COMMISSARIAT A L'ÉNERGIE ATOMIQUE

DIRECTION DE LA PHYSIQUE

DEPARTEMENT DE PHYSIQUE
DES PARTICULES ELEMENTAIRES

CEN - SACLAY
B. P. N° 2 - 91190 GIF-SUR-YVETTE
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SACLAY, LE OCTOBER 24, 1973.

PH I/COM-73/56

To : The members of the EEC

From : J.Bystricky et al (Proposal PH I/COM-73/44)

Subject : Complements of information on proposal 73/44.

Following the discussion at the open session of Oct. 8, and at the request of the EEC (PH I/COM-73/52, closed session, paragraph 1) we submit complementary information on the following subjects :

1) Role of the cut-off on high momentum spectator protons.

2) Background from baryon resonance production.

3) Additional information on the apparatus.

4) Programme of construction.

5) Programme of tests prior to installation.

6) Erratum.

1) Role of the cut-off on high momentum spectator protons.

The recognition of high energy spectator protons plays an important role :

a) in reducing the effects of double scattering and of final state interaction in the deuteron, and

b) in separating deuteron events from background events on heavier nuclei.

a) The momenta of all final particles (π^+, π^- and p) are measured and the momentum of the target nucleon can be determined from a one constraint fit assuming that no undetected particle has been produced (see below). It is possible, therefore, to introduce a cut-off on the target momentum in the data analysis. This cut-off is chosen a posteriori; its sharpness which depends on the precision of the angle and momentum measurements is not critical in a polarization experiment, only its reproductibility in successive runs is of importance.

b) In order to use the wings of the angular distribution of recoil protons from Carbon and Oxygen as a polarization independent monitor it is important to set a limit on the tails of the distribution from deuterons. This is achieved by anticoincidence counters vetoing the trigger signal whenever a spectator proton of more than about 300 MeV/c is emitted. The expected effect of cutting the distribution from deuterons has been calculated and will be checked by runs with a deuterium target.

2) <u>Background from baryon resonance production.</u>

We are investigating the expected background contribution from $\Delta(1236)$ production $K^+d \rightarrow K^o\Delta^+(p_s)$. For $\Delta^+ \rightarrow n\pi^+$ decay, the correlation between K^o and π^+ is weak and only a small fraction of π^+ will simulate a recoil proton from charge exchange $K^+d \rightarrow K^\circ p(p_s)$. The probability of $\Delta^+ \rightarrow p\pi^\circ$ decay is twice as large, and the correlation between K° and p is stronger. However, this reaction is vetoed by the converter-scintillator sandwiches detecting γ-rays. We are calculating the overall efficiency for detecting at least one of the two photons which is required in order to reduce this background to an acceptable level. This calculation will be extended to include also the continuous spectrum of (π,N) masses known from Dalitz plots measured for $K^+d \rightarrow K^\circ n\pi^+(p_s)$ and $K^+d \rightarrow K^\circ p\pi^\circ(p_s)$.

3) Additional information on the apparatus.

Characteristics of the required beam are given in the proposal, page 14 and Annex III.

Target : Deuteron polarization of 40% can be achieved only at very low temperature. The CERN polarized target group is considering the use of a dilution cryostat similar to the one being built for the CERN frozen spin target. We do not intend to make use of the long relaxation times since the target will be in fixed position in a constant field of 2.5 T. The magnet is of the type PT 7 (drawing CERN-MSC 302942) with 30 cm diameter pole tips sufficient for a target of 10 cm length.

Detection of incident particles : (page 7). Three threshold gaz Cerenkov counters of CERN standard design with 2 m length are used to identify K mesons. One of the counters is sensitive to pions and kaons ; the other two are sensitive to pions only and produce veto signals independently of each other to achieve a sufficient overall efficiency for detecting pions ($1 - 10^{-3}$). Direction and position of the incident track is given by two MWPC (code 1 and 2). A third MWPC downstream from the target (code 2') is required in order to accept events where two or three incident tracks are recorded within the resolving time. Should this type of detector prouve to be inadequat at the required high beam rates, classical but more expensive scintillation hodoscopes with 5 mm (Code 1) and 3 mm (code 2 and 2') resolution will be used. The CERN polarized target group is investigating the use of a solid state detector as a beam defining counter immediately upstream from the polarized target. This method would overcome the difficulty encountered with scintillators at low temperatures.

Detection of the K° : (page 9). The forward spectrometer will use the magnet presently installed in the Ke_4 experiment at CERN. The field integral of this magnet is 0.75 T x m for a gap of 50 cm. Details about the MWPC (code 6,7,8 and 9) are given in Table 1.

Detection of recoil protons : (page 7). The proposal describes the two types of detectors that may be used. Our choice is to use MWPC (code 3, 3',4,4',5 and 5') because of the lower cost, and because of the advantage of the improved spatial resolution when recording elastic scatterings on free protons : these elastic scatterings are used as a monitor for target polarization and for comparison polarization measured on free and on bound protons (page 11).

Anticoincidence counters : (page 13). Scintillator-convertor sandwiches intercept any photon emitted from the target, except for a beam entrance hole and for the aperture of the forward spectrometer. For most of the solid angle the converters present a total of 3 radiation lengths in 3 layers. A single converter followed by a MWPC behind the last chamber of the forward spectrometer detects forward emitted γ-rays. Forward emitted charged particles are vetoed by a scintillator 10 cm from the center of the target. A scintillator downstream from the target, on one side of the beam, completes the detection of high momentum spectator protons.

Electronics : The fast circuitry associated with scintillation counters is composed of 100 MHz logic modules identical to the ones used at present in the Ke_4 experiment at CERN. The MWPC working at high counting rates will be equipped with circuits of less than 100 ns dead time. The rest of the MWPC requires circuits of lesser performance : either MOS integrated circuits presently developped at LETI, or equivalent bipolar circuits will be used. For data acquisition a PDP 11-45 with a 32k memory of 16 bit words is used, the interface being of CAMAC standard. The system consists of two magnetic tape units, one CRT display unit and one teletype.

4) Programme of construction at Saclay.

Design of the six large chambers (code 5,5',7,8,9 and 9') follows closely the concepts used for similar chambers built for the Ke4 experiment at CERN. The construction period is from March to October 1974. The four smaller chambers (code 3,3',4 and 4') inside the magnet are of special design, construction will proceed in parallel with that of the large chambers, from May to September 1974. Decisions concerning the design of the four chambers exposed to the full beam rate (code 1,2,2' and 6) will be taken after test of an experimental chamber at Saturne.

Construction of the scintillation counters will take place between May and September 1974.

The fast electronics associated with the scintillation counters will be available in April 1974.

The decision concerning the circuits for the MWPC will be taken at the end of 1973. Construction will start in January 1974 and a first part will be completed by September 1974 for testing individual chambers.

Part of the interface already exists, construction of the remaining part will start in December 1973. The design is the same as that for an other experiment being prepared at Saclay, using MWPC of similar size connected to the same type of computer.

5) Programme of tests prior to installation.

Counting rate limitations in MWPC will be studied at Saturne beginning December 1973.

The scintillators and the MWPC built for this experiment will be tested individually at Saturne between September and December 1974. (Tests of similar chambers build for an other experiment are scheduled to start in February 1974).

Should there be a long interval between the end of our tests at Saclay and the installation in the beam at CERN, it could be interesting to consider using test facilities available in the South Hall of the PS. Major assemblies, for instance the forward spectrometer including the magnet, could be set up for tuning.

6) Erratum to proposal PH I/COM-73/44.

In the paragraphe "PLANNING", 6^{th} line,

instead of : "... suivies de 2,5 semaines de prises de données à la plus haute énergie..."

read : "... suivies de 2,5 semaines de prises de données à 6 GeV/c et de 5 semaines à la plus haute énergie accessible en K^+ (autour de 12 GeV/c)."

Enclosures :

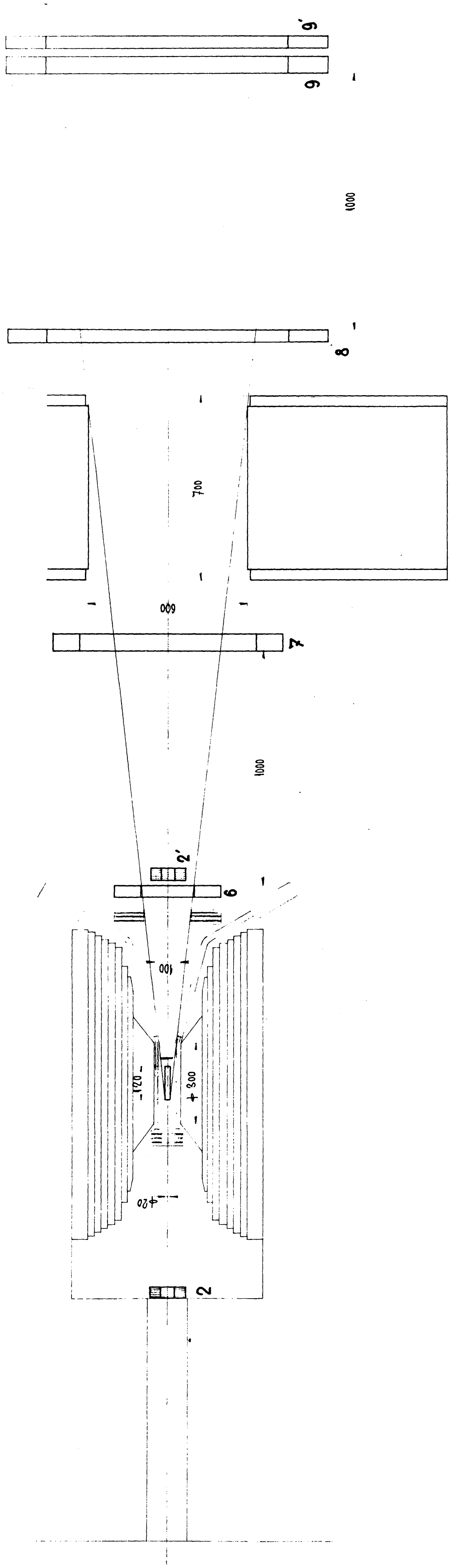
- Lay-out of apparatus.
- Schedule for construction and tests at Saclay.
- Schematic view of MWPC code 5,5' and 7.
- ~~Drawing of an existing MWPC of same type as 5,5',7,8,9 and 9'~~.

MWPC FOR $K^+ n \uparrow$ CEX

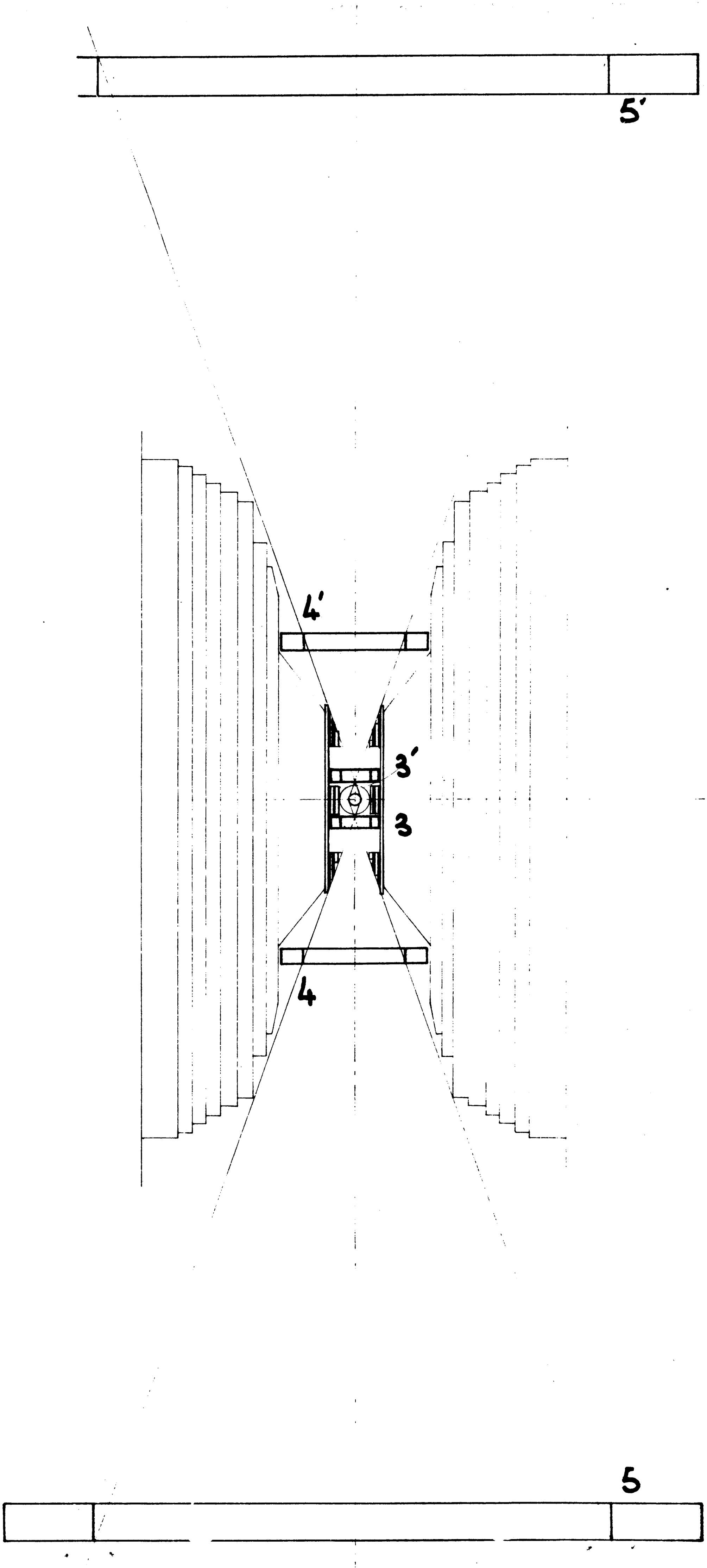
(Entrefer 60 cm)

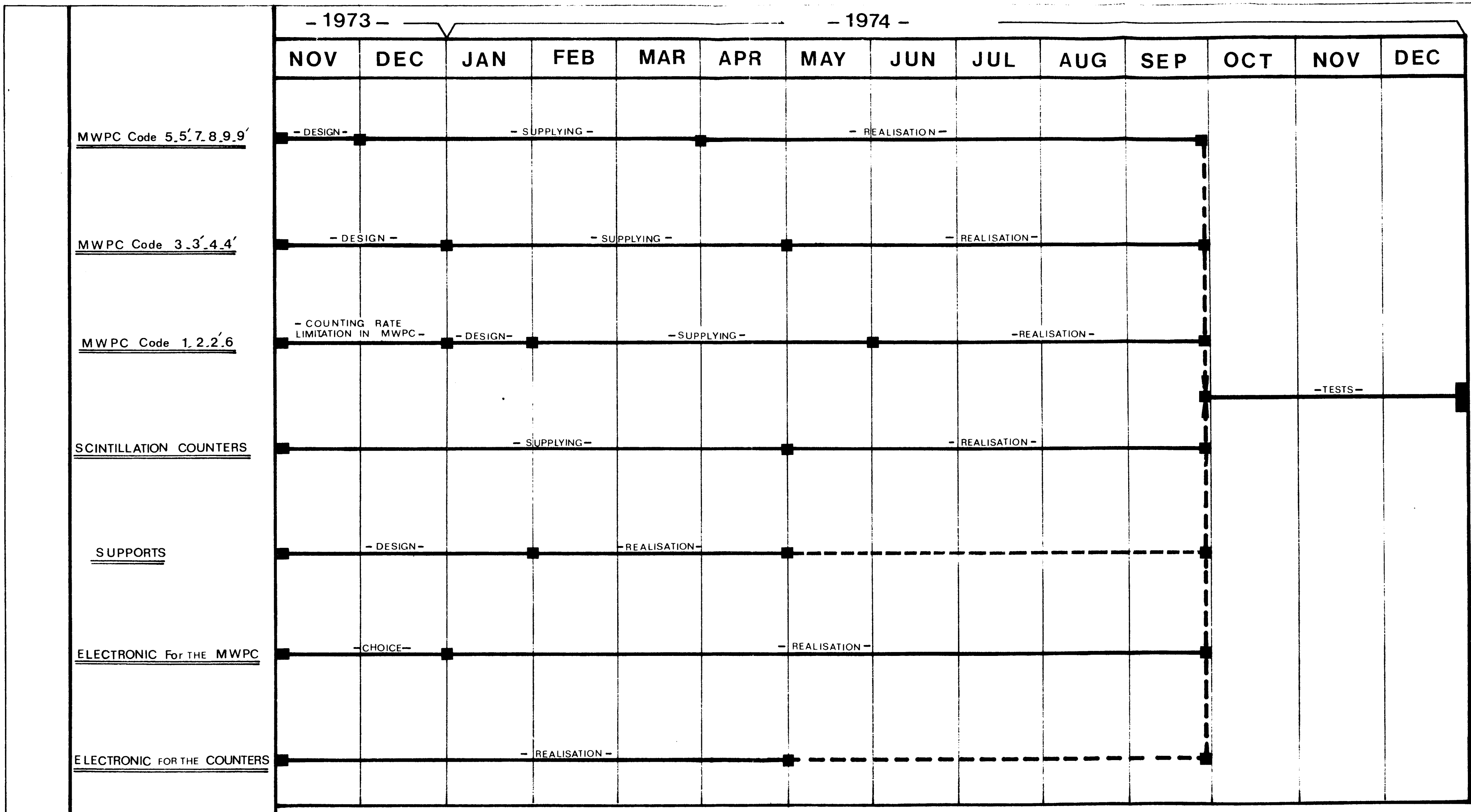
Code	Nombre	Dim. cm^2 Ho Ve	Esp^t fils mm	Nb de nappes (0° = Ve)
1	1	20 x 10	2	2 (0°,90°)
2,2'	2	5 x 5	0,5	1 (0°,90°)
3,3'	2	18,5 x 5,5	1	1 (0°)
4,4'	2	42 x 17	1	1 (0°)
5,5'	2	150 x 88	2	3 (0°,75°,90°)
6	1	46 x 20	2	2 (0°,90°)
7	1	150 x 88	2	3 (0°,75°,90°)
8,9'	2	223 x 91	2	2 (0°,90°)
9	1	223 x 91	2	3 (0°,75°,90°)

TABLEAU 1



9'
9
1000
8
700
600
7
1000
2'
6
100
120
φ300
φ20
2


5'
4'
3'
3
4
5



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COMMISSARIAT A L'ENERGIE ATOMIQUE

$K^+n^\uparrow$ CEX

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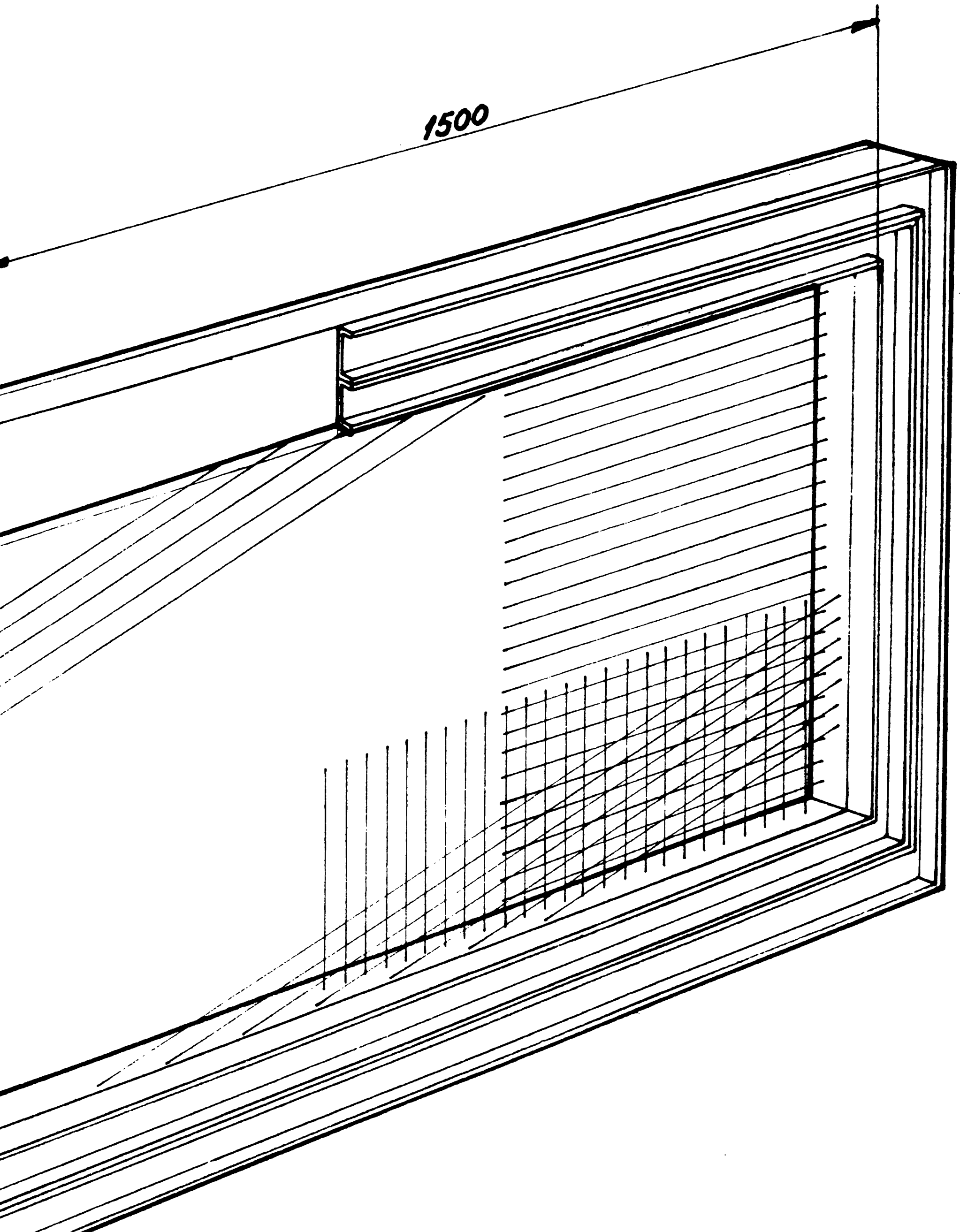

MWPC code 5-5' and 7

$K^+n^\uparrow$ CEX