67/14

NP/2/mk

24.4.1967 S48

Memorandum

To : NP Groups, B. Gregory, W. Paul, G. Petrucci, P. Preiswerk

From : C. Daum and J.C. Sens

Re : Kaon/antiproton beams after shutdown 1968.

The number of proposals concerned with incident kaons or antiprotons for counter experiments is increasing. To meet this situation, several "standard" beams could be constructed during the 1968 shutdown, so that the very long delays which are imposed on these experiments by the present facilities can be reduced.

We propose here - as a basis for more detailed discussions - the construction of a total of four beams in a lay-out, sketched in Fig. 1. Of these, two (KS1 and KL1) are derived from target #1, the other two (KS8 and KL8) from a new target, #8, to be placed between straight sections 7 and 8. One alternative solution, of four beams derived from one target - although preferable from the standpoint of sharing - is ruled out by lack of space. Another alternative is to derive at least two of these beams from the external beam in the East area; the present program for beams makes the addition of new beams in this area rather difficult.

For beams leading to either the North or South Hall the space between magnets 7 and 8 is the most suitable; the others are either in use for targets (#6) or for parts of the accelerator (pickup electrodes, sextupole magnets), or are too close to walls.

It is proposed to make two short beams (KS1 and KS8) in the 1-2.5 GeV/c range, and two long beams (KL1 and K18) in the 2-4 GeV/c range. All four beams are separated beams. KL1 and KL8 would contain each one of the five existing 9 m separators (improved to 100 kv/cm); KS1 and KS8 would contain each two 2 m, 100 kv/cm, separators. These latter units are extended versions of the 1 m separators such as are under construction in NPA, and of which one has been tentatively reserved for NP. KS1 and KL1

replace m and q , whose elements are then available for redistribution. They are similar in location and complexity, except for the addition or improvement of the separators. KS8 and KL8 are entirely new beams. Naturally, all four beams are potential pion beams of high intensity as well.

The short beams KS1 and KS8 should be as short as possible. The minimum length required to clear the PS shielding is ~ 30 meters for KS1, ~ 17 m for KS8. The length of the long beams is determined by the bending power of the system at ~ 4 GeV/c and by the 9 m separators. One arrives at ~40 m for KL1 and ~ 30 m for KL8.

The rates have been calculated on the basis of the following assumptions. 1) 5 x 10^{11} p/burst on the respective targets. 2) 75 % multitraversal efficiency. 3) $\pm$ 1 % dp/p. 4) 0.5 msr solid angle. 5) Be-target. 6) Production angle 0°-10°. 7) Cross-sections from experimental data.

In table 1 are listed the rates, the π/K ratios at the target and the π/K ratios at the end of the beam, with the separators off. The effect of the separator is difficult to estimate without a more detailed knowledge of the beam optics. Its effect is dependent on the settings of vertical slits in the beam and on the size of the PS targets. Empirical data taken in the m_{4b} beam show that the pion reduction factor, with the separator set for kaons can vary between ~ 5 and ~ 100 depending on momentum, slit settings, and on whether the upper or lower PS target #1 is used.

The rates in table 1 are for many experiments not realistic since the maximum rate that can be handled in an experimental set-up is often lower than the pion rate listed in the table. The maximum usable rate thus sets an upper limit on the required circulating proton intensity for a given separation factor. Putting the usable rate (from experience in several experiments, using counters and/or chambers in the beam) at ~ 5 x 10^5 incident particles/burst and assuming an average

separation factor of ~ 10, valid up to 2.0 GeV/c for the 2 x 2 m separators and up to ~ 3 GeV/c for the 9m separators, one obtains the kaon rates and π/K ratios of table 2. For the low momenta these rates are limited by the circulating beam, rather than by the maximum acceptable secondary rates. The rates obtained vary between 1000 and 60000 kaon/burst for the range 1-4 GeV/c.

The range below 1 GeV/c can only be covered by a beam derived from an external target.

For antiprotons the rates are similar to those of kaons at 40 m (see table 1 and 2).

T A B L E 1

KAON RATES *), NO SEPARATORS

p GeV/c	AT TARGET			L = 17 m			L = 30 m			L = 40 m		
	π x10^4	K x10^4	π/K	π x10^4	K x10^4	π/K	π x10^4	K x10^4	π/K	π x10^4	K x10^4	π/K
1.0	240	3	80	175	0.3	585	135	0.05	2700	110	0.012	10^4
1.2	325	6	55	250	0.75	335	205	0.18	1200	175	0.055	3200
2.0	540	18	30	460	5.5	84	405	2.3	180	370	1.2	320
2.5	675	28	25	590	11	54	540	5.5	100	500	3.0	170
4.0	920	48	19	850	27	32	800	17	47	760	12	60

*) Per 0.5 msr/ $\pm$ 1% $\Delta p/p$ / 5 x 10^{11} circulating protons on Be target with 75 % multitraversal target efficiency.

TABLE 2

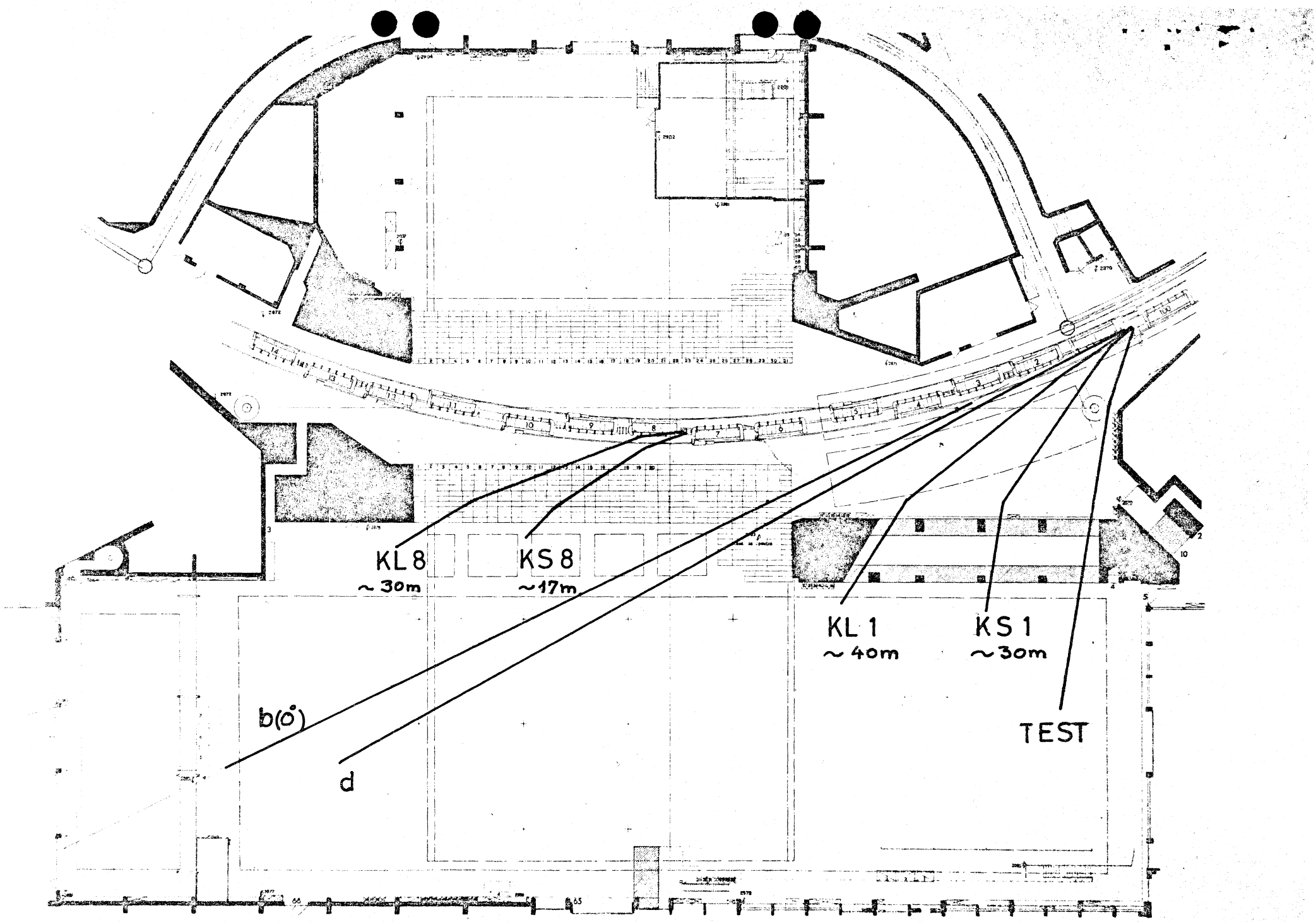
KAON RATES *) AFTER SEPARATION (ASSUMED REDUCTION FACTOR 10 FOR PIONS)

	KS8 (17 m)			KL8 (30 m)			KS1 (30 m)			KL1 (40 m)		
	K $\times 10^4$	π/K	PS BEAM $\times 10^{11}$	K $\times 10^4$	π/K	PS BEAM $\times 10^{11}$	K $\times 10^4$	π/K	PS BEAM	K $\times 10^4$	π/K	PS BEAM $\times 10^{11}$
1.0	0.6	58.5	10	-	-	-	0.1	270	10	-	-	-
1.2	1.5	33.5	10	-	-	-	0.4	120	10	-	-	-
2.0	6	8.4	5.5	2.8	18	6.2	2.8	18	6.2	1.6	32	6.8
2.5	0.9	54**)	0.4	5.1	10	4.6	0.5	100**)	0.5	3.0	17	5.0
4.0	-	-	-	1.1	47**)	0.3	-	-	-	0.8	60**)	0.3

*) Kaon rates per 0.5 msr/$\pm$ 1% $\Delta p/p$ on Be target with 75 % multitraversal target efficiency for indicated PS beam. Limiting factors are a maximum of 5×10^6 secondary particles/burst or 10^{12} circulating protons ***).

**) Separator not effective; limit now 5×10^5 secondary particles/burst.

***) Of course, the full PS beam on targets #1 and #8 simultaneously is not feasible. E.g., the sharing could be 80 % of the PS beam on #1, and 20 % on #8, making KS1 and KS8 equivalent at low momenta.


KL 8
~ 30m
KS 8
~17m
KL 1
~ 40m
KS 1
~30m
TEST
b(o)
d