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SINGLE-BUNCH BEAMS FOR BC-75*

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On June 8, 1983, a beam consisting of a single S-band bunch was transported through the linac into the beam switchyard (BSY) and analyzed in the C-line (Beamline 27) at 30 GeV. The C-line toroid 27I2 measured an intensity of approximately $2 \times 10^9 e^-$/pulse. The exact intensity was uncertain due to the limited response time of the toroid for fast, single-bunch beams. However, the linear Q intensity monitors (Lin Q) showed the transmission of the beam through the linac between Sectors 2 and 30 to be fairly flat with an intensity of $3 \times 10^9 e^-$/pulse in the final 19 sectors. See Table 1. The CID Faraday cup, which is located adjacent to the Gun Lin Q, was used to check the calibration of the Lin Q.

Table 1
Beam Intensity for a Single-bunch Beam in the Linac

Lin Q	e^-/pulse
Gun	3.3×10^{10}
25 ft	3.0×10^{10}
60 ft	2.5×10^{10}
Sectors 2 through 11-3	4.5×10^9
Sector 11-8	4.0×10^9
Sectors 12 through 30	3.0×10^9

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A single-bunch beam of about $3 \times 10^{10} e^- /$ pulse having a total energy spread of about 1% was produced by CID (Collider Injector Development), the SLC source.[1] The timing of the gun pulse was adjusted for the best energy gain in Sectors 2 through 30, which were SLEDed. For the test reported here, no adjustments from the regular settings of the *dc* steering or focusing in the linac were made. Pulsed steering was available at Sector 0 and the beginning of Sector 1. Unfortunately there was no other pulsed steering available until Sector 6, after which there was one corrector per sector. For certain orbits, a beam intensity of $1.5 \times 10^{10} e^- /$ pulse could be produced at the end of Sector 1. However, the highest intensity at Sector 6 was obtained by scraping off part of the beam at about the 200 MeV point ($z \sim 25\ m$). Under these conditions the intensity in Sector 1 as determined by the stripline position monitors was fairly flat at about $5 \times 10^9 e^- /$ pulse. Whether or not this intensity is a natural limit because of the effects of wake fields in the linac or is to be attributed to the non-optimized orbits remains to be determined.

In June 1981, a CID beam of comparable intensity was steered by Jack Truher through the linac using techniques similar to those described above. Earlier experience with single-bunch beams of about $1 \times 10^9 e^- /$ pulse generated by chopping the regular linac beam was summarized in the appendices to Ref. 2.

Implications for BC – 75

The 20 GeV/c photon beam used in the charm photoproduction experiment is generated by back-scattering laser light from the 30 GeV electron beam. This typically requires 3×10^{10} electrons per 100 nsec pulse to achieve the nominal 30 γ/pulse. However, only about a third of the electrons in a 100 nsec pulse are exposed to the laser light because of the shortness of the laser pulse (<10 nsec) and the 2 mrad crossing angle. This fraction is difficult to estimate because it depends strongly on the intensity distributions of both beams. If the photon beam could be generated with a single-bunch beam, it seems likely that the required electron flux would be reduced to $1.0 \times 10^{10} e^- /$ pulse or less. Unfortunately, the laser has been inoperable since June 7, so the effectiveness of the CID pulses for the photon beam has not yet been tested.

The use of such short pulses would have two advantages for BC-75. The first is that it would make possible the use of time-of-flight techniques for particle identification. A simple S.E.M. device in the electron beam or a fast shower detector at the photon

beam dump could provide a time reference signal for the bubble chamber interaction with an uncertainty limited only by the detector response. A second advantage is that it would reduce the muon background in the bubble chamber and its associated spectrometer. This comes about simply because the flux of the primary electron beam would be less by a factor of three or more.

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References

1. J. E. Clendenin, C. Blocker, M. Breidenbach, *et al.,* Proceedings of the 1981 Linear Accelerator Conference, Santa Fe (1981), p 130; M. B. James, J. E. Clendenin, S. D. Ecklund, *et al.,* SLAC-PUB-3085 (March 1983).
2. Design Report for SLC Beam Tests with Sector 1, July 3, 1980, with change 2, January 22, 1981 (unpublished).