PANEL DISCUSSION ON EXTRACTION

Panel Moderator : G.R. Lambertson.

Panel Members : E.D. Courant, J. Faure, W. Kubischta, B. Kuiper, L.C. Teng.

Summary of Discussion

The panel members first reported on current extraction programs, then proceeded to discussions of (1) thin septa and sharing modes and (2) the effect of extraction on accelerator design.

All the papers on slow extraction concerned 1/3-integer resonance systems. The choice of distributed sextupoles on a local nonlinear perturbation seems to depend upon details of the particular system and personal preference.

The fast extraction system for the IHEP 70-GeV Synchrotron was presented. A preliminary guess of the cost of the fast-kicker portion was 4 M.Sfr. B. Kuiper did not feel the variable pulse length was a major complication in this system.

Reports on experience with thin electrostatic septa revealed some problems. The CERN-PS encountered anomalously large (few hundred μA) current drain and sparking induced by the circulating beam and some electromagnetic coupling with the beam bunches. Brookhaven, in preliminary tests with a wire septum, observed no interactions from the beam but did have breaking wires and uncertain alignment.

A report on extraction at NAL was given by L.C. Teng. Concerning 1/3-integer resonant extraction, he pointed out that the small emittance of 0.25π mm mrad at 200 GeV calls for high precision in the control of the guide field. A change of 0.003 in Q will extract all the beam; this requires ripple control of 1 part in 10^7 in the main quadrupoles or 1 in 10^3 for ancillary quadrupoles. The efficiency of > 99% is based on the interception by a 0.05 mm septum of about o.5% in a beam that grows 10 mm in 3 turns. The septum would be made of 50-micron wires. Some problems of errors and alignment have not yet been resolved.

The first NAL extraction will use scattering only, no resonant growth, with a septum of 0.05 mm wires. An efficiency of over 90% is expected. A fast kicker having 50 ns rise time and 50 Gauss field will also be available.

To start the discussion of thin septa and the beam shaving method, Y. Baconnier reported calculations by C. Bovet on the possible application of this to provide 11-turn continuous transfer from the CPS to the 300 GeV accelerator. This method has the advantage of reducing the momentum spread that would otherwise be present if the beam were transferred in separated bunches. In other discussion that followed, it was clear that scattering from thin wires is receiving attention but is not yet understood or well calculated. The development of the thin-septum technique will provide a new tool for extracting a burst of duration intermediate between the fast-kicker length and the very slow extraction. One may expect this to reduce the demands on fast kickers and supply a better burst length for the rf-separated beams.

E. Courant and Y. Baconnier reported calculations on the effect of guide-field aberrations on resonant extraction. The studies for the CERN-300 GeV synchrotron set limits on the tolerable $\Delta B/B$ at the edges of the usable field at $\lesssim 10^{-3}$ quadrupole component and $\lesssim 3 \times 10^{-4}$ decapole.

There was little time left for discussion of other aspects of the interaction between extraction and accelerator design, but it seemed apparent that extraction and not injection requirements may control the tolerances on guide-field quality and aperture. We are trying to do precise operations in phase space at the end of acceleration when the field may be the most distorted. There was little mention of superconducting synchrotrons, but surely here we shall be even more dependent on the calculations of extraction requirements because of the lack of experience with the fields of these magnets and the new economic considerations in these designs.

With the new developments in extraction and its greater influence on accelerator design, we shall not feel very satisfied with our readiness to assume our part in the design of a new accelerator. Certainly we have problems to solve and the relative importance of extraction will increase in the next few years.

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Some of the papers which follow give further details on the problems discussed.