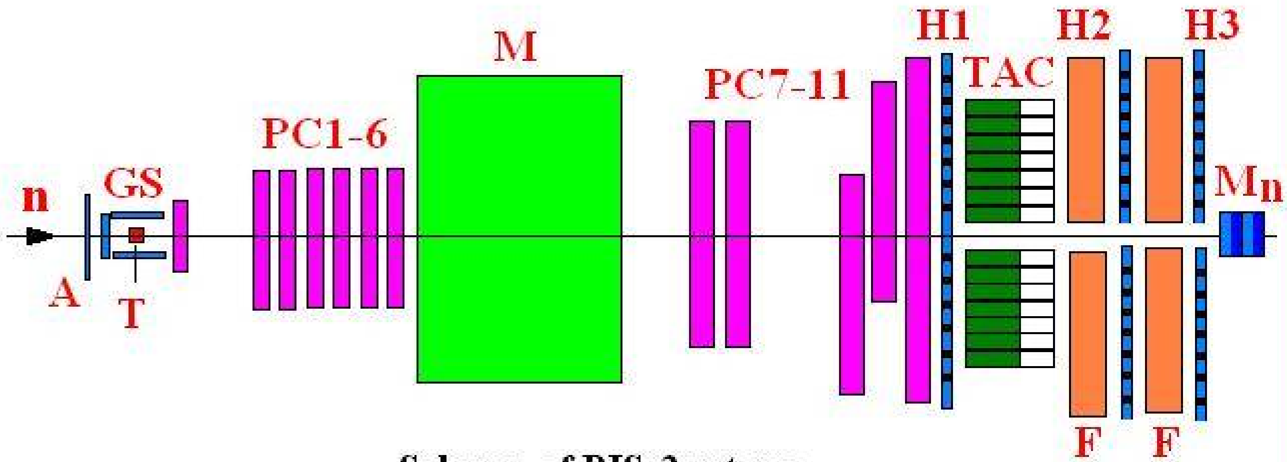
scintilační počítače a hodoskopy

elektromagnetický kalorimetr – skleněná stěna

detektor mionů

magnet

Spectrometer BIS-2

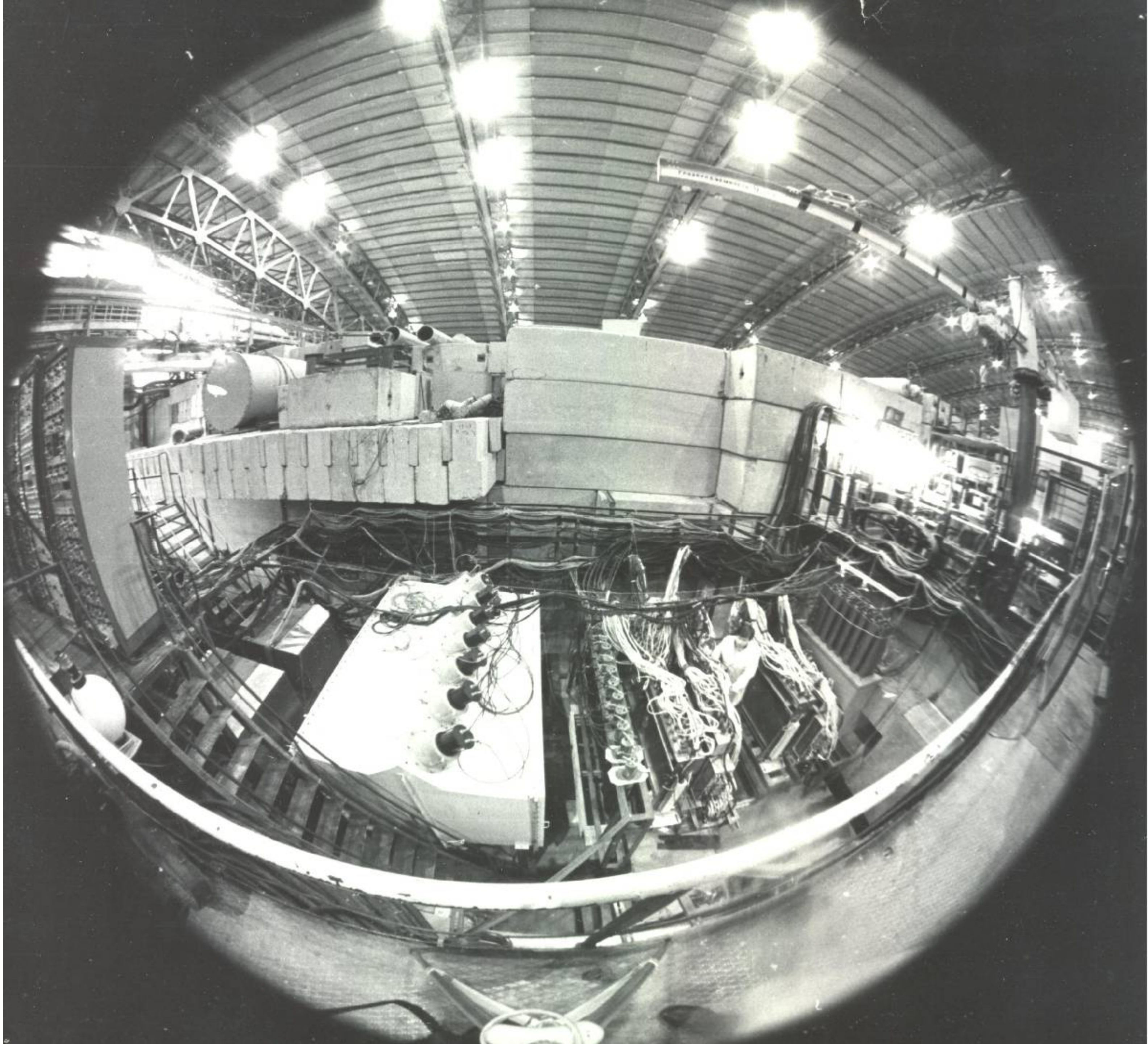


Scheme of BIS-2 set up:

M - magnet SP - 40, A- anticoincidence counter, F - iron filters.
PC1-11 - multiwire proportional chambers, GS - scintillation counters,
TAC - godoscope of the full absorbtion Cherenkov counters, T - target,
H1-3 - scintillation hodoscopes, M_n - neutron beam monitor

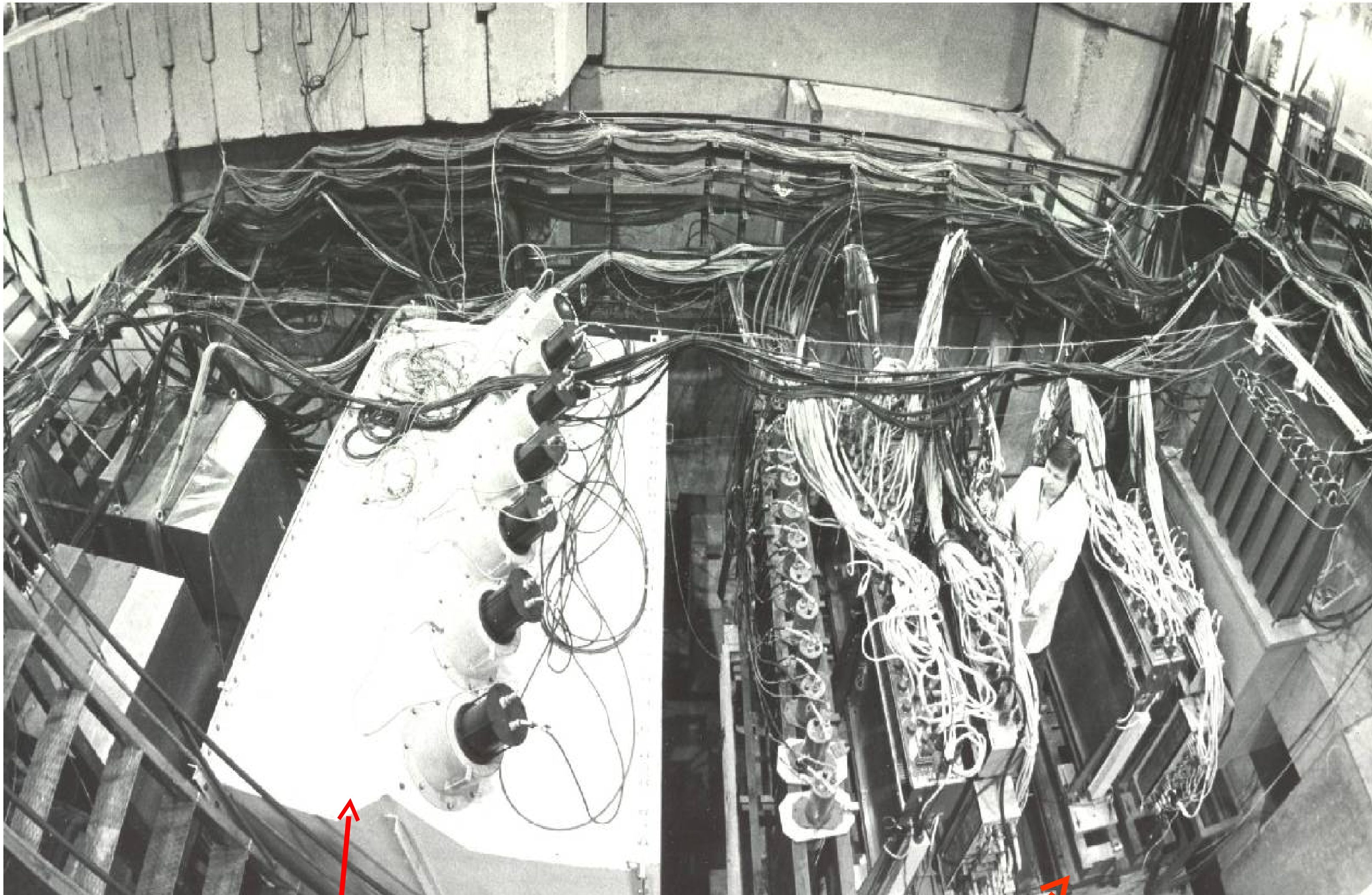
BIS - 2

A P A R A T U R A



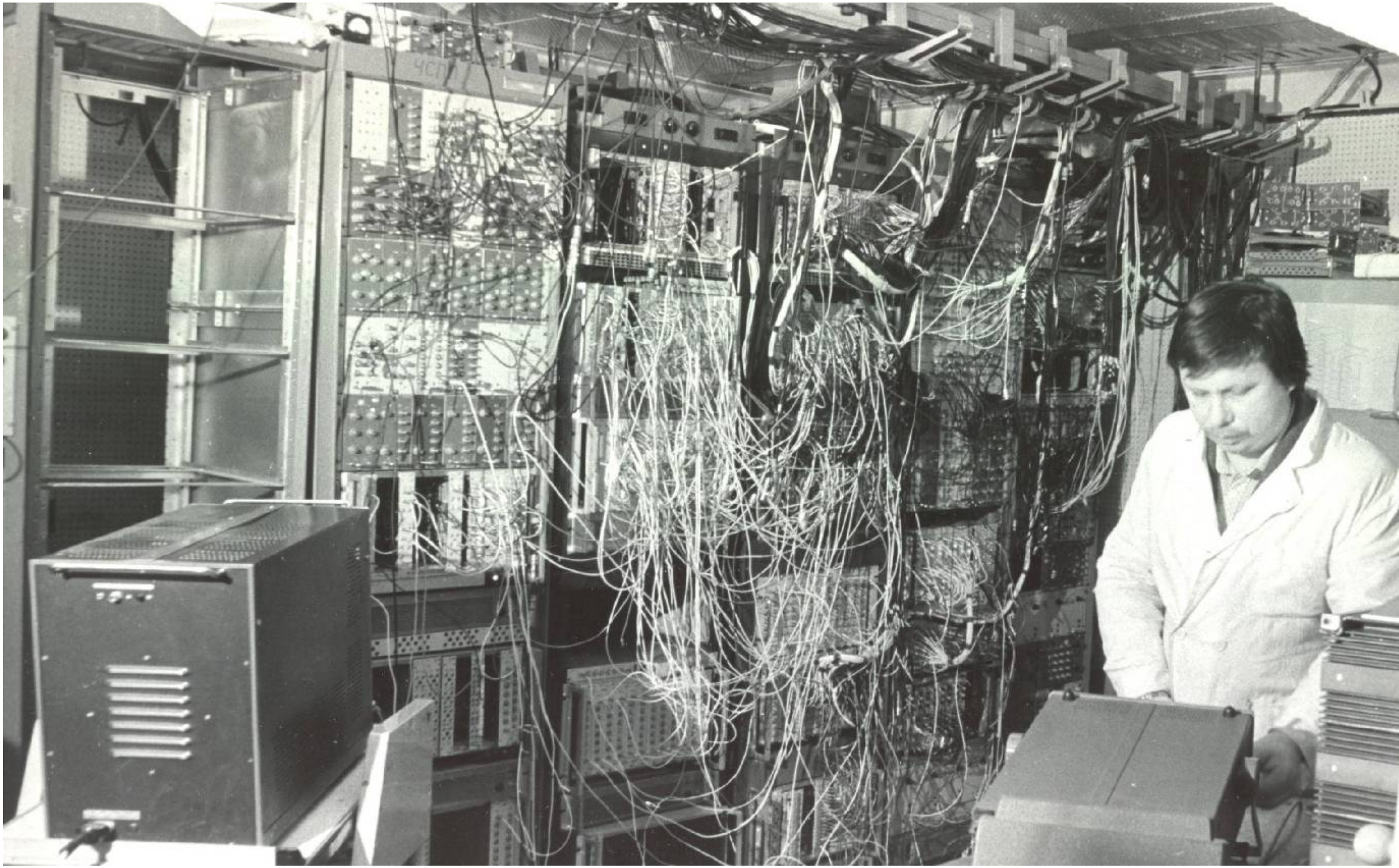
BIS - 2

A
P
A
R
A
T
U
R
A



Elektromagnetický kalorimetr

Detektor mionů

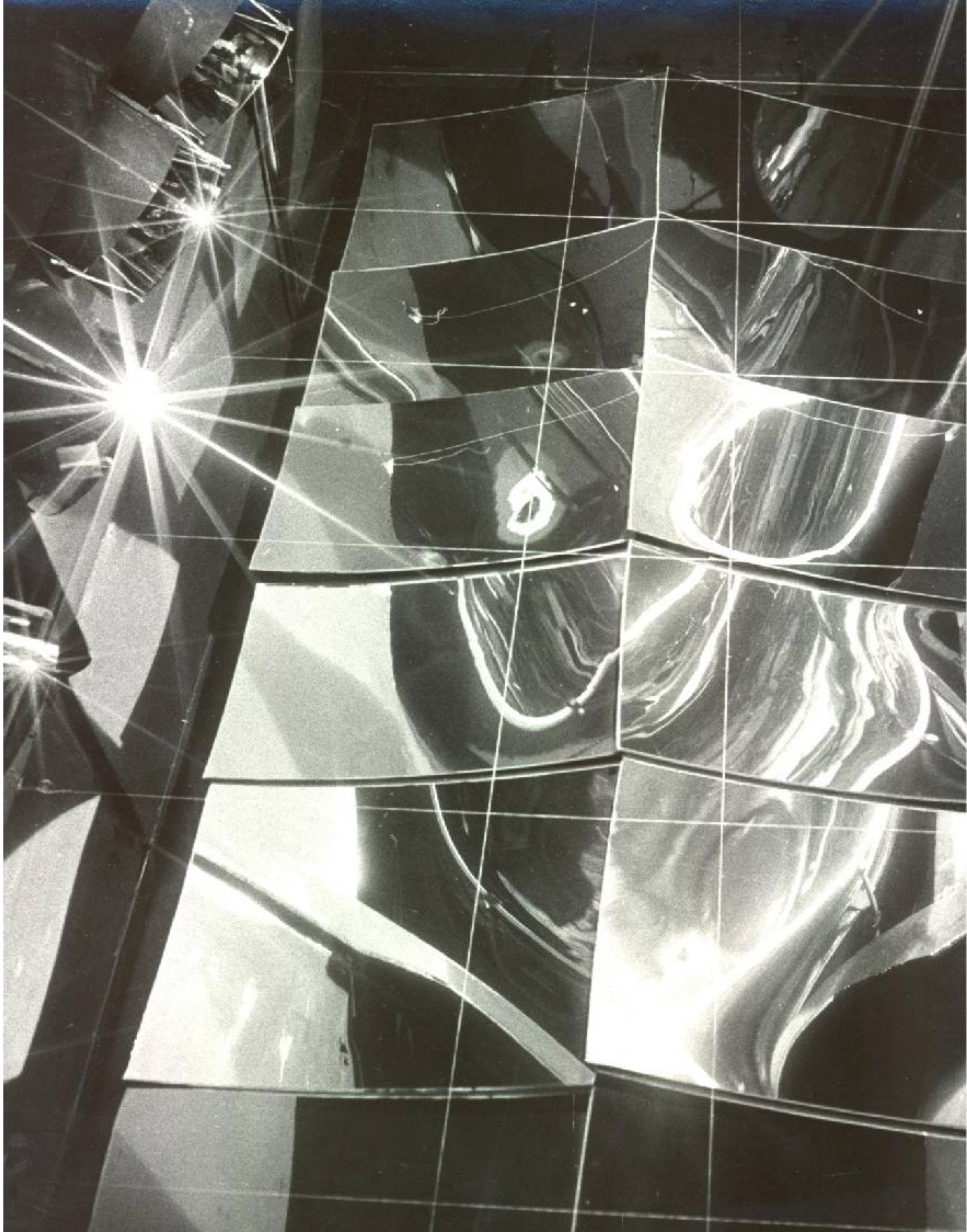


BIS - 2 elektronika

BIS-2

Čerenkovův detektor

(Pražská účast)



Hledání úzkých rezonancí:

❤ Půvabné částice - baryony Λ_c, Σ_c, Ξ_c, mezony D

◊ Podivné částice – hyperony, antihyperony

◊♦ Barionium

♦♦♦ Pentakvark

atd., … např. studium POLARIZACE částic

Zjištěny produkční parametry

Λ_c^+

$\rightarrow \bar{K}^0 p \pi^+ \pi^-$

$\rightarrow \Lambda^0 \pi^+ \pi^- \pi^+$

První pozorování nového rozpadového kanálu !

Z. Phys. C – Particle and Fields 23, 333–338 (1984)

Zeitschrift für Physik C Particles and Fields

The Λ_c^+ Production by 40–70 GeV Neutrons on Carbon

Collaboration BIS-2: Berlin-Budapest-Dubna-Moscow-Prague-Sofia-Tbilisi

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Received 23 January 1984

Abstract. The inclusive production of charmed baryons Λ_c^+ by 40–70 GeV neutrons on carbon has been observed. The decays $\Lambda_c^+ \to \bar{K}^0 p \pi^+ \pi^-$ (130±18 events) and $\Lambda_c^+ \to \Lambda^0 \pi^+ \pi^+ \pi^-$ (57±14 events) have been detected. The mean value of Λ_c^+ mass is (2,268 ±6) MeV/c². The invariant cross section for $X > 0.5$ is described by

$E \cdot d^3\sigma/dp^3 \propto \exp(-bP_T) \cdot (1-X)^n$

with $b = (2.5 \pm 0.6)$ (GeV/c)$^{-1}$ and $n = (1.5 \pm 0.5)$.

The cross section of the Λ_c^+ inclusive production measured for $X > 0.5$ times the branching ratios are

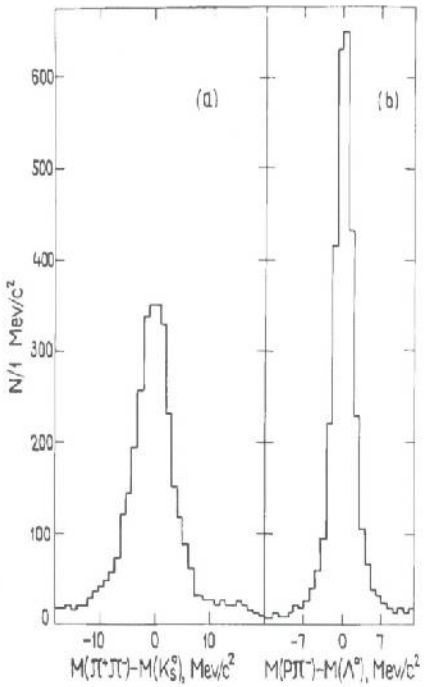


Fig. 3a and b. "Vees" invariant mass spectra illustrating K_s^0 and Λ^0 detection; **a** the $M(\pi^+\pi^-)$ spectrum in the mass region around $M(K_s^0)=497.67$ MeV/c²; **b** the $M(p\pi^-)$ spectrum in the mass region around $M(\Lambda^0)=1{,}115.6$ MeV/c².

netic field in M were changed. These changes of the experimental conditions allowed systematic errors to be taken into account. A more detailed description of the spectrometer BIS-2 and the experimental conditions is given elsewhere [23]. 11.4×10^6 events were recorded corresponding to an integral neutron flux of $M_n \simeq 6\times10^{11}$ through the target.

To select the decays of strange particles (3) and

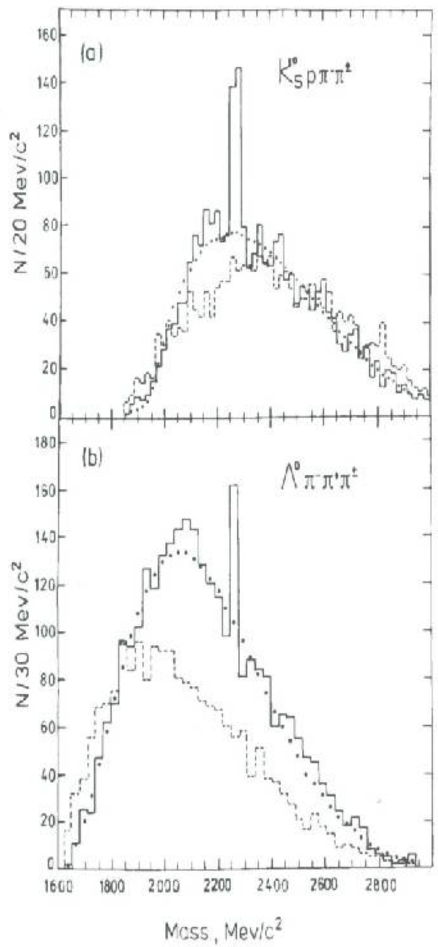
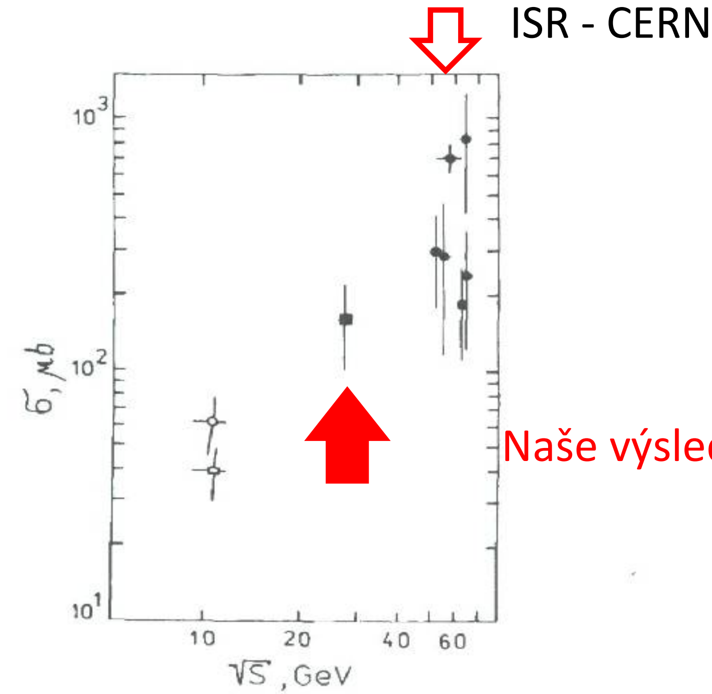


Fig. 4a and b. The invariant mass distributions: **a** for $K_s^0 p\pi^+\pi^-$ (solid line) and $K_s^0 p\pi^-\pi^-$ (dashed line) systems; **b** for $\Lambda^0\pi^+\pi^+\pi^-$ (solid line) and $\Lambda^0\pi^+\pi^-\pi^-$ (dashed line) systems. The dotted lines show the result of the polynomial fit to these distributions



Naše výsledky

Fig. 7. Comparison of the Λ_c^- production cross sections in the region $X>0$ obtained in different experiments: open circle – results of this experiment obtained in the frame of the A model; open square – results of this experiment obtained on the assumption of constancy $d\sigma/dX$; black points – compilation of the ISR data taken from review [21] assuming that the values of $d\sigma/dX$ are constant; black square – data of paper [8] recalculated according to $\sigma\propto A^{2/3}$

Repotér J. Halzen

na XX. ICHEP Madison 1980:

…" σ veliké, modely nepasují ….

… ostatní exper. padají pod stůl"

$\Gamma(\Lambda\ \text{anything})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.27±0.09 OUR AVERAGE					
0.49±0.24		ADAMOVICH	87	EMUL	γA 20–70 GeV/c
0.23±0.10	8	[4] ABE	86	HYBR	20 GeV γp

[4] ABE 86 includes Λ's from Σ^0 decay.

$\Gamma(\Lambda\pi^+)/\Gamma(p\overline{K}^0)$ Γ_{10}/Γ_1

We regard this mode as seen, but with a limit given by the ALBRECHT 88C result.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
seen OUR EVALUATION						
<0.26	90		[5] ALBRECHT	88C	ARG	e^+e^- 10 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.4	90	40	RUSSELL	81	SPEC	Photoproduction
$0.54^{+0.62}_{-0.27}$		9	KITAGAKI	80	DBC	νd in FNAL 15-ft
$0.67^{+0.73}_{-0.33}$		5	[6] BALTAY	79	HLBC	ν Ne H in 15-ft

[5] This ALBRECHT 88C result is redundant with their limit on $\Gamma(\Lambda\pi^+)/\Gamma(pK^-\pi^+)$, below.
[6] Calculated by KITAGAKI 80 from BALTAY 79 results.

$\Gamma(\Lambda\pi^+)/\Gamma(pK^-\pi^+)$ Γ_{10}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.16	90	ALBRECHT	88C	ARG	e^+e^- 10 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.33	90	ANJOS	90	TPS	γBe 70–260 GeV
<0.8	90	WEISS	80	MRK2	e^+e^- 5.2 GeV

$\Gamma(\Lambda\pi^+\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{11}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.019±0.007 OUR FIT					
0.028±0.007±0.011	70	[7] BOWCOCK	85	CLEO	e^+e^- 10.5 GeV

[7] See BOWCOCK 85 for assumptions made on charm production and Λ_c production from charm to get this result.

$\Gamma(\Lambda\pi^+\pi^+\pi^-)/\Gamma(p\overline{K}^0)$ Γ_{11}/Γ_1

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<3.1	90	220	RUSSELL	81	SPEC	Photoproduction

$\Gamma(\Lambda\pi^+\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ Γ_{11}/Γ_2

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.68±0.15 OUR FIT						
0.64±0.15 OUR AVERAGE						
0.82±0.29±0.27		44	ANJOS	90	TPS	γBe 70–260 GeV
0.61+0.16±0.04		105	ALBRECHT	88C	ARG	e^+e^- 10 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.4	90		WEISS	80	MRK2	e^+e^- 5.2 GeV

$\Gamma(p\overline{K}^0\pi^+\pi^-)/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ Γ_5/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
4.3±1.2 OUR FIT					
4.3±1.2	130	ALEEV	84	BIS2	nC 40–70 GeV

$\Gamma(\Sigma^\pm\ \text{anything})/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1±0.05	5	ABE	86	HYBR	20 GeV γp

$\Gamma(\Sigma^0\pi^+)/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	3	KITAGAKI	82	DBC	νd in FNAL 15-ft

$\Gamma(\Sigma^+\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{15}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.10±0.08		ADAMOVICH	87	EMUL	γA 20–70 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	1	AMMAR	86	EMUL	νA

$\Gamma(p\ \text{hadrons})/\Gamma_{\text{total}}$ Γ_{20}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.41±0.24	ADAMOVICH	87	EMUL	γA 20–70 GeV/c

$\Gamma(pe^+\ \text{anything})/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.018±0.009	[8] VELLA	82	MRK2	e^+e^- 4.5–6.8 GeV

[8] VELLA 82 includes protons from Λ decay.

$\Gamma(\Lambda e^+\ \text{anything})/\Gamma_{\text{total}}$ Γ_{19}/Γ

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.011±0.008			[9] VELLA	82	MRK2	e^+e^- 4.5–6.8 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.022	90	1	BALLAGH	81	HYBR	νNe-H in 15-ft

[9] VELLA 82 includes Λ's from Σ^0 decay.

$\Gamma(\Lambda e^+\ \text{anything})/\Gamma(\Lambda\ \text{anything})$ Γ_{19}/Γ_9

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.027±0.017	[10] SON	82	DBC	νd in FNAL 15-ft

[10] SON 82 uses own data and $\Lambda_c \to e^+$ events of MURTAGH 79.

$\Gamma(\Lambda\pi^+\pi^+\pi^-)/\Gamma(\Lambda e^+\ \text{anything})$ Γ_{11}/Γ_{19}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.7	90	KLEIN	89	MRK2	e^+e^- 29 GeV

$\Gamma(e^+\ \text{anything})/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.045±0.017	VELLA	82	MRK2	e^+e^- 4.5–6.8 GeV

REFERENCES FOR Λ_c^+

We have omitted some papers that have been superseded by later experiments. The omitted papers may be found in our 1986 edition (Physics Letters 170B) or in earlier editions.

ANJOS	90	PR D41 801	+Appel, Bean+	(Tagged Photon Spectrometer Collab.)
BARLAG	89	PL B218 374	+Becker, Boehringer, Bosman+	(ACCMOR Collab.)
KLEIN	89	PRL 62 2444	+Hime, Abrams, Amidei, Bade+	(Mark II Collab.)
AGUILAR-...	88B	ZPHY C40 321	Aguilar-Benitez, Allison, Bailly+	(LEBC-EHS Collab.)
Also	87	PL B189 254	Aguilar-Benitez, Allison, Bailly+	(LEBC-EHS Collab.)
Also	87B	PL B199 462	Aguilar-Benitez, Allison, Bailly+	(LEBC-EHS Collab.)
Also	88	SJNP 48 833	Begalli, Otter, Schulte, Gensch+	(LEBC-EHS Collab.)
		Translated from YAF 48 1310.		
ALBRECHT	88C	PL B207 109	+	(ARGUS Collab.)
ALBRECHT	88E	PL B210 263	+Boeckmann, Glaeser+	(ARGUS Collab.)
ANJOS	88B	PRL 60 1379	+Appel	(Tagged Photon Spectrometer Collab.)
ADAMOVICH	87	EPL 4 887	+Alexandrov, Bolta+	(Photon Emulsion Collab.)
Also	87	SJNP 46 447	Vaggi, Bonsanni+	(Photon Emulsion Collab.)
		Translated from YAF 46 799.		
AMENDOLIA	87	ZPHY C36 513	+Bagliesi, Batignani, Beck+	(CERN NA1 Collab.)
BARLAG	87	PL B184 283	+	(MPIM, CERN, PAL, ANIK, BRIS, CRAC+)
CHAUVAT	87	PL B199 304	+Cousins, Hayes+	(CERN, UCLA, SACL, UDCF)
DIESBURG	87	PRL 59 2711	+Ladbury+	(COLO, ILL, FNAL, UGNA, MILA, INFN)
JONES	87	ZPHY C36 593	+Jones+	(BIRM, CERN, LOIC, MPIM, OXF, LOUC)
ABE	86	PR D33 1	+	(SLAC Hybrid Facility Photon Collab.)
AMMAR	86	JETPL 43 515	+Ammosov, Bakic, Baranov, Burnett+	(ITEP)
		Translated from ZETFP 43 401.		
USHIDA	86	PRL 56 1767	+Kondo+	(AICH, FNAL, GIFU, GYSU, KOBE, SEOU+)
BOWCOCK	85	PRL 55 923	+Giles, Hassard, Kinoshita+	(CLEO Collab.)
ALEEV	84	ZPHY C23 333	Aleev, Balandin, Berdyshev+	(BIS-2 Collab.)
		PL 109B 234	+Graessler+	(AACH, BONN, CERN, MPIM, OXF)
KITAGAKI	82	PRL 48 299	+Tanaka, Yuta+	(TOHO, IIT, UMD, STON, TUFT)
SON	82	PRL 49 1128	+Snow, Chang+	(UMD, IIT, STON, TOHO, TUFT)
VELLA	82	PRL 48 1515	+Trilling, Abrams, Alam+	(SLAC, LBL, UCB)
BALLAGH	81	PR D24 7	+Bingham+	(LBL, UCB, FNAL, HAWA, WASH, WISC)
BASILE	81B	NC 62A 14	+Romeo+	(CERN, BGNA, PGIA, FRAS)
RUSSELL	81	PRL 46 799	+Avery, Butler, Gladding+	(ILL, FNAL, COLU)
ABRAMS	80	PRL 44 10	+Alam, Blocker, Boyarski+	(SLAC, LBL)
ALLASIA	80	NP B176 13		(AMST, BARI, CERN, DUUC, LOUC, KEYN+)
CALICCHIO	80	PL 93B 521		(BARI, BIRM, BRUX, CERN, EPOL, RHEL+)
KITAGAKI	80	PRL 45 955	+Tanaka, Yuta+	(TOHO, IIT, UMD, STON, TUFT)
WEISS	80	Toronto Conf. 319		(SLAC)
BALTAY	79	PRL 42 1721	+Caroumbalis, French, Hibbs+	(COLU, BNL)
CNOPS	79	PRL 42 197	+Connolly, Kahn, Kirk, Murtagh, Palmer+	(BNL)
GIBONI	79	PL 85B 437	+	(AACH, CERN, HARV, MUNI, NWES, UCR)
KERMAN	79	Lepton Conf. FNAL		(UCR)
MURTAGH	79	Fermilab Symp. 277		(FNAL)
KNAPP	76	PRL 37 882	+Lee, Leung, Smith+	(COLU, HAWA, ILL, FNAL)
CAZZOLI	75	PRL 34 1125	+Cnops, Connolly, Louttit, Murtagh+	(BNL)

$\Sigma_c(2455)$

$I(J^P) = 1(\frac{1}{2}^+)$

J^P not confirmed. $\frac{1}{2}^+$ is the quark model prediction.

$\Sigma_c(2455)$ MASSES

The mass measurements in this section are redundant with the mass difference measurements that follow. We get the masses by adding the $\Sigma_c(2455) - \Lambda_c^+$ mass differences to the Λ_c^+ mass.

$\Sigma_c(2455)^{++}$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
2453.0±1.2 OUR FIT Error includes scale factor of 1.4.						
• • • We do not use the following data for averages, fits, limits, etc. • • •						
2449 ±3	2	JONES	87	HBC	++	νp in BEBC
2480	1	ADAMOVICH	84	EMUL	++	γA (OMEGA)
2454 ±5	1	BOSETTI	82	HBC	++	See JONES 87
2435 ±10	6	BALTAY	79	HLBC	++	νNe-H in 15-ft
>2430	2	BARISH	77B	DBC	++	νd in 12-ft
2426 ±12	1	CAZZOLI	75	HBC	++	νp in BNL 7-ft

$\Sigma_c(2455)^+$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
2453.2±3.2 OUR FIT						
• • • We do not use the following data for averages, fits, limits, etc. • • •						
2457 ±4	1	CALICCHIO	80	HBC	+	νp in BEBC-TST

$\Gamma(\Delta(1232)\overline{K}^*(892))/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	35	AMENDOLIA	87	SPEC	γGe-Si

$\Gamma(pK^-\pi^+\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ Γ_{14}/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.022±0.016	BARLAG	90D	NA32	π^- 230 GeV

$\Gamma(pK^-\pi^+\pi^0\pi^0)/\Gamma(pK^-\pi^+)$ Γ_{15}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.06±0.07±0.03	15	BOZEK	93	NA32	π^-Cu 230 GeV

$\Gamma(pK^-\pi^+3\pi^0)/\Gamma(pK^-\pi^+)$ Γ_{16}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.10±0.06±0.02	8	BOZEK	93	NA32	π^-Cu 230 GeV

——— Hadronic modes with a p: $S = 0$ final states ———

$\Gamma(p\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ Γ_{17}/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.069±0.036	BARLAG	90D	NA32	π^- 230 GeV

$\Gamma(pf_0(980))/\Gamma(pK^-\pi^+)$ Γ_{18}/Γ_2

Unseen decay modes of the $f_0(980)$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.055±0.036	BARLAG	90D	NA32	π^- 230 GeV

$\Gamma(p\pi^+\pi^+\pi^-\pi^-)/\Gamma(pK^-\pi^+)$ Γ_{19}/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.036±0.023	BARLAG	90D	NA32	π^- 230 GeV

$\Gamma(pK^+K^-)/\Gamma(pK^-\pi^+)$ Γ_{20}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.015±0.006 OUR AVERAGE Error includes scale factor of 2.1.					
0.014±0.002±0.002	676	ABE	02C	BELL	$e^+e^- \approx \Upsilon(4S)$
0.039±0.009±0.007	214	ALEXANDER	96C	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.096±0.029±0.010	30	FRABETTI	93H	E687	γBe, $\overline{E}_\gamma$ 220 GeV
0.048±0.027		BARLAG	90D	NA32	π^- 230 GeV

$\Gamma(p\phi)/\Gamma(pK^-\pi^+)$ Γ_{21}/Γ_2

Unseen decay modes of the ϕ are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0164±0.0032 OUR AVERAGE Error includes scale factor of 1.2.					
0.015 ±0.002 ±0.002	345	ABE	02C	BELL	$e^+e^- \approx \Upsilon(4S)$
0.024 ±0.006 ±0.003	54	ALEXANDER	96C	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.040 ±0.027		BARLAG	90D	NA32	π^- 230 GeV

$\Gamma(pK^+K^-\ \text{non-}\phi)/\Gamma(pK^-\pi^+)$ Γ_{22}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.007±0.002 ±0.002	344	ABE	02C	BELL	$e^+e^- \approx \Upsilon(4S)$

——— Hadronic modes with a hyperon: $S = -1$ final states ———

$\Gamma(\Lambda\pi^+)/\Gamma(pK^-\pi^+)$ Γ_{23}/Γ_2

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.214±0.016 OUR FIT Error includes scale factor of 1.1.						
0.204±0.019 OUR AVERAGE						
0.217±0.013±0.020		750	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
0.18 ±0.03 ±0.04			ALBRECHT	92	ARG	$e^+e^- \approx$ 10.4 GeV
0.18 ±0.03 ±0.03		87	AVERY	91	CLEO	e^+e^- 10.5 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.33	90		ANJOS	90	E691	γBe 70–260 GeV
<0.16	90		ALBRECHT	88C	ARG	e^+e^- 10 GeV

$\Gamma(\Lambda\pi^+\pi^0)/\Gamma(pK^-\pi^+)$ Γ_{24}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.73±0.09±0.16	464	AVERY	94	CLE2	$e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$

$\Gamma(\Lambda\rho^+)/\Gamma(pK^-\pi^+)$ Γ_{25}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.95	95	AVERY	94	CLE2	$e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$

$\Gamma(\Lambda\pi^+\pi^+\pi^-)/\Gamma(pK^-\pi^+)$ Γ_{26}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.525±0.032 OUR FIT					
0.522±0.032 OUR AVERAGE					
0.508±0.024±0.024	1356	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
0.65 ±0.11 ±0.12	289	AVERY	91	CLEO	e^+e^- 10.5 GeV
0.82 ±0.29 ±0.27	44	ANJOS	90	E691	γBe 70–260 GeV
0.94 ±0.41 ±0.13	10	BARLAG	90D	NA32	π^- 230 GeV
0.61 ±0.16 ±0.04	105	ALBRECHT	88C	ARG	e^+e^- 10 GeV

$\Gamma(\Sigma(1385)^+\pi^+\pi^-, \Sigma^{*+} \to \Lambda\pi^+)/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ Γ_{27}/Γ_{26}

VALUE	DOCUMENT ID		TECN	COMMENT
0.28±0.10±0.08	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\Sigma(1385)^-\pi^+\pi^+, \Sigma^{*-} \to \Lambda\pi^-)/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ Γ_{28}/Γ_{26}

VALUE	DOCUMENT ID		TECN	COMMENT
0.21±0.03±0.02	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\Lambda\pi^+\rho^0)/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ Γ_{29}/Γ_{26}

VALUE	DOCUMENT ID		TECN	COMMENT
0.40±0.12±0.12	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\Sigma(1385)^+\rho^0, \Sigma^{*+} \to \Lambda\pi^+)/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ Γ_{30}/Γ_{26}

VALUE	DOCUMENT ID		TECN	COMMENT
0.14±0.09±0.07	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\Lambda\pi^+\pi^+\pi^-\ \text{nonresonant})/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ Γ_{31}/Γ_{26}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.3	90	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(p\overline{K}^0\pi^+\pi^-)/\Gamma(\Lambda\pi^+\pi^+\pi^-)$ Γ_9/Γ_{26}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.5±1.3		ALEEV	96	SPEC	n nucleus, 50 GeV/c
4.3±1.2	130	ALEEV	84	BIS2	nC 40–70 GeV

$\Gamma(\Lambda\pi^+\pi^+\pi^-\pi^0\ \text{total})/\Gamma(pK^-\pi^+)$ Γ_{32}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.36±0.09±0.09	50	[10] CRONIN-HEN...03		CLE3	$e^+e^- \approx \Upsilon(4S)$

[10] CRONIN-HENNESSY 03 finds this channel to be dominately $\Lambda\eta\pi^+$ and $\Lambda\omega\pi^+$; see below.

$\Gamma(\Lambda\pi^+\eta)/\Gamma(pK^-\pi^+)$ Γ_{33}/Γ_2

Unseen decay modes of the η are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.36±0.07 OUR AVERAGE					
0.41±0.17±0.10	11	CRONIN-HEN...03		CLE3	$e^+e^- \approx \Upsilon(4S)$
0.35±0.05±0.06	116	AMMAR	95	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Sigma(1385)^+\eta)/\Gamma(pK^-\pi^+)$ Γ_{34}/Γ_2

Unseen decay modes of the $\Sigma(1385)^+$ and η are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.17±0.04±0.03	54	AMMAR	95	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Lambda\pi^+\omega)/\Gamma(pK^-\pi^+)$ Γ_{35}/Γ_2

Unseen decay modes of the ω are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.24±0.06±0.06	32	CRONIN-HEN...03		CLE3	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Lambda\pi^+\pi^+\pi^-\pi^0, \text{no}\ \eta\ \text{or}\ \omega)/\Gamma(pK^-\pi^+)$ Γ_{36}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.13	90	CRONIN-HEN...03		CLE3	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Lambda K^+\overline{K}^0)/\Gamma(pK^-\pi^+)$ Γ_{37}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.093±0.018 OUR FIT Error includes scale factor of 1.7.					
0.131±0.020 OUR AVERAGE					
0.142±0.018±0.022	251	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
0.12 ±0.02 ±0.02	59	AMMAR	95	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Xi(1690)^0K^+, \Xi^{*0} \to \Lambda\overline{K}^0)/\Gamma(\Lambda K^+\overline{K}^0)$ Γ_{38}/Γ_{37}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.28±0.07 OUR AVERAGE					
0.32±0.10±0.04	84±24	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
0.26±0.08±0.03	93	ABE	02C	BELL	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Lambda K^+\overline{K}^0)/\Gamma(\Lambda\pi^+)$ Γ_{37}/Γ_{23}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.43 ±0.08 OUR FIT Error includes scale factor of 2.0.					
0.395±0.026±0.036	460 ± 30	AUBERT	07C	BABR	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Sigma^0\pi^+)/\Gamma(pK^-\pi^+)$ Γ_{39}/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.210±0.018 OUR FIT					
0.20 ±0.04 OUR AVERAGE					
0.21 ±0.02 ±0.04	196	AVERY	94	CLE2	$e^+e^- \approx \Upsilon(3S), \Upsilon(4S)$
0.17 ±0.06 ±0.04		ALBRECHT	92	ARG	$e^+e^- \approx$ 10.4 GeV

$\Gamma(\Sigma^0\pi^+)/\Gamma(\Lambda\pi^+)$ Γ_{39}/Γ_{23}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.98 ±0.05 OUR FIT					
0.98 ±0.05 OUR AVERAGE					
0.977±0.015±0.051	33k	AUBERT	07C	BABR	$e^+e^- \approx \Upsilon(4S)$
1.06 ±0.11 ±0.19	753	LINK	05F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

Z. Phys. C – Particles and Fields 37, 243–249 (1988)

Zeitschrift für Physik C Particles and Fields

Pražská iniciativa + Berlín

Production of $\bar{D}^0$ and D^- mesons in neutron–carbon interactions at 40–70 GeV

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Abstract. The production of $\bar{D}$ mesons in neutron-carbon interactions at 40–70 GeV/c has been investigated. The $\bar{D}$ mesons were detected via the hadronic decay modes $\bar{D}^0 \to K^{*+}(892)\pi^-$ and $D^- \to K^{*+}(892)\pi^-\pi^-$. In the kinematical region $x_F > 0.5$ and $p_T < 1$ GeV/c the following inclusive cross sections were measured: $\sigma_{\bar{D}^0} = (28 \pm 14)\mu b$ and $\sigma_{D^-} = (26 \pm 13)\mu b$ per carbon nucleus. The invariant longitudinal momentum spectra can be described by $(1-x)^N$ with $N_{\bar{D}^0} = 1.1 \pm 0.5 \pm 0.4$ and $N_{D^-} = 0.8 \pm 0.4 \pm 0.4$. The transverse momentum spectra were parametrized by $\exp(-Bp_T^2)$ with $B_{\bar{D}^0} = (1.2^{+1.1}_{-0.4})$ (GeV/c)$^{-2}$ and $B_{D^-} = (1.8^{+1.3}_{-1.0})$ (GeV/c)$^{-2}$.

V rozpadech

$\bar{D}^0 \to K^{*+}(892)\,\pi^-$

$D^- \to K^{*+}(892)\,\pi^-\pi^-$

v oblasti $x_F > 0.5$ a

$p_T < 1.5$ GeV/c

je $\sigma = (28 \pm 14)$ μb a

(26 ± 13) μb na C jádro.

Podélná hybnost tvaru $(1 - x)^N$

fituje $N = 1.1 \pm 0.5 \pm 0.4$ a

$0.8 \pm 0.4 \pm 0.4$,

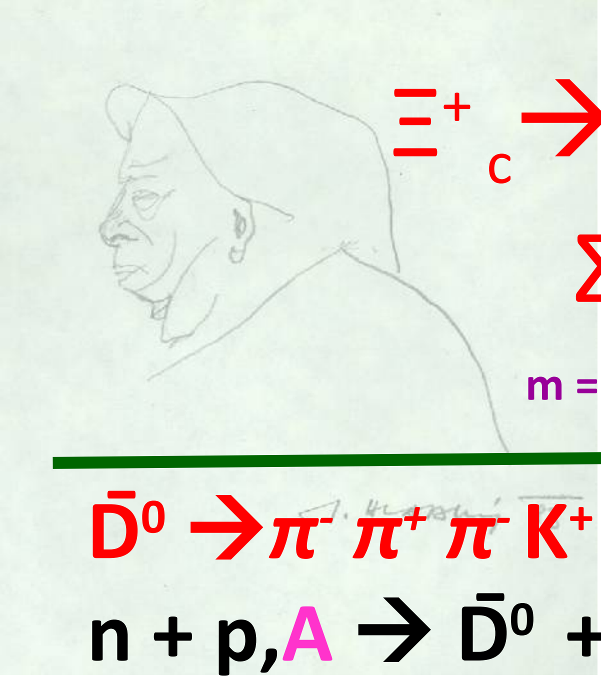
příčná hybnost tvaru $\exp(-Bp^2_T)$

fituje $B = 1.2 \pm 1.0$ a 1.8 ± 1.3

σ velké !

~ 10 μb/ nucleon pro difr.model

~ 20-30 μb/nucleon pro $(1-x)^N$



$\Xi^+_c \rightarrow \Lambda^0 \pi^+ \pi^+ K^-$

$\Sigma^0 \pi^+ \pi^+ K^-$

$m = (2440 \pm 29)\ MeV/c^2$

CZECHOSLOVAK JOURNAL OF PHYSICS
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SEARCH FOR THE CHARMED STRANGE BARYON Ξ_c^+ IN NEUTRON-PROTON INTERACTIONS AT $\sqrt{S} \approx 10$ GeV

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$\bar{D}^0 \rightarrow \pi^- \pi^+ \pi^- K^+$ **z reakce :**

$n + p, A \rightarrow \bar{D}^0 + X$

Pro $\sigma_A = K\, \sigma_H\, A^\alpha$ dává fit:

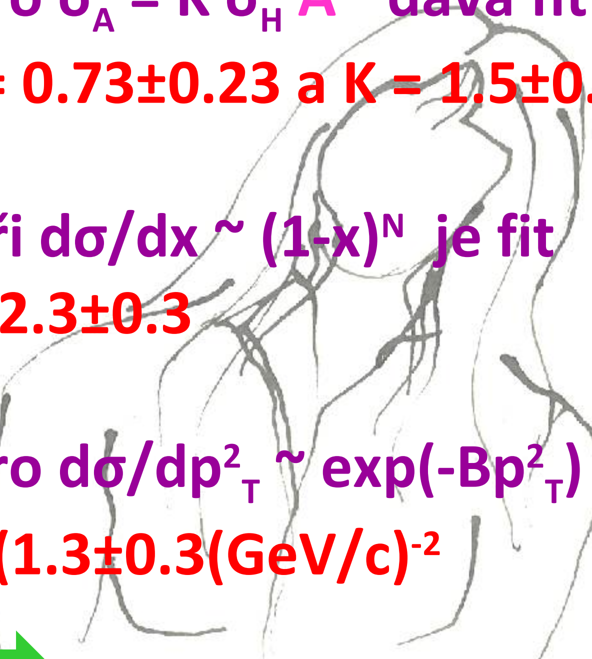
$\alpha = 0.73 \pm 0.23$ a $K = 1.5 \pm 0.8$

Při $d\sigma/dx \sim (1-x)^N$ je fit

$N = 2.3 \pm 0.3$

Pro $d\sigma/dp_T^2 \sim \exp(-Bp_T^2)$ je fit

$B = (1.3 \pm 0.3 (GeV/c)^{-2}$



souhlas s teorií a experimenty

CZECHOSLOVAK JOURNAL OF PHYSICS
Volume 42 · 1992 Number 10 · pp. 953–1048

THE STUDY OF $\overline{D^0} \rightarrow K^+\pi^-\pi^+\pi^-$ IN NEUTRON INTERACTIONS WITH HYDROGEN, CARBON AND ALUMINIUM AT $\sqrt{s} \approx 10$ GeV

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Inkluzivní produkce

hyperonů a antihyperonů

a jejich polarizace - Λ^0 , Ξ^-

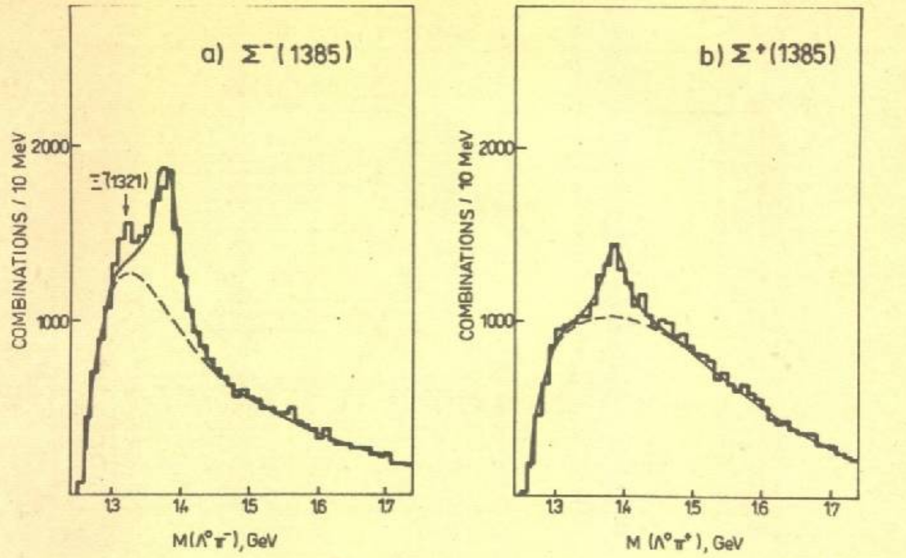

FIG.3

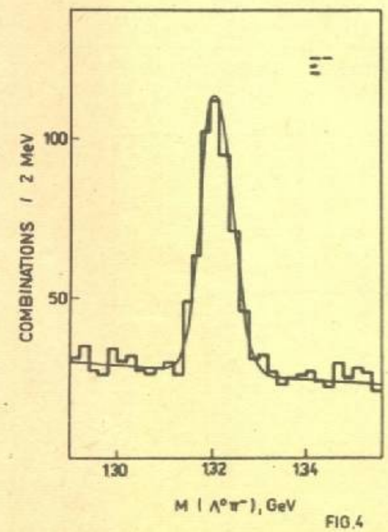

FIG.4

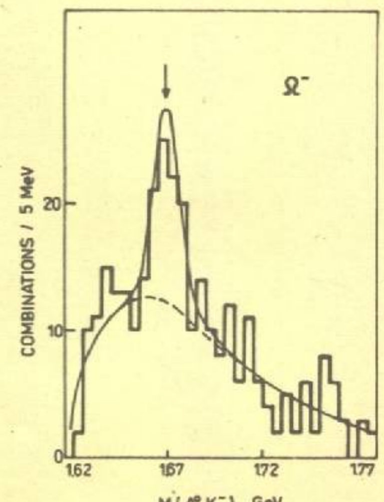

FIG.5

Produkce podivných částic na terčích Al, C, Cu

◊ $\Lambda(1520) \rightarrow \Lambda^0 \pi^+ \pi^-$ $\Gamma \sim 16$ MeV/c^2

souhlas s pp 5,6 GeV a ISR v CERN

♦ $\Phi \rightarrow K^+ K^-$ (Pražská iniciativa + Berlín)

Do objevu J/ψ málo experimentů s $\Phi(s\bar{s})$-strangeonium.
Produkce v np při $E_n = 30 - 70$ GeV na BIS-2:
Pro závislost $\sigma \sim A^{\alpha}$ nalezeno $\alpha = 0.81 \pm 0.06$,
Asociovaná produkce Φ a podivné částice,
Produkce ΦΦ,
Test OZI-rule.
Možnost studia $F(c\bar{s})$ $D_s \rightarrow \Phi\pi$.

$\Phi \rightarrow K^+ K^-$

Při $d\sigma/dx_F \sim (1-x_F)^N$ je fit $N=4.28\pm0.42$

Pro $d\sigma/dp^2_T \sim \exp(-Bp^2_T)$ je fit $B=(3.02\pm0.55)(GeV/c)^{-2}$

$\sigma_t \rightarrow (220\pm85)\mu b$ (jako u pp)

Na jádrech A (C,Al,Cu) závislost $\sim A^\alpha$

$\alpha = 0.81\pm 0.08$,

nezávisle na $x_F > 0.1$ a $p_T < 1$ GeV/c

Produkce mezonu Φ s Λ^0, K^0, K^+, K^-

je v (20±4, 55±17, 33±11, 26±10)%

(pro Φ, kde $p_L > 8$ GeV/c a $p_T < 1$ GeV/c).

Ze dvou posledních čísel se očekává

produkce $\Phi K^+K^- \sim (10 – 20)\%$.

Produkce $\Phi\Phi$ je $(15\pm9)\mu b$.

INCLUSIVE PRODUCTION OF ϕ-MESONS IN NEUTRON-PROTON INTERACTION AT 30—70 GeV/c

BIS-2 Collaboration

A-DEPENDENCE OF INCLUSIVE Φ-MESON PRODUCTION IN NEUTRON-NUCLEUS INTERACTIONS AT 30-70 GeV

BIS-2 Collaboration

ASSOCIATED PRODUCTION OF ϕ-MESONS AND STRANGE PARTICLES AND DOUBLE ϕ-MESON PRODUCTION

BIS-2 Collaboration

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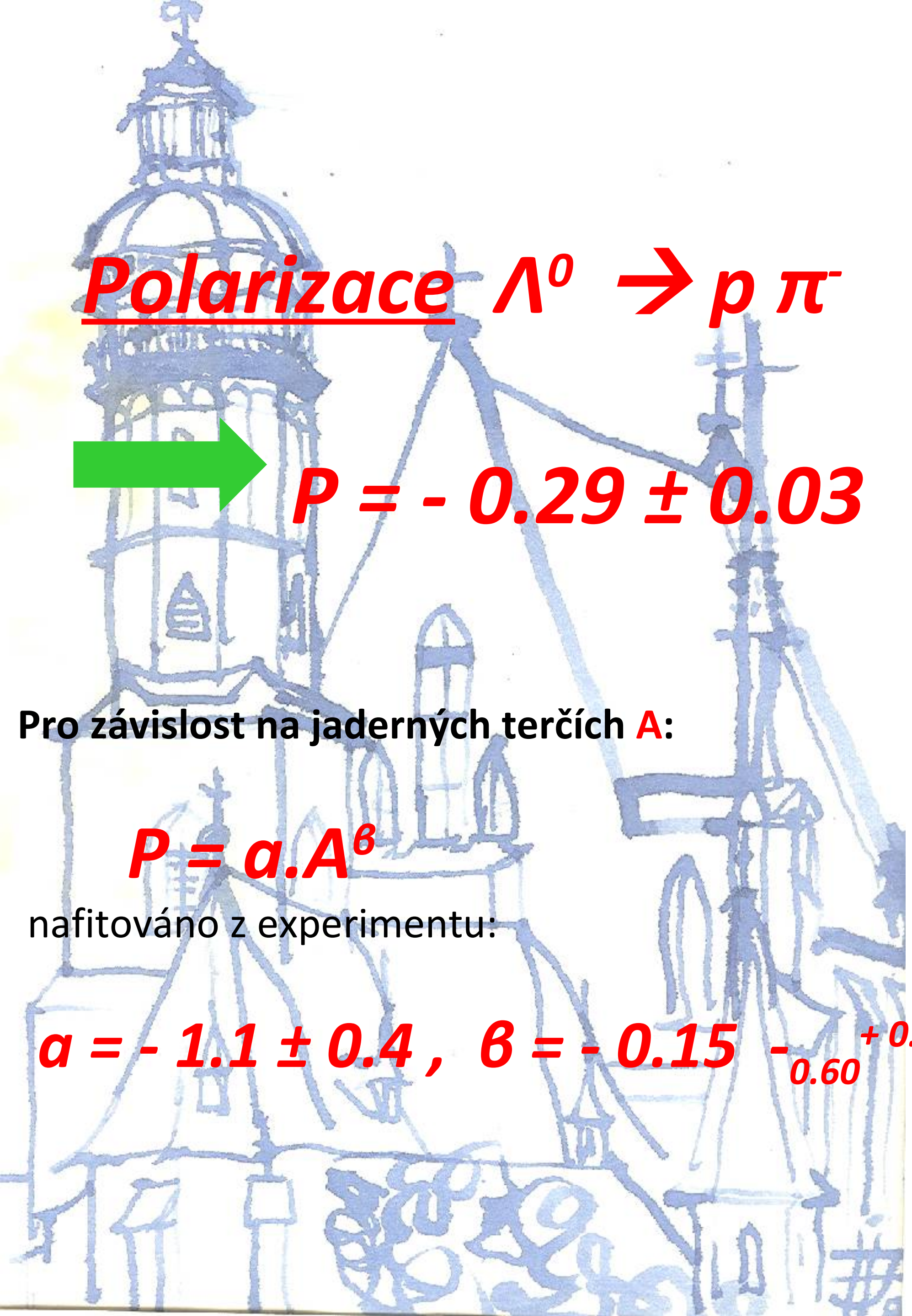

Polarizace $\Lambda^0 \rightarrow p\,\pi^-$

$$P = -\,0.29 \pm 0.03$$

Pro závislost na jaderných terčích A:

$$P = a.A^{\beta}$$

nafitováno z experimentu:

$$a = -\,1.1 \pm 0.4\,, \quad \beta = -\,0.15\,{}^{+\,0.07}_{-\,0.60}$$

Z. Phys. C – Particles and Fields 36, 27–31 (1987)

Zeitschrift für Physik C Particles and Fields

A-Dependence of polarization of Λ^0 produced inclusively in neutron-nucleus interactions

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Abstract. The A-dependence of the polarization of Λ^0's produced inclusively in neutron-nucleus interactions at a mean neutron momentum of about 40 GeV/c has been measured in an experiment performed using the BIS-2 spectrometer at the Serpukhov accelerator. Carbon, Aluminium and Copper targets were used. The Λ^0's were produced in the kinematical region of $0.6 < p_T < 1.3$ GeV/c and $0.2 < x_F < 0.9$. Describing the polarization of the Λ^0's by $\mathcal{P} = a \cdot A$ a value of $(-0.15\ +0.07/-0.60)$ was obtained by a fit to our data.

Polarizace Λ_c^+ :

$P = 0.5 \pm 0.2$

Polarization of Λ_c^+ charmed baryons produced in neutron-carbon interactions

Berlin-Budapest-Varna-Dubna-Moscow-Prague-Sofia-Tbilisi Collaboration BIS-2

Yad. Fiz. 43, 619–623 (March 1986)

The asymmetry in decays of Λ_c^+ produced in neutron-carbon interactions has been measured in an experiment carried out by means of the BIS-2 spectrometer at the Serpukhov 70-GeV proton synchrotron. The averaged transverse momentum of the recorded Λ_c^+ was 0.43 GeV/c. The decays $\Lambda_c^+ \to \bar{K}^0 p \pi^+ \pi^-$ and $\Lambda_c^+ \to \Lambda^0 \pi^+ \pi^+ \pi^-$ were studied. The asymmetries of baryon emission in the decay with respect to the Λ_c^+ production plane are $A(p) = -(0.24 \pm 0.13)$ and $A(\Lambda^0) = 0.30 \pm 0.22$. It follows from this that the minimum absolute polarization of the Λ_c^+ is 0.5 ± 0.2.

The observation and study of the polarization of charmed baryons produced in hadron interactions presents obvious interest. Studies of this type could make clear certain properties of the production of c quarks in hadronic processes and would make possible an advance in study of the nature of the large polarization of inclusively producted Λ^0 and other hyperons by beams of unpolarized hadrons which had been observed in several experiments.[1–13] The polarization of the hyperons increases with increase of the transverse momentum and is practically independent of both the beam energy and the target material. The Λ^0 polarization is due to polarization of the s quark and consequently is directly related to the mechanism of production of strange quarks in hadronic interactions. Qualitative explanations of this effect have been given in a number of models.[4,14–20] Some of them[16,18] predict a dependence of the polarization on the type of quarks produced.

The baryon polarization appears as an asymmetry of the emission of secondary particles as a consequence of the weak decay. The angular distributionof the decay probability $W(\cos\Theta)$ for a decaying baryon with spin $\frac{1}{2}$ will depend on the polarization P as follows:

$$W(\cos\theta) = {}^1/_2(1+\alpha P\cos\theta), \tag{1}$$

where α is the decay asymmetry parameter and θ is the angle between the polarization axis and the decay analyzer, for example, the direction of travel of the secondary baryon in the rest system of the decaying particle.

In this article we report the results of a search for polarization of charmed baryons Λ_c^+ produced inclusively in neutron-carbon interactions. Preliminary results of this study have been reported in Ref. 21. The experiment was carried out in the neutron beam of the Serpukhov 70-GeV proton accelerator by means of the BIS-2 spectrometer.[22] The spectrometer efficiency made possible detection of Λ_c^+ produced by neutrons with momenta in the region 40–70 GeV/c. The Λ_c^+ were recorded by means of the decays

$$\Lambda_c^+ \to \bar{K}^0 p \pi^+ \pi^- \tag{2}$$

and

$$\Lambda_c^+ \to \Lambda^0 \pi^+ \pi^+ \pi^-. \tag{3}$$

These decays were identified as statistically significant peaks in the spectra of the corresponding invariant masses. A detailed description of all experimental conditions and of the selection of events has been given in Refs. 23–26.

Since the process of production of Λ_c^+ is parity-conserving, the Λ_c^+ polarization vector could be perpendicular to the plane of production. Therefore the polarization axis was chosen along the normal to this plane $\mathbf{n} = \mathbf{p}_n \times \mathbf{p}_c / |\mathbf{p}_n \times \mathbf{p}_c|$ where $\mathbf{p}_n$ and $\mathbf{p}_c$ are respectively the momentum vectors of the incident neutron and the Λ_c^+ in the lab. The direction of travel of the emitted particle with momentum p in the Λ_c^+ rest system is characterized by $\cos\theta = \mathbf{pn}/|\mathbf{p}|$. The decay asymmetry is defined as

$$A = \frac{N(\mathrm{up}) - N(\mathrm{down})}{N(\mathrm{up}) + N(\mathrm{down})}, \tag{4}$$

where $N(\mathrm{up})$ and $N(\mathrm{down})$ are respectively the number of Λ_c^+ emitting an analyzed particle upward ($\cos\theta > 0$) and downward ($\cos\theta < 0$). With inclusion of Eq. (1) the asymmetry (4) can be related to the polarization by the equation

$$\alpha P = 2A. \tag{5}$$

In Figs. 1a and b we have shown distributions of events with a proton emitted respectively up and down, as a function of the value of the invariant mass of $\bar{K}^0 p \pi^+ \pi^-$. In both distributions clear signals of Λ_c^+ decays (2) are visible; these appear as narrow peaks at the appropriate mass. The background spectra (dotted curves) were obtained by fitting the given distributions with a polynomial. These spectra in Figs. 1a and b are identical within experimental error. The Λ_c^+ detection efficiency calculated by the Monte Carlo method does not depend on the direction of emission (up or down) of the secondary particles. The results of these calculations

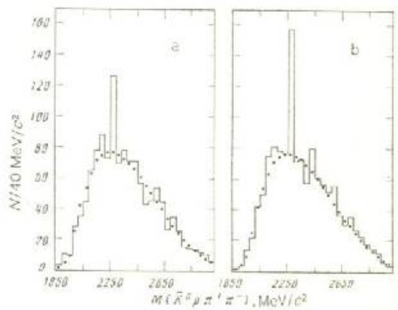

FIG. 1. Invariant-mass spectra of $\bar{K}^0 p \pi^+ \pi^-$ for events with a proton emitted in the up direction (a) and in the down direction (b). The dotted curves show the result of fitting the spectra by the background function.

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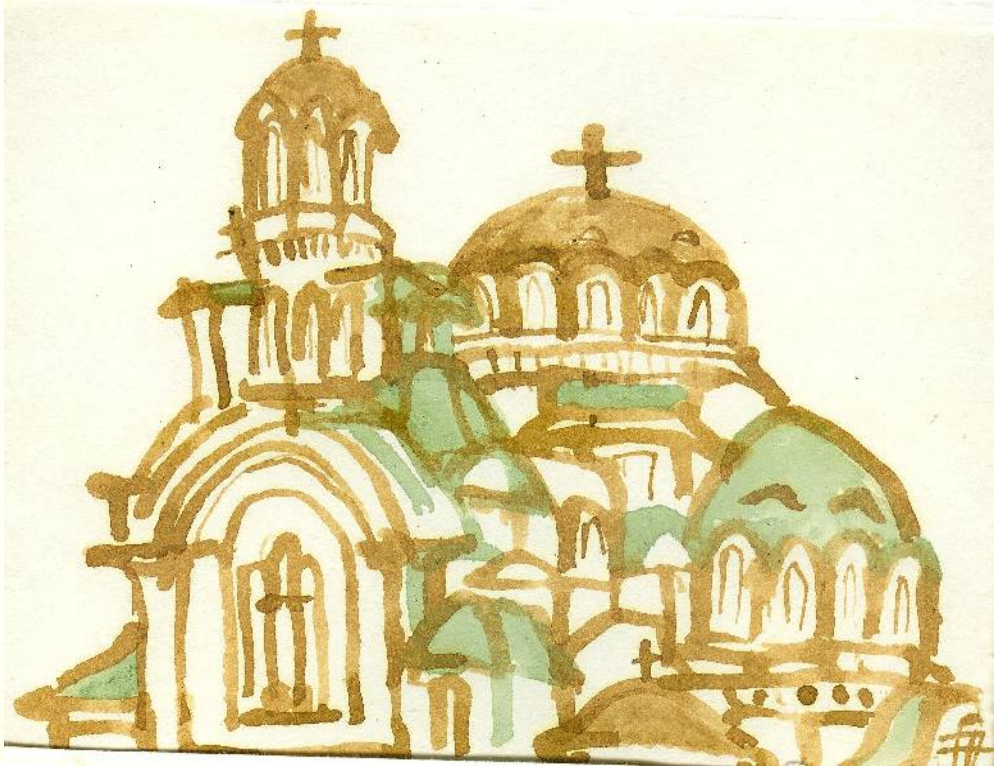

Краткие сообщения ОИЯИ № 19-86 JINR Rapid Communications No.19-86
УДК 539.126.6

ПОЛЯРИЗАЦИЯ Ξ^-, РОЖДЕННЫХ ИНКЛЮЗИВНО НЕЙТРОНАМИ

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Polarizace

$P = -0.3 \pm 0.2$

(záporná, jako Λ^0)

Краткие сообщения ОИЯИ № 19-86 JINR Rapid Communications No.19-86
УДК 539.126

OBSERVATION OF U(3100) IN BIS-2 EXPERIMENTS

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Nové rozpady:

$U^0 \rightarrow \Lambda^0 \bar{p} \pi^+$ a $\Lambda^0 \bar{\Delta}$ (1700)

$U^- \rightarrow \Lambda^0 \bar{p} \pi^-$

$U^+ \rightarrow \bar{K}^0 p \bar{p} \pi^-$

Závislost na jaderných terčích A^α:

$\alpha = 0.6 \pm 0.3$

U^+, U^0, U^- (pozorován na WA62, CERN SPS, svazek Σ^- 135 GeV/c, terč Be).

M=3.1Gev/c^2,

B=0, S=-1, náboj +1,0,-1. **Co to je?4-kvark?**

Jaký je to rozpad? Silný?

Verification highly desirable , PL B(1986)

Baryonium - Antibaryonium

mnohokvarkový stav např. ***s q q q*** ***neb*** ***s q q q***

Hledání baryonia s negativní, pozitivní a neutrální podivností:

úzké rezonance s hmotností okolo 3 GeV

s rozpady na Λ^0/ $\bar{\Lambda}^0$, protony/antiprotony a piony

Nalezeny **úzké rezonance** v kanálech

$\Lambda^0\, \bar{p}\, \pi^\pm$, $\Lambda^0\, \bar{p}\, \pi^+ \pi^\pm$

s kladnou a

$\bar{\Lambda}^0\, p\, \pi^\pm$, $\bar{\Lambda}^0\, p\, \pi^+ \pi^\pm$ se

zápornou podivností,

v kinematické oblasti $x_F \geq 0.2$ a

$p_T \leq 1$ GeV/c.

Rozpadají se na $\Lambda^0/\bar{\Lambda}^0$, protony/antiprotony a piony.

Střední hmotnost M a šířku Γ mají

M = (3035± 25) (MeV/c²) a

Γ ≤ (36±15) (MeV/c²).

Isotopický spin I ≥ 3/2.

→ **Baryonia**

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Zeitschrift für Physik C Particles and Fields

Search for narrow baryonia with negative and positive strangeness

BIS-2 Collaboration

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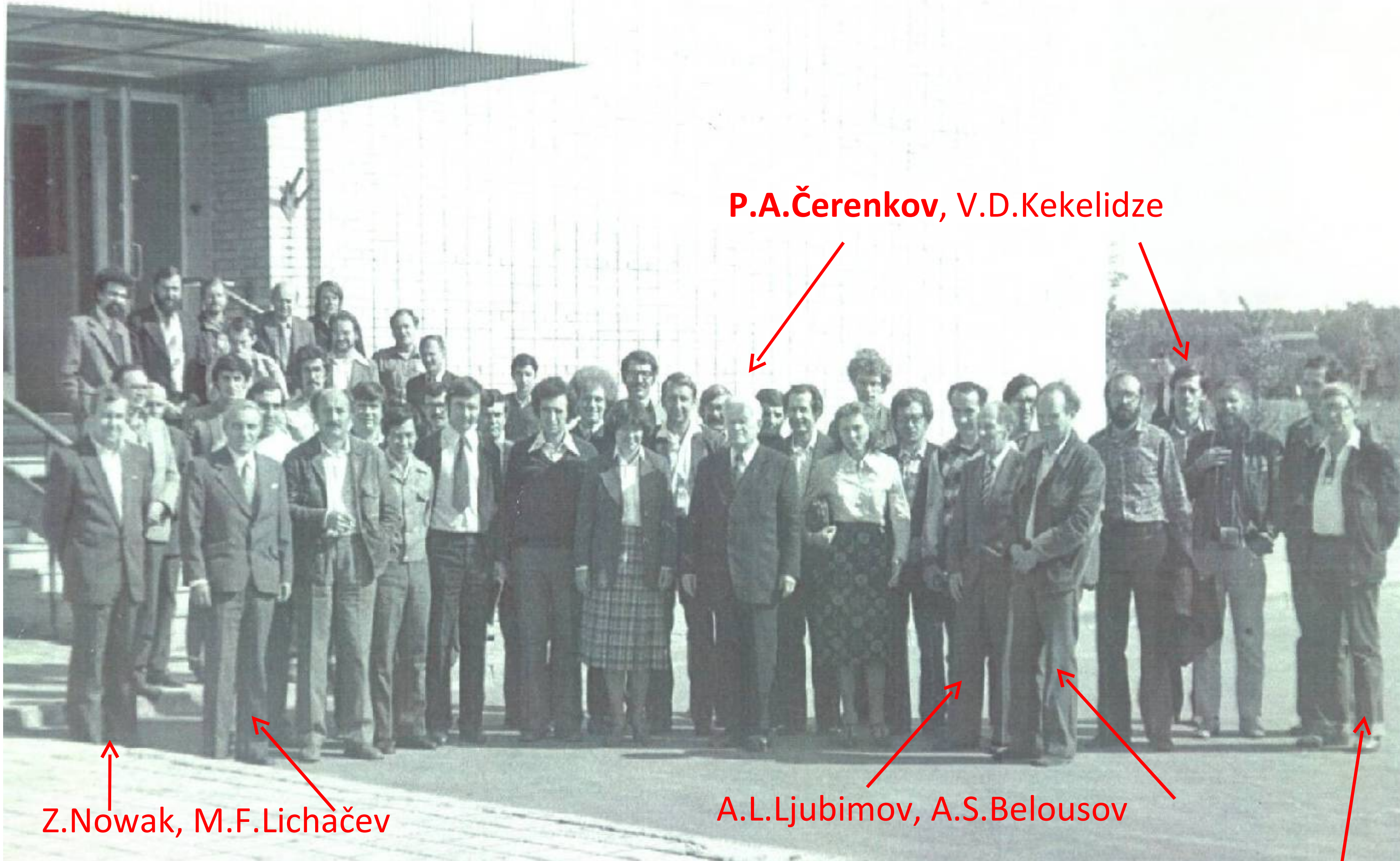
Abstract. A search for baryonia with negative and positive strangeness decaying respectively into $\Lambda + \bar{p}$ + pions and $\bar{\Lambda} + p$ + pions has been carried out in a neutron beam with a mean momentum of ≃ 40 GeV/c in an experiment performed at the Serpukhov accelerator. There is a strong indication of the existence of these baryonia. The following four charge states are observed for negative and positive strangeness: neutral, negative, positive and doubly charged. Their mean mass is 3055 ± 25 MeV/c² and the width $\Gamma \lesssim 36 \pm 15$ MeV/c². The data show that the isotopic spin of the baryonia is ≥ 3/2. The baryonia production cross sections in the acceptable kinematic region $X_F \geq 0.2$ and $P_T \leq 1$ GeV/c times the branching ratios of the observed decays are of the order of 1 μb per nucleon.

The problem of the existence of multiquark states is of great significance for the development of strong interaction theory. However, an experimental search for such states has not yet led to convincing results.

A narrow exotic state, a baryonium with negative strangeness decaying into Λ, $\bar{p}$ and pions, has been observed in the WA-62 experiment carried out in a hyperon beam at the CERN SPS [1]. Unlike the experiment in the hyperon beam, the BIS-2 experiment performed in a neutron beam allowed one to search for baryonia with negative and positive strangeness alike. The existence of a narrow baryonium with negative strangeness was confirmed and the indications of the existence of a new baryonium with positive strangeness and also of doubly charged states of the baryonia were obtained [2]. The latter suggests a multiquark structure



BIS – 2 kolaborace, Krasnaja Pachra-Troick 1988

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Observation and Study of a Narrow State in a $\Sigma^-(1{,}385)K^+$ System

Berlin–Budapest–Dubna–Moscow–Prague–Sofia–Tbilisi Collaboration

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Abstract. New data on the observation and study of a narrow resonance decaying into $\Sigma^-(1{,}385)K^+$ have been obtained. The mass of the resonance is $(1{,}956^{+8}_{-6})$ MeV/c^2, and its width is (27 ± 15) MeV/c^2. The resonance is produced in the diffraction dissociation of neutrons on quasi free nucleons of carbon nuclei. The slope parameter of the differential cross section in P_t^2 is (9.9 ± 3.0) $(\mathrm{GeV}/c)^{-2}$. The cross section times the branching ratio is (0.22 ± 0.04) μb per nucleon. The resonance has one of the natural spin-parities: $5/2^-$, $7/2^+$ and so on.

We have reported [1–4] the observation of an anomalously narrow resonance N_φ decaying into $\Sigma^-(1{,}385)$ and K^+. The small width of the resonance observed indicates its exotic nature. An investigation of the features of this resonance and an additional confirmation of its existence are of obvious interest. The study of the production mechanism and the decay properties of the N_φ could also clarify its nature.

Here we report on new results of a search for and a study of the N_φ produced in neutron-carbon interactions. This investigation is based on the data obtained in a charm search experiment at the Serpukhov accelerator using the forward spectrometer BIS-2. A good mass resolution of the spectrometer allowed a reliable registration of known hyperon decays [5] including

$$\Sigma^-(1{,}385) \to \Lambda^0\pi^- \tag{1}$$

N_ϕ

1984

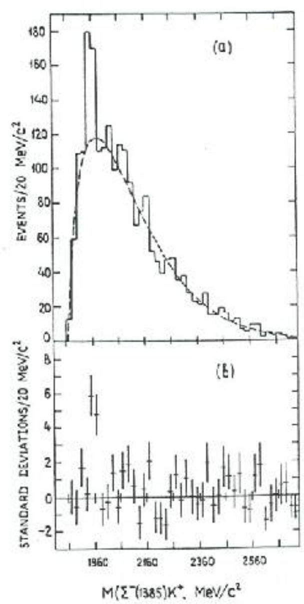


Fig. 5. **a** The $\Sigma^-(1{,}385)K^+$ invariant mass spectrum for the events selected providing $P_t^2 < 0.24$ $(\mathrm{GeV}/c)^2$ (histogram) and the result of fitting to this spectrum by a smooth background function (curve).

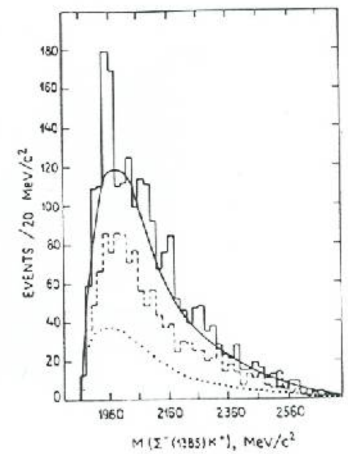


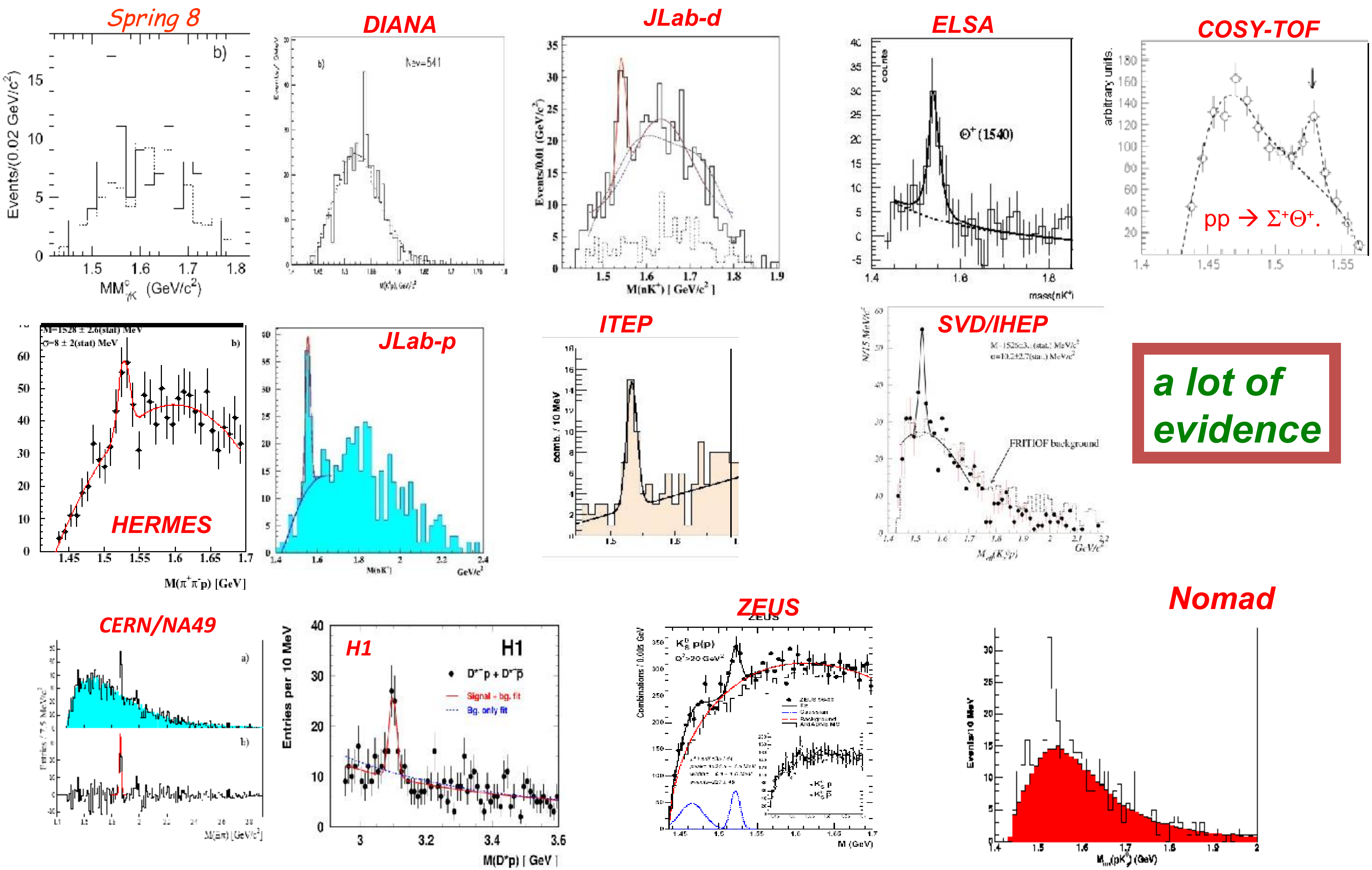
Fig. 6. The $(\Sigma^-(1{,}385)K^+)$ invariant mass spectrum for the events investigated (solid-line histogram) and for the events, where additional charged particles are detected (dashed histogram). Dotted curve correspond to the calculated mass spectra for the processes of diffraction dissociation. Solid curve is the resulting background spectrum

accepted $\Sigma^-(1{,}385)K^+$ invariant mass spectrum re-

Pentakvark ?

Móda přišla opět:
1997 Diakonov->2003 CERN Ξπ, 2003 LEPS-Osaka □$^+$,
2003 a 2005 CEBAF (CLAS) □$^+$ $\bar{K}^0$, HERA-H1 D^*p,
Zeus a HERMES □$^+$, atd.

From January 2003 (from T. Nakano)



a lot of evidence

Varna 1983 BIS – 2 a Ludmila kolaborace

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DIFFRACTIVE DISSOCIATION REACTION $np \to \Lambda^0 K^0 p$ FOR INCIDENT NEUTRON MOMENTA BETWEEN 30 AND 70 GeV/c

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Test Deck-modelu (výměna K)

Fitováno: $d\sigma/dt=\exp(A+Bt)$, kde $B=11.4\pm3.3$ (GeV/c)$^{-2}$

Zjištěno:

- závislost B na hmotnosti systému Λ^0K^0
- rozdělení t prudce stoupá k malým |t|
- difrakční minimum spojené s nízkou hmotností systému Λ^0K^0
- v difrakční systém Λ^0K^0 se rozpadá s Λ^0 produkovaném ve směru svazku

Vyhovuje Deck modelu s výměnou K

Srovnáván souhlas s jinými experimenty

Návrh experimentu (únor 1979):

Měření přímých párů $e^+ e^-$ nízkých hmotností

$m(\pi^0) < m(e^+ e^-) < m(\omega)$

na BIS-2.

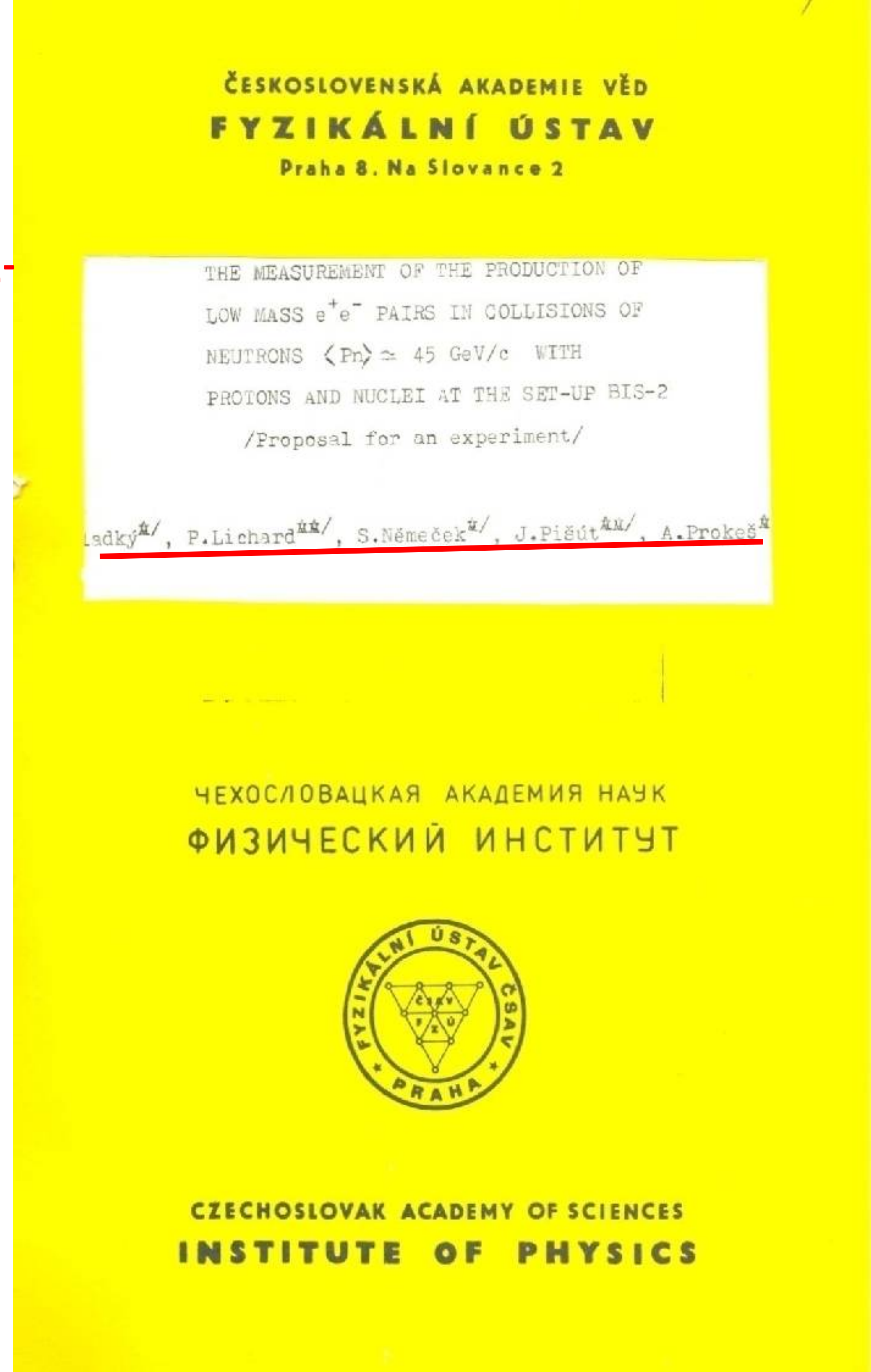
Elmg. kalorimetr Pb sklo

$\Delta m/m \sim 10\%$

Test modelů:

Drell-Yan,

Bratislava, atd.



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THE MEASUREMENT OF THE PRODUCTION OF LOW MASS e^+e^- PAIRS IN COLLISIONS OF NEUTRONS $\langle P_n \rangle \simeq 45$ GeV/c WITH PROTONS AND NUCLEI AT THE SET-UP BIS-2

/Proposal for an experiment/

...adký[x], P.Lichard[xx], S.Němeček[x], J.Pišút[xx], A.Prokeš[x]

ЧЕХОСЛОВАЦКАЯ АКАДЕМИЯ НАУК
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Konec našeho půvabu v 90. létech