A HIGH INTENSITY ENRICHED BEAM OF KAONS AND ANTIPROTONS*

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I would like to report the results obtained at CERN with a new high intensity separated beam of pions, kaons and antiprotons especially designed for counter experiments.

So far the use of separated beams has mostly been limited to bubble chamber experiments where the requirement of intensity has little importance. On the contrary for counter experiments intensity is of vital importance and a physical separation of the wanted particles is necessary in order not to overload the apparatus with unwanted fluxes of particles which can be several order of magnitude more intense. On the other hand, for counter experiments a degree of separation as high as that required for the bubble chamber experiments is not necessary because the electronic technique can provide powerful means for rejecting the unwanted particles. The relaxation of requirements on separation can be used to achieve a higher intensity.

Fig. 1 shows the layout of the beam. The new elements of the beam are.

a) A special bending magnet inside the proton synchrotron vacuum chamber. This magnet which has a gap of 3.5 cm high and 9.5 to 16.5 cm wide is mounted very close to the PS circulating beam and works in the same machine vacuum. The purpose of this bending magnet is to pick up a small production angle without increasing the distance between the target and the first quadrupole.

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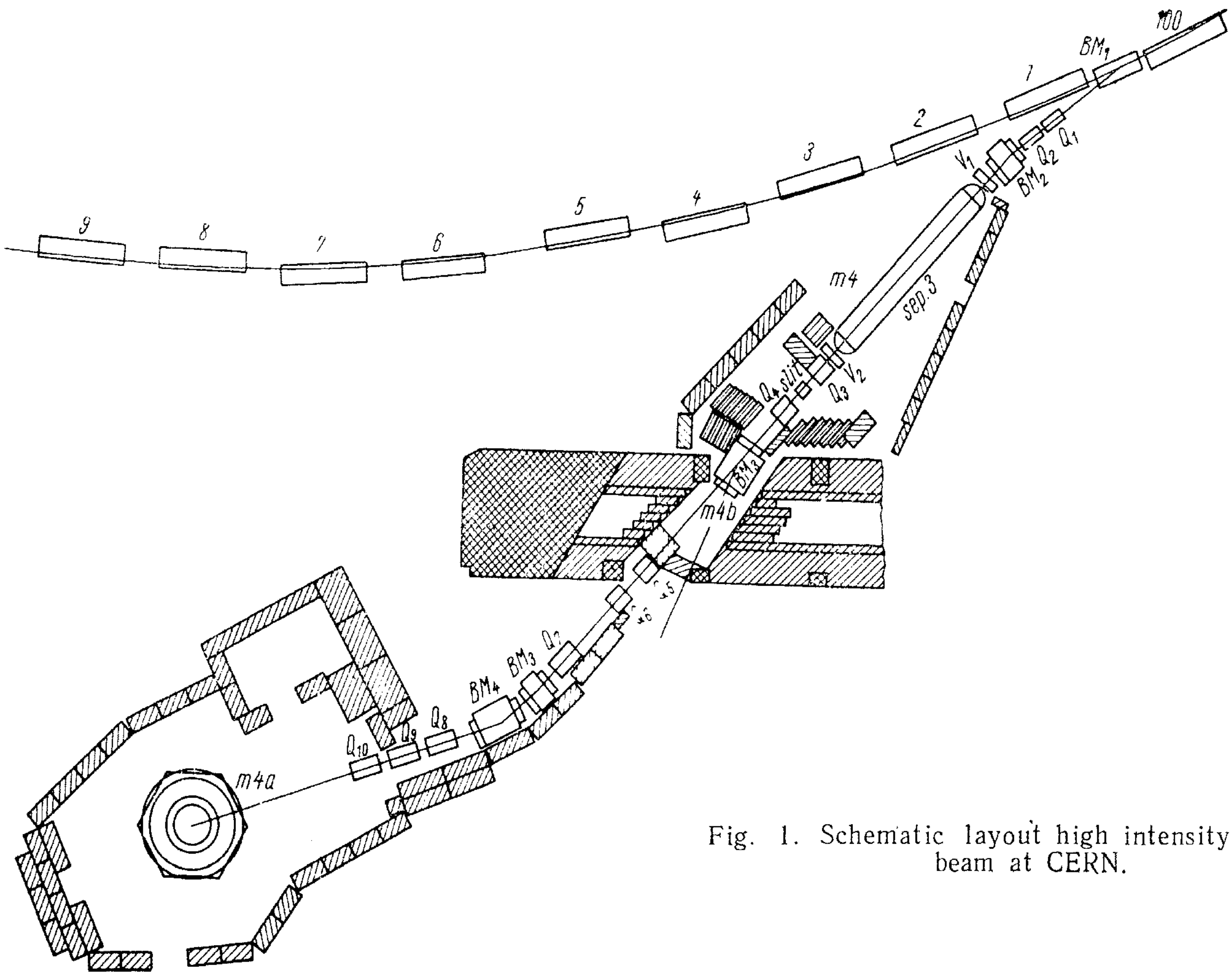

Fig. 1. Schematic layout high intensity enriched beam at CERN.

b) Two quadrupoles of special design which allow a horizontal and vertical acceptance equal to ± 32 mrad. These quadrupoles inspite of their overall dimensions (1.26 m length, 0.77 cm width, 0.45 m height) present a horizontal aperture of 36 cm, a vertical aperture of 18 cm and an effective length of 1.08 m; furthermore, they can be joined directly to the beam vacuum pipe so that their useful space is not reduced by the walls of any chamber.

this first doublet a 1 m standard PS bending magnet (17 cm gap) deflects beam by 163 mrad providing for a reasonable momentum selection. A 10 m MPA electrostatic separator follows and provides the mass separation. Two start magnets are mounted at the ends of se separator to compensate, for the wanted particles, the deflection of the electric field. After the separator two field lenses provide for the transmission of a momentum band equal to ± 2.5%

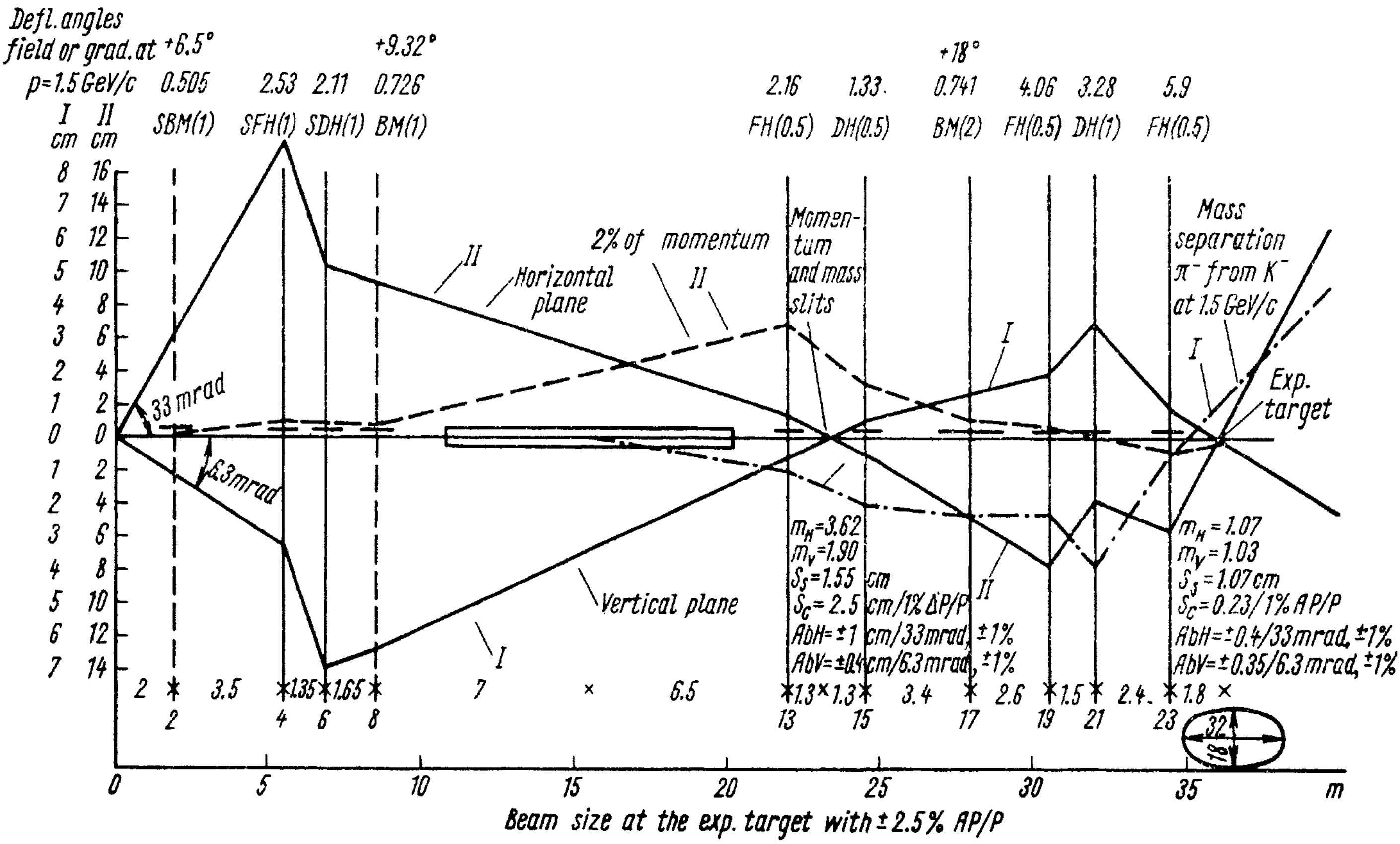

Fig. 2. Ray diagram for K^--branch.

The beam has two branches: 1) the K-meson branch, b) the p branch. The K-meson branch is as short as possible in order to have maximum K-flux. The existence of these two branches allows two groups to work alternatively thus giving to the beam an extra flexibility.

Fig. 2 shows the optical behaviour of the beam which is designed to be as simple as possible in order to reduce to minimum the chromatic aberrations and to allow a very short branch (K^--branch).

I will give now a very brief description of the beam (see Figs. 1 and 2). The beam is generated from target 1 at III mrad production angle. It is then deflected outwards by 106 mrad. by the lst special bending magnet. The and 2nd quadrupoles represent the lst doublet and are of special design, as mentioned above. After

and furthermore are used to regulate the divergence of the beam in the following stage. The momentum and mass-slit consists of a set of brass block-pairs (three pairs for the mass and two for the momentum slit) remotely controlled. The blocks of the mass slit are shaped according to the beam shape, i. e. taking into accunt the position of the vertical focus for the different momenta of the accepted band. The following 2 m bending magnet is the switching point of the two branches: this magnet is excited only when the K-branch is used and provides in this case for the compensation of momentum dispersion. This magnet as well as two of the following quadrupoles in the K^--branch and one quadrupole in the p-branch are located inside the PS shielding wall, to shorten the beam length. The K^--branch consists finally of a triplet which gives a target image at about 2 m outside the wall. This image is about 1 cm horizontally and 0.6 cm vertically. The p-branch is more complicated as it is necessary to form an intermediate horizontal image before the deflection; this in order to create the necessary conditions for the compensation of the dispersion. Two quadrupoles produce this intermediate image in the center of the following quadrupole which acts also as a field lens. Two standard bending magnets and a triplet end this branch.

The final image at about 9 m from the last quadrupole appears to be about 3 cm horizontally and 2.2 cm vertically.

As it appears from this description our beam consists of only two stages; first provides simultaneously for momentum and mass separation, the

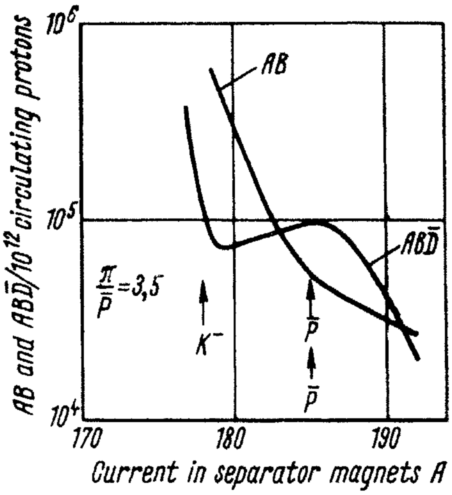

Fig. 3. Separation curves for 2,5 GeV/c antiprotons. The ordinate is number of coincidences and anticoincidences per monitor count.

second for compensation of the momentum dispersion and for the desired magnification of the final target image in the experimental areas.

Fig. 3 shows our experimental results for p of 2.5 GeV/c. As we can see from this figure with a circulating proton beam of 10^{12} p/burst we get 10^5 p/burst with a number of pions equal to 3.5 times the number of antiprotons.

Fig. 4 shows our experimental results for K^- of 1.8 GeV/c. As we see from this Figure with 10^{12} p/burst we get 40.000 K/burst. The π contamination obtained in these settings turns out to be factor of at least two worse than what the results of the $\tilde{p}$ branch indicate. We expect a π contamination of about 8 times the number of K's.

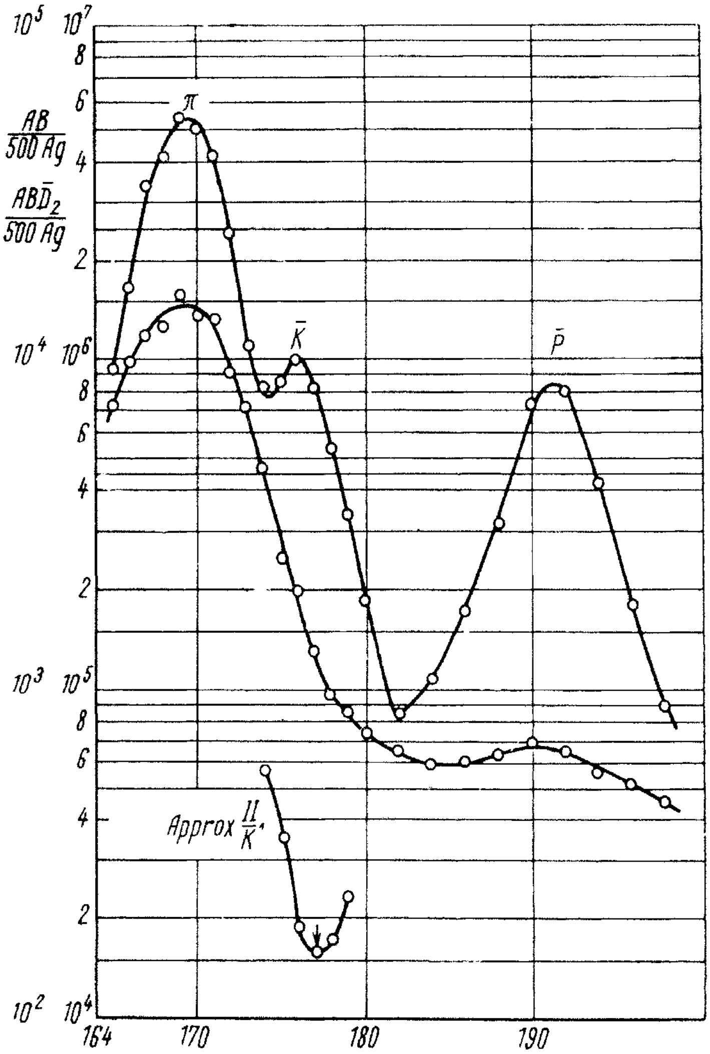

Fig. 4. The same for 1,8 GeV/c K^--mesons.

As far as absolute fluxes are concerned we want to emphasize that it has been impossible to calibrate the intensity of our beam in an absolute way with respect to the number of circulating protons for scheduling difficulties. We hope to be able to make an absolute calibration as soon as possible. We can assert with certainty that the intensity of the present beam is an order of magnitude greater than the previous beam and than any other beam we know of.