CERN/SPSC/77-40
SPSC/M 78
April 7, 1977

Ref.: EP/CR/sm

M E M O R A N D U M

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From/De : NA4 Collaboration

Subject/: Objet : Expected muon fluxes during the fi year of operation of NA4

We understand that the SPSC has solicited our expectations in terms of running time for the first year of operation of NA4. We have been also told that these do not represent commitments from the SPSC, since the schedule of the machine is not yet defined beyond the end of September 77.

We anticipate to run primarily at the highest energies and with a carbon target. Data on deep inelastic and multimuon events will be collected simultaneously with a unique trigger signature.

The intensities of particles are taken from the report CERN/SPSC/74-12 by R. Clifft and N. Doble and from the NA2 original proposal, Table C.2.1, page 129. From these papers we can readout the following figures:

E_{μ^+}	280 GeV
$E_{\pi^+,\ K^+}$	300 GeV
Beam yields	
(a) from π^+	10^{-5}/interacting p.
(b) from K^+	3.5×10^{-6}/interacting p.
Berillium target efficiency	1/3
Muon yield/incident p	4.67×10^{-6}

Assuming 5×10^{12} incoming protons on the target, we get 2.34×10^{7} μ^+/pulse. The μ^- flux is 4.78×10^{-6} μ^-/pulse.

Note that at the peak of the flux, i.e. E_μ = 120 GeV, we expect as many as 5.18×10^{8} μ^+/pulse. At the cycle rate given in the original CERN/1050 document (4.77 seconds) this would give 14.5×10^{3} pulses/day with 80% efficiency.

It is more reasonable however to take a 9.2 sec. cycle time, again with 80% efficiency, giving 7.5×10^3 pulses/day. The total number of muons which we can hope to collect in one day of running at 280 GeV is then 1.76×10^{11}.

We remark that the FNAL accelerator, which currently operates at 2×10^{13} ppp and 6 sec. cycle time gives 11.5×10^3 pulses/day, again at 80% efficiency. According to R. Johnson, with 1.5×10^{13} particles incident on target they have recently measured $\sim 10^7$ μ^+ at 275 GeV, corresponding to 1.15×10^{11} μ^+/day. To all practical purposes the daily outputs of CERN and FNAL beams at least at high energies look entirely similar. A further serious drawback of the CERN beam is the incompatibility between NA2 and NA4 which would demand an additional split up of the resources. We could therefore expect realistically to receive no more than one half of the beam that the direct competitor at FNAL (E225) will receive during a given period of running. It is clear that our only chance to give significant contribution relies almost entirely on the strength and ingenuity of the apparatus and most important, the support of the Laboratory.

The luminosity integrated over one day for the machine conditions above mentioned is

$$L = 1.76 \times 10^{11} \times 6.06 \times 10^{23} \times 2.0 \times 5000 = 1.06 \times 10^{39} \text{ cm}^{-2} \text{ day}^{-1} \text{ nucleon}^{-1}$$

For 280 GeV, negative beam we have $L = 2.17 \times 10^{38}$ and for 200 GeV positive beam, $L = 10^{40}$ cm^{-2} day^{-1} nucleon^{-1}.

The actual counting rates can be easily estimated from fig. 4 of document CERN/SPSC/74-79, August 1, 1974 and Table 2 of CERN/SPSC/77-12, February 17, 1977, already in your files.

We would like to remark that although it is clear that a reasonable fraction of the SPS protons can lead to a highly significant exploration of the domain of large q^2-phenomena in deep inelastic scattering and a search for eventual new phenomena, our experiment remains one of the most "proton hungry" devices on the SPS floor.