MASTER

BEAM DUMPING AT ISABELLE

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Safely ejecting the ~40 MJ stored energy per beam at ISABELLE is clearly a major problem, both for experimental apparatus and for superconducting magnets. Intensive study of this problem, primarily being done by H. Foelsche and J. Claus, is just beginning. A brief review of the current status was thought worth while.

SLOW EXTRACTION

There will (one hopes) be times during ISABELLE operation when one wishes to dump the beam, but when no machine component has failed. A slow (~20 min) scheme has been devised, primarily by S. Myers, which involves rebunching the beam and is discussed fully elsewhere in these Proceedings ("Efficient Extraction of the ISABELLE High Energy Beam by Rebunching"). The scheme is essentially lossless and allows the possibility of generating a high intensity pulsed neutrino beam which might be useful for special applications such as the calibration of large neutrino detectors (G.E. Bozoki, A.M. Thorndike, and A.K. Mann, "Experimental Use of Neutrinos From ISABELLE Beam Dumps," these Proceedings).

FAST EXTRACTION

A fast extraction system, clearly necessary in case of power failure, magnet quench, etc., is currently in the design stage. The system will be located in the wide-angle hall area. Two alternatives are under study: (1) a vertical extraction scheme in which the phase advance (between kicker and septum magnet) implies that the septum be located upstream of the crossing point and that additional vacuum pipes go through the experimental area ~0.5 m below the main vacuum pipe, and (2) a horizontal scheme in which the extraction channel would be in the main vacuum pipe through the experimental area and the septum would be located downstream of the crossing point.

Each scheme presents problems which are currently being studied. The primary problem with the vertical scheme is the presence of the upstream septum, which becomes a source of background for experiments in the wide-angle hall. During ejection ~0.1% of the $\leq 6 \times 10^{14}$ protons will interact in this septum. Although this is clearly undesirable, life in the wide-angle hall may not be impossible, since (as shown in Fig. 1) particle flux per dump is comparable with the integrated particle flux from 24 h of beam-beam interactions at $L = 2 \times 10^{32}$. A more subtle problem with the septum is the time-integrated flux resulting from stray interactions. A strategically placed vertical limiting aperture collimator may reduce this problem to a tolerable level. It should also be noted

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Fig. 1. Charged particle flux at 90° from crossing point. Upper curve: flux from 10^{12} protons interacting 80 m upstream (unshielded), 500 GeV/c proton-proton (from H. Grote, R. Hagerdorn, and J. Ranft, Atlas of Particle Production Spectra, CERN, 1970).

Lower curve: Integrated flux per day for $L = 2 \times 10^{32}$ per $\text{cm}^2\text{-sec}$ (from Paige, in ISABELLE 1977 Summer Workshop, p. 202, BNL 50721).

Fig. 2. Illustration of aperture problem in horizontal extraction scheme.

that a great deal of local shielding will be necessary downstream of the ejection septum to protect the superconducting magnets from radiation heating.

Horizontal extraction presents an aperture problem (at 30 GeV) which is complex. Figure 2 shows the 2.5σ beam size at the position of the proposed septum where momentum dispersion is zero. As can be seen there is little margin for error (~ 4 mm) here. If one were considering a more conservative (realistic?) 5σ beam size, the proposed scheme would be marginal. The limiting aperture in the example discussed is the quadrupole Q2 in the stright section. Moreover, during the rise time of the kicker, the beam moves across the aperture as indicated by the dashed line in Fig. 2. This effective enlargement is reflected everywhere in the lattice, and, for horizontal extraction, the beam becomes largest at positions of maximum momentum dispersion. Providing reasonable "safety" in these regions may be possible only by restricting the momentum bite.

In summary, the proposed vertical fast extraction scheme imposes geometric and background limitations on experiments in the wide-angle hall, and any horizontal scheme, if efficient, may restrict the luminosity of ISABELLE. Since extremely reliable operation of the ejection system is essential to the protection of the ISABELLE rings and hence to the carrying out of any experiments at ISABELLE, the compromise to the wide-angle hall may be necessary.