PH I/COM-73/10
5th March 1973

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PS/vss

M E M O R A N D U M

To/A : Members of the EEC

From/De : P. Sonderegger, Omega Coordinator

Subject/Objet : Present Situation and Future Prospects of Omega

The object of this Note is to summarize the satisfactory performance of Omega so far, and to stress the difficulties which will arise from the reduced beam time, and the absence of parasitic testing time.

Time has still to be allocated to the six approved experiments. Also, regarding the future experiments under discussion, a quick decision on the Ξ^* experiment is required.

1. Preceding EEC/NPRC Decisions.

In March 1971, the EEC recommended, and the NPRC approved, 6 experiments (see list in the Table below) to be completed during the first year of Omega operation, once the spectrometer would be fully operative. No time allocation was given. It was assumed

a) that 10 - 15 days of data taking per experiment would yield statistics superior to the best bubble chamber experiments by usually one order of magnitude, and in two instances (pion induced channels of the forward proton and forward Λ experiments) even three orders of magnitude; and would also saturate the available computing power;

b) implicitly, that a successful experiment would have a chance of performing another production run on Omega, later on;

c) implicitly, that roughly half of the PS time for physics would be available for production at Omega, i.e. some 100 days yearly; and

d) explicitly, that parasitic beam would be regularly available during the remaining PS time; this in order to assimilate the frequent modifications in the apparatus and layout made necessary by the fast alternation of experiments, so that each production period could be faced with fully operative equipment.

2. Omega Progress Report.

Omega started operation on June 8th, 1972, a few days later than foreseen in the December 1969 schedule, but with one coil only. 1972 was therefore considered as a test period. In all, there were 30 days of beam in 1972, ending on October 31st. 4 experiments (S112, S113, S114, S115) were installed and tested. Trigger rates were found to be generally much higher than expected, partly because of the low magnetic field. Also, the dead time of the spark chamber and readout system was still rather high: 25 msec. Nevertheless, 10^6 triggers could be recorded during the last ten days in October, mostly for the four main installed experiments, but also for some tests in view of another approved and four unapproved experiments, as shown in the Table.

Table: Status of Experiments and Tests

Experiment	Triggers (Oct. 1972)	Status of Analysis, Feb. 1973 (SCANning, Pattern Recognition, GEOMetry, KINematics)	Remarks
1. Approved Experiments, installed in 1972			
S112: B-RHEL-TA-W Slow Neutron	270,000	PR, GEOM, KIN	η, ρ, f, ω, A_2 seen. Neutral particle trigger is delicate! Background should improve in 1973. Level of HBC experiment reached.
S113: B-B-C-D-L-M Slow Proton	290,000	PR, GEOM, KIN	η, ρ, ω, A_2 seen, 4-C and 1-C channels well identified. Stat. level of average HBC expt. reached.
S114: C-E-F-K-S Fast Lambda	230,000	PR, GEOM	10,000 Λ's (well above HBC level; polarization).
S115: Glasgow-Saclay Antibaryons	120,000	PR, GEOM	620 $\bar{\Lambda}$'s; $\bar{\Lambda}pn\pi^+$, ϕ in $K^-K^+K^+p$ seen. Statistics as HBC experiment.
2. Approved Experiments, not yet installed			
S116: CERN-ETH K^{*o}			MWPC 1 under test.
S117: C-CdF-EP-O Fast Proton			MWPC 3 tested, High-Pressure Cerenkov is being assembled.
3. Tests			
S117 Ferrer	20,000	PR, GEOM	Fast K^+, p.
Ξ^* ICL	30,000	SCAN, PR	Promising; K^+ laborious in 1972 geometry.
$\pi\pi$ Makowski	10,000	PR, GEOM, KIN	10 ev/μb from 1 h data taking (aim: $\pi\pi$ scattering lengths).
e Treille	5,000	SCAN	Clean electron tracks (relevant for SPS electron physics)
K^+ Turnbull interaction trigger	25,000	PR, GEOM	Promising. 1 ev/μb in few hours data taking, better resolution (with 1 coil!) than HBC.

Most of these events have been analysed since, at least up to the geometry level. The full processing time is slightly below 1 sec 6600 CPU/event. Some of the first, very preliminary outcome is shown in the attached figures, mostly in order to document the reasonable accuracy reached with one coil and the imperfect status of the Plumbicon calibration and software; the good performance of the Cerenkov counter; and the absence of unexpected physics results at this level of statistics (typically 5% of the wanted data).

Also, after the October run, the second coil has been installed and successfully tested. The first two spark chamber modules surrounding the target have been replaced by frameless Orsay chambers with plates parallel to the beam.

At least three of the first four experiments should be ready to go in final production by April 1973. The two not yet installed experiments S116 and S117 will do partial tests for this summer, and should be ready for production before the end of 1973.

3. New Experiments for Omega

The potentialities of Omega are by no means exhausted by the six experiments under way. The four additional experiments proposed in 1970/71, as well as some new ideas, round up a vigorous physics programme limited only by the available machine time. We list hereafter proposals, letters of intent, as well as ideas which have not yet materialized in a proposal, under three headings: A new trigger (K^+ detector for Ξ*'s); Extensions of the approved experiments; a Polarized Target for use with some of the installed trigger systems. Most of the proposals of the latter two groups are expected to be submitted not before the end of this year, when the performances of the basic trigger systems will be better known.

a) Ξ* Spectroscopy using a K^+ Detector (Imperial College, PH I/COM-71/2 and 73/2).

One of the five planned K^+ detectors was built and tested at RHEL, and installed at CERN at the beginning of October 1972, with a non-standard on-line computer. In ~ 12 hours of beam time granted to the group during the October run, the counter was made to work and produced useful data - in itself a remarkable achievement. Results are reported on March 5th, 1973. Some details of the full-scale installation, which is not entirely compatible with the present Omega layout, remain to be discussed. In any case, in two PS periods not before spring 1974, the group hopes to do considerably better than the very high statistics bubble chamber experiments under way. The long range perspective is essential: one or two further orders of magnitude can be gained a few years later using the RF separated beam.

b) Extensions of approved trigger systems..

A list of suggested new experiments using the approved trigger schemes follows:

Experiment	Group or Spokesman	Trigger used	Reference
Strange Bosons, by Λ recoil trigger	B-B-C-D-G-L(-M)	Modification of slow proton trigger	PH I/COM-73/8 (and 70/64)
Double Charge Exchange	(Sonderegger)	Fast proton trigger	(PH I/COM-70/65) Still of interest also for back-wards $\pi^- \pi^+$ scattering
$\pi\pi$ Scattering Lengths	(Lemoigne-Makowski)	Fast Λ trigger + 1st Multiplicity Chamber (K^{*o} Trigger)	PH I/COM-73/13
(Quasi-)Two Body Reactions at large Momentum Transfer	(Michelini)	Probably extension of of fast proton trigger	-
K^+p Interaction Trigger	(Hughes-Turnbull)	Beam Veto Counter	PH I/COM-73/11 (Letter of Intent)

c) Polarised Target

A separate paper summarizes the potentialities of a frozen spin polarized target in Omega (PH I/COM-73/12 ; see also the Proposal on Helicity Amplitudes in Hypercharge exchange reactions, PH I/COM-71-7; and the Letter of Intent on $\pi p\uparrow \rightarrow \pi\pi n$, PH I/COM-73/9). A wide field of new results using the standard triggers would be expected.

Concerning the time scale, the polarized target should be installed in Omega during the January 1975 shutdown, and would then be used more or less continously, until the West Hall shutdown.

4. Beam Time for Approved Experiments and for New Proposals

The beam time situation is less favourable now than originally foreseen in two respects:

a) There appears to be no possibility of parasiting during East Hall periods (unless one is willing to interrupt the East Hall operation). This is a serious blow to Omega productivity. Without the ability to check the new equipment needed by new production experiments while it is being mounted, even during short 2 - 3 day periods and under poor spill conditions, there is a clear risk of losing more than the corresponding time during production periods.

b) The standard "West Hall" PS period for 1973 is:

PS MD	17 + 1/3 x 10 + 32 + 39 h	= 91 1/3 h
ISR	16 + 16 + 20 + 1/3 x (7 x 6)	= 66 h
PS SU	12 + 12	= 24 h
[PS PHYS 1st part (Omega)	= 205 + 2/3 (7 x 6 + 10)	= 239 2/3 h ≅ 10 days]
[PS PHYS 2nd part (Omega or GGM-ν)		= 158 h ≅ 6.5 days]
	total	579 h

Assuming that Gargamelle will have 5 weeks yearly (during which no slow ejection is possible), and that Omega gets 50% of the 10.6 yearly periods, Omega would have 2.8 x 16.5 + 2.5 x 10 = 71 days of beam per year.

This means 142 days for Omega in 1973/74, plus 30 - 70 days in 1975, depending on the exact date of the West Hall shutdown (~ July 1975), and on the possibility of using most of the available periods between February and July 1975, leaving the rest of the year to the East Hall.

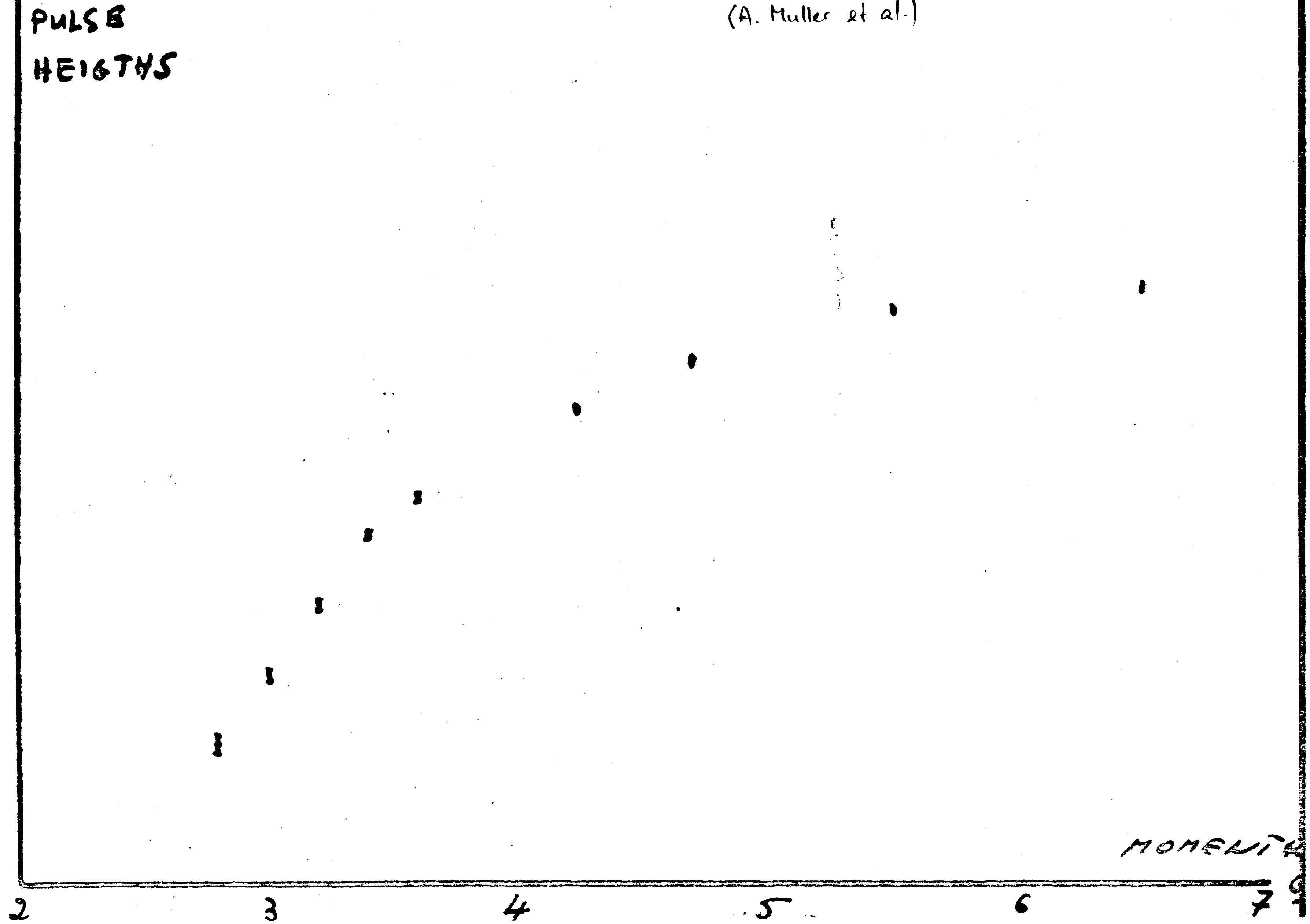
If under these conditions production were to be completed within one year, then, considering that 2 - 3 days of each period are needed for routine checks, calibrations, and tests for forthcoming experiments, a maximum of 9 - 10 days of production could be granted to each experiment.

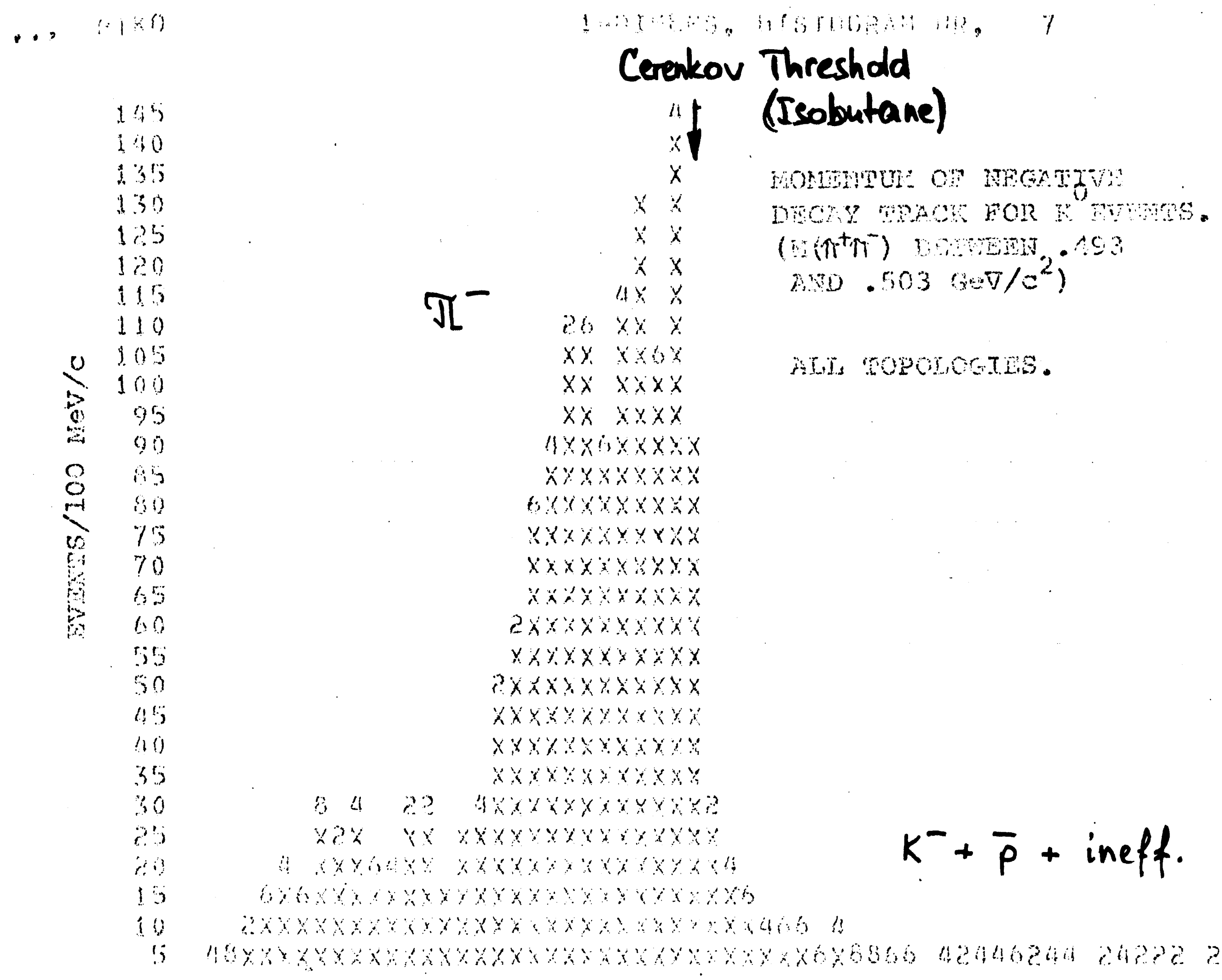
This is clearly not enough; each experiment would need another similar period before the West Hall shutdown, and almost no time would be left for new initiatives.

If, on the other hand, we assume that each approved experiment is granted 15 days for production; that 8 days are needed for running in the two-coil spectrometer with the new spark chamber geometry; and that the routine checks and tests take 2 days per period, then the approved programme would require some 114 days in 1973/74, leaving two periods in 1974 and the 2 - 5 periods expected for 1975 as a reserve and for new initiatives. The six first experiments would have to leave the floor, and would not have their next opportunity before 1976/77 with the RF beam from the SPS. Even so, not more than half of the second generation programme outlined in Section 3 could possibly be encouraged.

Fig 1. Čerenkov Performance

(A. Muller et al.)






```
CHANNELS
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        0   0        1         2         3         4         5
        0   1234567890123456789012345678901234567890123456789012345678

CONTENTS
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       10   0001112221122122457800813049211000000000000000000000000000
        1   2463739178766557668766820320673708374433021223122012111010
       0.   0000000000000000000000000000000000000000000000000000000000
        0   0000000000000000000000000000000000000000000000000000000000

LOW EDGE
        1   0000000000111111111122222222223333333333444444444455555555
       0.   0123456789012345678901234567890123456789012345678901234567
        0   0000000000000000000000000000000000000000000000000000000000
        0   0000000000000000000000000000000000000000000000000000000000
        0   0000000000000000000000000000000000000000000000000000000000

   1565   ENTRIES      ALL CHANNELS      1565.00      UNDERFLOW

      MEAN VALUE =      2.151     STANDARD DEV =      .814      SKEW
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Fig. 2: Cerenkov Performance

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IRY DST(SPI) FORMAT F2

BL5 HGR  19          '+19        ' M(PI- X0)          DC 2 PR

XLOC  116
TEST   36

 BITS BINS  CAP.  LOST    NX    DELX    XLOW     XMEAN     XR
   10    6  1023  8296    45     .04      0.    1.4101   .381

  315                                              6     5
  306                                              X     6
  297                                              X     7
  288                                            8 X     8
  279                                            X X     9
  270                                            X8X     0
  261                                           8XXX     1
  252                                          XXXXX     2
  243                                          XXXXX     3
  234                                          XXXXX     4
  225                                          XXXXX     5
  216                                 1        XXXXX     6
  207                                 X       9XXXXX     7
  198                                 X       XXXXXX     8
  189                                 X9      XXXXXX     9
  180                                 XX8     XXXXXX     0
  171                                 XXX    XXXXXXX     1
  162                                 XXX   XXXXXXXX     2
  153                                 XXX   XXXXXXXX     3
  144                                9XXX 12XXXXXXXX     4
  135   9                            XXXX XXXXXXXXXX     5
  126   X                            XXXX3XXXXXXXXXX     6
  117   X                            XXXXXXXXXXXXXXX     7
  108   X                           9XXXXXXXXXXXXXXX     8
   99   X                           XXXXXXXXXXXXXXXX     9
   90   X                          7XXXXXXXXXXXXXXXX     0
   81   X                         7XXXXXXXXXXXXXXXXX     1
   72   X                         XXXXXXXXXXXXXXXXXX     2
   63   X                         XXXXXXXXXXXXXXXXXX     3
   54   X                         XXXXXXXXXXXXXXXXXX     4
   45   X                        4XXXXXXXXXXXXXXXXXXX    5
   36   X                       1XXXXXXXXXXXXXXXXXXXX    6
   27   X                       XXXXXXXXXXXXXXXXXXXXX    7
   18   X                     27XXXXXXXXXXXXXXXXXXXXX    8
    9   X14846332773211234X2+4XXXXXXXXXXXXXXXXXXXXXXX    9

CON-    1                            1121111111222223
TENT    3                     11244780408723367055861
        414745332563211234 92+41580587738880672162968 1

BIN              1         2         3         4
NOS     123456789012345678901234567890123456789012345

LOW                              11111111111111111111
BIN    .
EDGE    000112223344455666773839900011222334445566677
        048260482604326048260482604826048260482604826
```

A₂+B

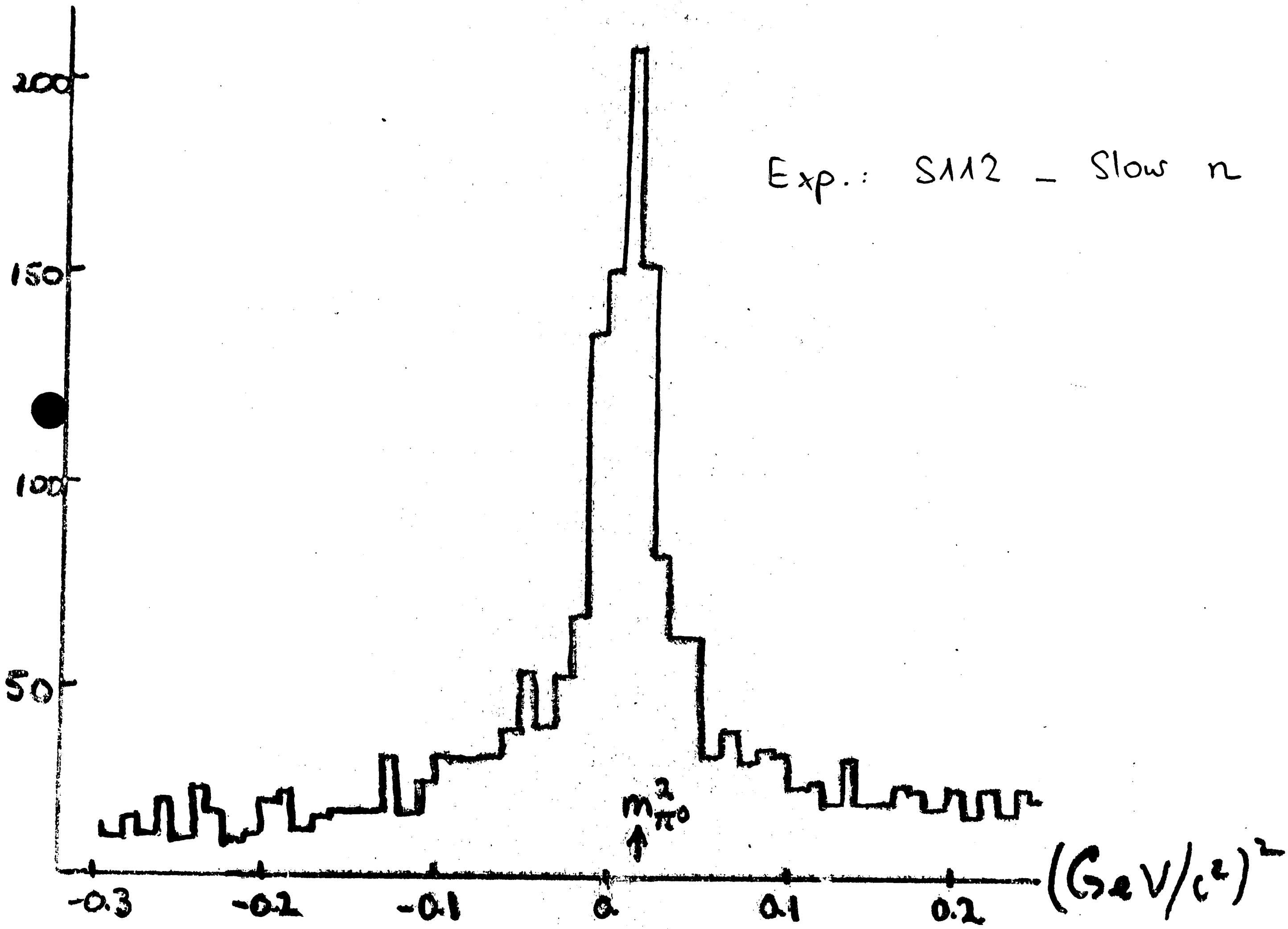
A₂ ↓

Exp: S113 (Slow p)

$\pi^- p \rightarrow p \pi^- X^0$

$M(\pi^- X^0)$

Fig. 3: $\pi^- p \rightarrow p A_2 (\rightarrow \rho^- \pi^0)$



MM^2 to $n\pi^+\pi^-$, 4C events excluded.

MM^2 to each $n\pi$ combinatión > 0

Fig. 4 : π^0 Squared Missing Mass.

... REF1 M_φ ↓ 1-DIMENS. HISTOGRAM NR. 7 IDENT

Exp.: S115 (ANTIBARYONS)

K+ K- EFFECTIVE MASS.

3 PRONG AND 4 PRONG EVENTS.

1 COMBINATION/EVENT.
(TAKING THE HIGHEST MOMENTUM +ve)

MOMENTUM OF NEGATIVE TRACK > 3.0 GeV/c

EVENTS / 10 MeV/c^2

```
297    1
288    X
279    X
270    X
261    X
252    X
243    X
234    X
225    X
216    X
207    X
198    X
189    X
180    X
171    X
162    X
153    X
144    X
135    X
126    X5
117    XX
108    XX
 99    XX
 90   7XX
 81   XXX
 72   XXX3
 63   XXXX
 54   XXXX176XX3     7
 45   XXXXXXXXXX25742X 3 6    2
 36  2XXXXXXXXXXXXXXXXX8X X25  X  37 1
 27  XXXXXXXXXXXXXXXXXXXX5XXXX5XX XX1X5536 33
 18  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX4XX433 78 74 2 633     3 1
  9  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX7XX7XX7XXXXXX8X8X86X7

CHANNELS
  0  0         1         2         3         4         5         6
  0  1234567890123456789012345678901234567890123456789012345678901234

CONTENTS
100  0021000000000000000000000000000000000000000000000000000000000000
 10  2882645555434443533242322321331222212211101101101011100010010
  1  989266214488130825932927387804983314311322767763719524989828607
 0.  0000000000000000000000000000000000000000000000000000000000000000
  0  0000000000000000000000000000000000000000000000000000000000000000

LOW EDGE
  1  0111111111111111111111111111111111111111111111111111111111111111
 0.  9000000000011111111112222222222333333333344444444445555555555666
  0  9012345678901234567890123456789012345678901234567890123456789012
  0  5555555555555555555555555555555555555555555555555555555555555555
  0  0000000000000000000000000000000000000000000000000000000000000000

2190 ENTRIES     ALL CHANNELS     2032.00     UNDERFLOW     9.00

   MEAN VALUE =     1.185     STANDARD DEV =     .171     SKEWNESS
```

Fig. 5 : $K^+ p \rightarrow K^- K^+ K^+ p$

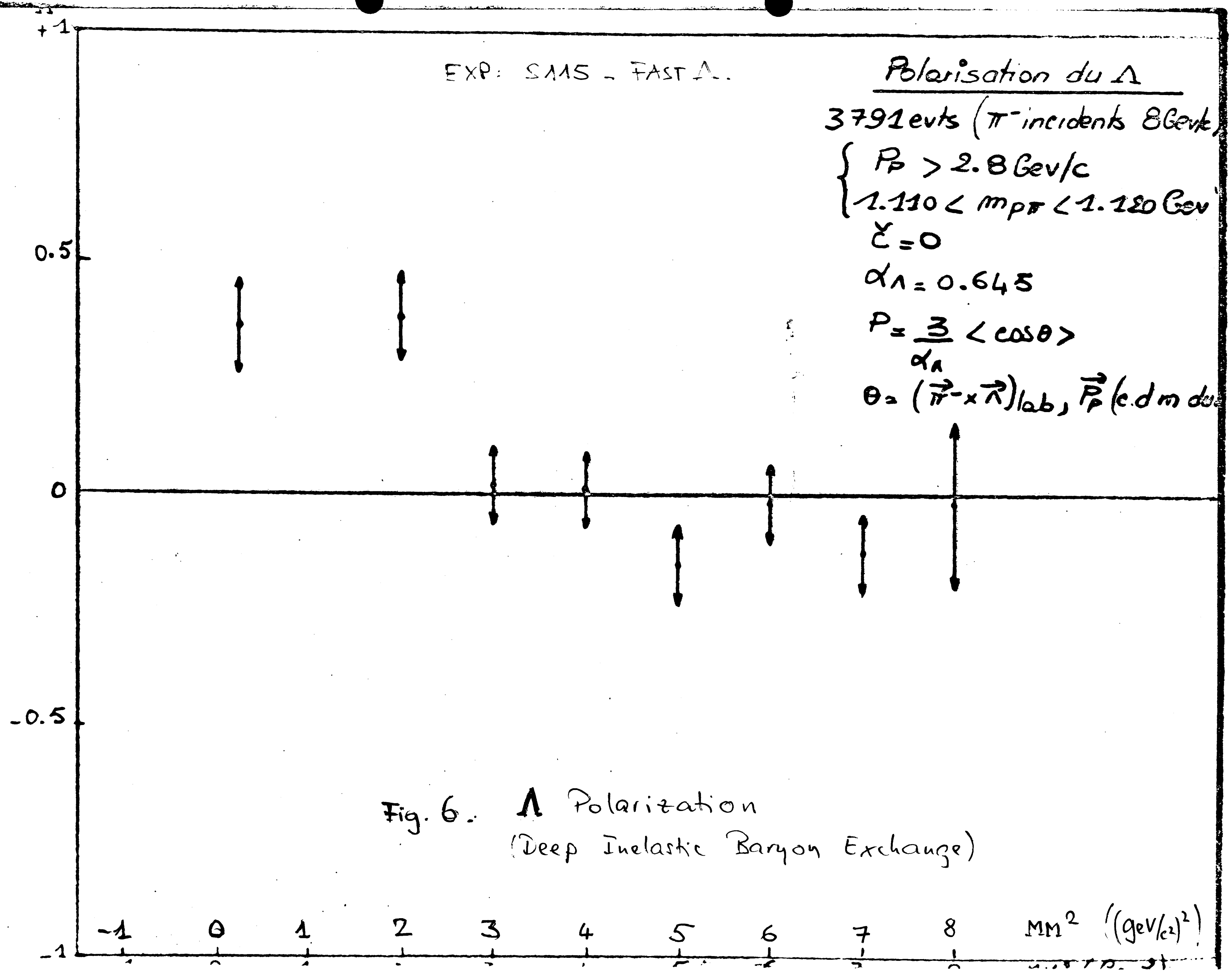


Fig. 6. Λ Polarization
(Deep Inelastic Baryon Exchange)