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EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

14 November, 1966

To : Members of the Electronic Experiments Committee

From : B.D. Hyams, W. Koch, E. Lorenz, G. Lütjens, D. Pellett, D. Potter, U. Stierlin, L. von Lindern, P. Weilhammer (CERN - Munich)

Re : EXPERIMENTAL PROPOSAL

We request machine time for our proposal of 18 November, 1964, to measure φ - production by 11 GeV/c π^- in the reaction

$$\pi^- + p \to n + \varphi \quad (\varphi \to K^+K^-) \qquad (1)$$

and

$$\pi^- + p \to n + K^+ + K^- \qquad (2)$$

Noting is known so far about reaction (1) at high energies because its cross section is small and it is difficult to observe it in bubble chambers. At incident momenta around 1 GeV/c the cross section of (1) is about 1/150 of that for

$$\pi^- + p \to n + \omega \qquad (3)$$

There is theoretical interest in reactions (1) and (3) because their comparison provides a test of the quark model and a value for the $\omega - \varphi$ mixing angle[1]. As the spin alignment of the φ can be measured, the results may test peripheral model predictions as well. Also the threshold enhancements in the $K\bar{K}$ system as reported by various authors[2] could be studied. Furthermore, togather with our 2μ data the experiment could yield the branching ratio

$$\frac{\varphi \to \mu^+\mu^-}{\varphi \to K^+K^-} \qquad (5)$$

The experimental set-up would be essentially that used in experiment S42 ($\rho^0 \to 2\mu$) with a large gas Čerenkov counter ($1.8 \times 1.8 \times 3\ m^3$) set behind the last spark chamber. Scintillation counter arrays in front and behind the Čerenkov trigger on 2 charged particles, lead shielded anticounters surrounding the acceptance region help to suppress multiparticle background. The Čerenkov in anticoincidence cuts out pions down to a momentum of 3.2 GeV/c. With these conditions one triggers on K-pairs and low energy 2π events. This trigger background is easily rejected either at scanning or in the analysis. High energy pion background due to Čerenkov inefficiency is probably negligible and can be corrected for once the Cerenkov is calibrated. In the φ region the angular acceptance of the apparatus is 90% , the mass resolution 2 MeV.

To estimate the number of φ's produced in reaction (1) we assume its cross section to be 1/150 of the corresponding ω cross section (2) at 11 GeV/c, i.e. $\sigma(\varphi) = 0.2\ \mu b$. A lower limit for other $(n\ K^+K^-)$ final states can be derived from the reaction

$$\pi^- + p \rightarrow K_1^0\ K_1^0 + n \qquad (4)$$

which was studied at 12 GeV/c by Beusch et al.[2] The low energy 2π background is estimated on the basis of events already measured with our apparatus. With this information we expect the subsequent trigger rates:

Event type	Triggers per $10^5\ \pi^-$beam	Events per day
$\pi^- p \rightarrow n\,\varphi$ $\varphi \rightarrow K^+K^-$	0.01	75
$\pi^- p \rightarrow n\,K^+K^-$ other than φ	0.3	2300
log energy π pairs	1.7	12700

So 200 φ's and 6000 other K^+K^- pairs can be collected in 40 000 pictures taken in 64000 machine bursts. As in our present experiment S42 ($\rho^0 \rightarrow 2\mu$) half of our events are produced on a Li H target, we would like to take a similar amount of pictures ($\sim$ 30 000) for φ- production on Li H in order to get the branching ratio (5).

Therefore, we request 10 days of machine time, 6 days for the actual run of the experiment and 4 days to set up and calibrate the Čerenkov counter.

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REFERENCES

1. H.J. Lipkin, "Quarks and Higher Symmetries", Yalta international School 1966.

2. W. Beusch et al., CERN preprint, July 1966.