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2203 University Avenue, Madison, Wisconsin

BEAM SEPARATORS

M. Good**, D. Meyer+, B. Richter++

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ABSTRACT

Beam separation techniques are discussed in relation to particle beams produced by a 15 Gev high intensity a accelerator.

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** Lawrence Radiation Laboratory, University of California

+ University of Michigan

++ Stanford University

A variety of separation schemes were discussed. It was felt that the feasibility of particle separation at high energy would not influence much the choice of a MURA design, but that it might affect very appreciably the usefulness of high current accelerators relative to other types of machines.

Several salient points emerged concerning RF separators designed to provide separated K Meson beams of high energy:

(1) The kinematic limit for producing K is $p_{K^-} = p$ beam. Appreciable yeilds would be expected then up to say 10 Bev/c for a 15 Bev accelerator.

(2) For 10 Gev/c K's and an RF λ = 10 cm. the path length required to produce a $\frac{\lambda}{4}$ path length difference between π's and K's of the same momentum, is small compared to a K Meson decay length. (25 meter compared to 80 meter).

(3) Enough pulsed power is available at 10 cm. to produce deflections of 10 Bev/c particles large compared to the angular spread that the particles of the beam might have.

(4) Short (a few μ sec) pulsed external proton beams would be available from any MURA accelerator.

With present ideas it seems difficult to build a 3000 megacycle beam buncher or analyzer for 10 Bev/c particles which would operate <u>continously</u> because of the power requirements (10 megawatts) although such a device with a 1% duty cycle is feasible. Bunching the beam in the accelerator may be possible, however. Combining this with microwave gated counted systems might be quite valuable.

At first glance it seems that the power consumption of an RF system might be considerably reduced by using aluminum cavities operated at

around $30^{o}K$. Only about a factor of 20 in Q value can be gained, however, because the skin depth effect causes the Q to be proportional to the square root of the conductivity. Thishardly justifies the additional cooling problem which involved hundreds of liters of liquid hydrogen per hour or the equivalent. A superconductor would allow a much higher Q but the rf magnetic field is too large at these high power levels.

(5) Short pulsed separated K beams would be highly useful, at least for bubble chamber work, if not for other detectors.

No real design could be effected in this short time of the sessions; but it became difficult to escape the conclusion that it will be feasible, by the time the MURA machine might be built, to separate K mesons at any energy at which the MURA machine might produce them.+

Anti-proton separation is always much easier, so it goes without saying that separated anti-proton beams would also be available, at any energy at which the machine might produce them.

The acceptance of the separators for the K Meson schemes appears to be, however, 10 to 10^3 times smaller than those of systems currently in use at the Bevatron. Further improvements may, of course, occur as more thought is given to these problems. An intensity increase of 10^3 over the present Bevatron would be needed to compensate for the small acceptance and produce the larger separated beam intensities that are desirable. This amount to 2 μamp average current.

Even higher currents would be necessary if the K Meson production per steradian per fraction momentum acceptance is lower that it is at the Bevatron.

+ RF separators are described in an accompanying report by B. Richter (MURA-576) and in a LRL report by M.L. Good (UCRL 8929).