

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Date: 9 January 1962

M e m o r a n d u m

To : The Members of the Nuclear Physics Research Committee.
 From : G. Salvini.
 Subject : The programme for counter experiments at the PS machine during the period 1-5-1962 to 1-10-1962.

The list of counter experiments proposed at the PS for which machine time is asked during the period 1-5-1962 to 1-10-1962 (Period II) is attached to this memorandum.

Considering previous decisions by the NRC and the Directorate, the situation with regard to the counter experimental programme for Period II presents itself as follows.

I. Beams available for the proposed counter experiments

According to decisions taken in the NRC meeting of 29-11-1961, the following beams will be available for counter experiments during Period II:

1. d_9 , a 10-20 GeV/c π beam in the South Hall (SH);
2. a_2 , a high intensity 1-2 GeV/c π -K beam in the North Hall (NH), which will replace the present K beam a_1 ;
3. q_2 , a test beam in the SH from target 1.

According to a decision by the Directorate, the following beam will be available as from 16 January 1962:

4. q_1 , a 1-1.5 GeV/c π beam in the S.H.

In addition, the following beams can be available during Period II:

5. c_3 , a 25 GeV/c proton beam with an intensity of 10^7 p/burst in the SH;
6. Probably a 0° neutral beam from target 1. This beam is required for experiment S_{15} , the charge exchange scattering.

II. Machine time available

According to present information (Hyams) experiments in beams d_9 , q_1 , and c_3 could run in parallel whenever target 1 (which is the machine target from which these beams originate) can be operated with a long burst. In addition, a_2 could be run in parallel with at least some of these three beams if the machine intensity can be shared between target 1 and target 6.

Period II consists of 13 weeks of machine operation and 9 weeks of shut-down.

Of the 13 weeks machine operation, only 4 weeks are available for counter experiments. This number is arrived at as follows:

- 4 weeks in Period II for track chambers;
- 1 week in Period II for track chambers to make up for 1 week of machine time in Period I that the TC will make available for beam survey (N_4);
- 1 week in Period II for emulsion experiments;
- 3 weeks reserve, corresponding to one week per month
- 9 weeks in Period II not for counters.

This leaves 4 weeks for counter experiments or 60 shifts.

If 10 of the 60 shifts are given to the neutrino group for background tests (Directorate decision), this leaves:

50 shifts in each of the beams d_9 , a_2 , q_1 , and c_3 available in Period II for counter experiments, supposing these beams can be run all in parallel.

According to NERC decisions there are, for Period II, two firm commitments:

- i) 15 shifts in a_2 beam for S_7 (Argonne) as main user;
- ii) 15 shifts in a_2 beam to set up the a_2 beam as parallel user.

From the foregoing it follows that there remain to be allocated at most (if complete parallel running is possible):

20	shifts in a_2)	
50	" "	" d_9	} of which a total of 35 shifts as main user.
50	" "	" q_1	
50	" "	" c_3	
		or neutral beam	

III. Conclusions

Considering the list of proposed experiments, and assuming again that complete parallel running is possible, the following conclusions can be drawn.

1. The experiments proposed in beam c_3 (K_4 and S_8) can probably both be finished in Period II.
2. Experiment S_{15} in the neutral beam may be allocated 10 shifts for preliminary tests, for which a C-CH₂ target is not needed.
3. Experiment S_6 in the q_1 beam can be scheduled up to a maximum of 50 shifts in Period II if there are no limitations on parallel running.
4. In beam a_2 , apart from the firm commitments, at most 20 shifts in total will be available for the experiments S_7 , S_{11} , and L_2-S_{13} , of which S_7 and L_2-S_{13} have already started in Period I.
5. A total of 140 shifts is asked for in beam d_9 , all by experiments that will not start before Period II. As only 50 shifts at most are available, and as it would be inefficient to divide up this number among too many experiments, some experiments proposed in d_9 cannot be scheduled during Period II.

From the point of view of available machine time, decisions are therefore mainly required with regard to the use of beams a_2 and d_9 .

The following remarks can be made on the experiments proposed in these beams.

Beam a_2

- S_7 : Measurement of Σ -A parity by the Argonne group. A total of at least 60 shifts is needed to finish the experiment, of which at most 25 can be allocated in Period I. The balance of 35 shifts should be allocated as early as possible, because this group can stay only for a limited period.
- S_{11} : Annihilation of p - \bar{p} into a positron-electron pair. It would be of great advantage to the group if at least 15 shifts could be allocated early, if possible in Period I, to get an estimate of the cross-section of the process. The beam a_2 is satisfactory for this measurement.
- L_2-S_{13} : Strange particle physics. These experiments are part of a long-range programme which, the group feels, should not again be interrupted completely during half a year.

Beam d₂

- S₁ : π -p elastic scattering at 12 and 18 GeV.
- and
- S₂ : Peripheral processes $\pi + N \rightarrow 2\pi$ or $2K$. These experiments use essentially the same equipment and, at least partly, the same people are involved. To finish only one of these experiments in Period II, 30-35 shifts are needed.

- C₅ : π -p diffraction scattering. Proposed by the same group that proposed S₃ and S₁₅. As these last two experiments can be more easily scheduled in Period II, the group is prepared to postpone experiment C₅.

- S₄₋₅ : Peripheral photon production. It is not yet definitely known whether this experiment, after the first preliminary measurements, will turn out to be feasible.

- S₉ : Test of special relativity. No special remarks.

- S₁₄ : μ -p scattering. The request is for 10 shifts to test equipment. This test run can be made simultaneously with experiment S₁ by using the transmitted π beam, and therefore no machine time is needed for S₁₄ if machine time is allocated to S₁.

* * *

LIST OF PROPOSED EXPERIMENTS REQUIRING MACHINE
TIME IN PERIOD II (1-5-62 to 1-10-62)

A. Experiments requiring a high-energy external proton beam with an intensity of about 10^7 p/burst (c_3)

These experiments are all compatible with the c_3 (Berne) beam, but require one set of quadrupoles and one or two bending magnets in the South Hall.

<u>Symbol</u>	<u>Name</u>	<u>Title</u>	<u>No. of shifts required in Period II</u>
K ₄	Goebel	Al ²⁷ -Na ²⁴ cross-section	3
S ₈	Taylor	Deuteron production in p-p collision, in particular $p + p \rightarrow d + \pi^+$	20

Remarks

- K₄ : 25 GeV/c proton beam of 10^7 p/burst is required. Main problems are the monitoring and possible neutron contamination (therefore bending magnet in South Hall needed).
- S₈ : 25 GeV/c proton beam of 3×10^7 p/burst is required. At least 20 shifts are required, or which 10 shifts are needed for a preliminary experiment. Apparatus will be ready on 1 February 1962.

B. Experiments requiring a π -meson beam of an energy between 10 and 18 GeV/c (d_9)

Beam d_9 will probably be installed around 1 April 1962.

<u>Symbol</u>	<u>Name</u>	<u>Title</u>	<u>No. of shifts required in Period II</u>
S ₁	Jones	Elastic π -p scattering	20 - 35
S ₂	Caldwell	Peripheral processes $\pi + N \begin{cases} \rightarrow 2\pi \\ \rightarrow 2K \end{cases}$	25 - 30
C ₅	Taylor	π -p diffraction scattering	~ 30

<u>Symbol</u>	<u>Name</u>	<u>Title</u>	<u>No. of shifts required in period II</u>
S _{4,5}	(Zavattini (Hyams	Peripheral photon production	~20
S ₉	von Dardel	Relation between momentum and velocity for relativistic π mesons) 10-20)
S ₁₄	Citron	p - p scattering	10

Remarks

S₁) : Beam requirements: 12 GeV/c π^- 3×10^4 /burst 12 GeV/c π^+ 10^4 /burst
S₂) : 18 GeV/c π^- 3×10^4 /burst.

In these experiments the same spark chambers will be used. The change from S₁ to S₂ therefore only requires modification of the triggering system and takes little time.

The number of shifts required depends on whether a minimum or an optimum programme is adopted.

Apparatus can be ready on 1 March 1962.

C₅ : 12 GeV/c π^- at 10^6 /burst is required. This experiment is complementary to S₁ in providing data on elastic π - p scattering at the smaller scattering angles. Equipment is essentially ready.

S_{4,5} : 8 GeV/c π^+ at 3×10^4 /burst is required. It is not certain that the d9 beam is suitable for this experiment. This problem is being studied. The experiment will start in the d8 beam, as decided by the NPRC on 2.11.1961.

S₉ : 10-15 GeV/c π beam is required of 10^5 π /burst.

S₁₄ : The 10 shifts in this beam are required for testing equipment. For beam tests a 4-5 GeV/c π^- beam of 10^5 /bursts is required for another 10 shifts (see below).

C. Experiments requiring a 1-2 GeV/c π^- or K-meson beam of high intensity (a_1 or a_2)

These experiments require the present a_1 beam, set up by the Lundby-Argonne groups, or the new beam of higher intensity, a_2 , which may be installed in May.

Symbol	Name	Title	No. of shifts required in Period II
A ₂	Lundby	Setting up of a new K beam of higher intensity (a_2)	15
S ₁₃ -L ₂	Lundby	Further search for new particles	15
L ₅	Roberts	K ⁺ leptonic decays	15 + 45 par.
S ₁₁	Conversi	\bar{p} -p annihilation to electron pair	> 30
S ₁₂	Conforto	Test of $\Delta S = \Delta Q$ rule	< 40
S ₇	Roberts	Σ -A parity	30 + 45 par.

Remarks

- A₂ : For this project new magnets are needed which will be available before the end of February. The installation can only take place during a fairly long shut-down of the machine.
- S₁₃ : This experiment requires essentially the same apparatus as the L₂ experiment and could be done immediately after L₂.
- L₅ : See S₇ below.
- S₁₁ and S₁₂ : After discussion with the Directors, the authors are prepared to consider only S₁₁ for Period II. A number of 15 shifts is needed as early as possible to obtain an estimate of the cross-section.
- S₇ : It is the intention to do this experiment in preference to L₅. Some time was allocated already at the NRC meeting of 29-11-61.

D. Other Experiments

<u>Symbol</u>	<u>Name</u>	<u>Title</u>	<u>No. of shifts required in period II</u>
S ₆	Cork	$\Sigma - \Lambda$ parity	30 + 60 par.
N _{3,5}	Faissner	Neutrino	15
S ₁₄	Citron	μ -p scattering	10
S ₁₅	Wetherell	Charge exchange scattering	10

Remarks

S₆ : This experiment needs a special beam Q1, which will be built at Christmas 1961.

N_{3,5} : 15 shifts are needed for background measurements.

S₁₄ : A beam of 4-5 GeV/c π^- at 10⁵/burst is needed (see Section B) for beam tests closely approximating the future experimental conditions for the PS muon channel. It is not yet clear how a beam of this kind could be made available.

S₁₅ : For this experiment a 0⁰ neutral beam from target 1 is needed.

* * *