SPEAR-205
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PARTICLE DETECTORS FOR MONITORING INJECTION BEAM SPILL

In the very first stages of commissioning a storage ring or other type of accelerator, it can be useful to have particle detectors spotted around the machine to look for spilled beam. This gives one a zero-order indication of how far the beam is getting, and, perhaps, where it is being lost.

In SLAC we have a 3 km long ion chamber which covers the entire length of the accelerator (PLIC, Panofsky's Long Ion Chamber), as well as individual ion chambers throughout the BSY. D. Neet also put ion chambers around the periphery of the ISR. The CESR group plans to put 100 scintillation counters around the periphery of their new storage ring.

Simple scintillation counters have been tested in SPEAR under normal operating conditions to see how useful they are for optimizing injection. Two counters were used, each with $10cm^2$ plastic scintillators normal to the local beam direction. The outputs of both counters were studied on an oscilloscope synchronized to the injection triggers. Counter A was in a thin aluminum case, counter B was shielded by 5 cm of lead.

SPEAR was set up in a good running mode, i.e. it would easily store beam. We inserted a beam stopper (1.5 mm aluminum plate) and injected a beam. Counter A (unshielded) showed counts out to 7 turns, depending on the settings of the beam steering magnets, counter B (shielded) showed only 1 turn. It is not clear exactly what is making 7 turns around the ring with the stopper in, but whatever was striking counter A was soft enough to be effectively stopped by the lead shield. The direct, high-energy scattered particles alone affect the shielded counter. One may conclude that well-shielded counters are most appropriate for spilled-beam detection in electron machines.

Another experiment was conducted to study the efficacy of the scintillation counters as monitors for injection optimization in the absence of other beam monitors. Starting from the good configuration referred to above, various controls were mis-set, e.g. kicker timing,

beam steering, septum strength. Simply by studying the number of turns indicated by counter B, it proved simple to bring the machine into effective injection, and to optimize injection rate quite close to the settings determined with other instruments. The maneuvers were effective with RF on and RF off, and optimization was operationally easy with injection repetition rates down to 10 pps.

Appendix

A simple, cheap scintillation counter

Each counter requires a small amount (10 cm^2 x 1 cm) of Pilot B scintillator. The tube used is the venerable 931A 9-stage side-window photomultiplier: the scintillator is glued directly to the tube envelope. Each counter has an on-board unregulated DC-DC 10-1000 volt power supply, thus the power supply wiring around the ring can be bell wire. The total component cost is $\approx$ $100. The counters used in SPEAR were read out through the position-monitor cabling system. This need not be a temporary expedient: an extra pole on some of the coax relays which read the position monitors would allow one to do this in a regular way.

It is not necessary to read out the scintillation pulses through high-quality cable. Sufficient information on the spill or non-spill of beam can be read out as long as the signal are not low-pass filtered below a bandwidth of twice the revolution frequency of the ring. In SPEAR this cutoff frequency would be 2 MHz.