SLAC MEMORANDUM

7 May 2002

To: Distribution

From: Roger Erickson

Subject: **Photon Beam Sweeping Magnet**

In this memo, we propose a set of parameters for the sweeping magnet required for the coherent bremsstrahlung photon beam being planned for the A-Line. The purpose of the sweeping magnet is to remove charged particles from the photon beam before they reach ESA. Most of these charged particles are generated in collimator C37 by the interaction of photons outside the coherent peak with the collimator jaws. This proposal meets the requirements of the three proposed experiments, it is based on fairly conservative engineering designs, and it minimizes costs through the use of existing equipment.

Magnet to be Salvaged from B-Line

A large dipole magnet, similar to the original 3-degree bend magnets in the A-Line, remains in the B34 position in the B-Line. This magnet could be removed from the B-Line and re-used as the sweeping magnet for the new photon beam line. L. Keller has calculated that an integrated field strength of at least 50 kG·m is necessary for the desired sweep magnet and that a higher field would be advantageous.

Magnetic Field Strength

This magnet and the others like it in the A-Line were originally designed to run at currents up to 800 amps. With increased LCW flow, we have run them for extended periods at about 980 amps. Calculations suggest that the coils can be run up to about 1200 amps, although we have experienced two coil failures in recent years; one while running at 980 amps, and the other at some higher current while the magnets were being standardized. These experiences argue against designing for continuous operation above 1000 amps. We expect the B34 magnet will have an integrated strength of about 51.7 kG·m at 1000 amps if used with its existing 60 mm gap configuration. At 1000 amps the voltage drop at the magnet will be about 90 volts.

Proposed Modification to Reduce Magnet Gap

When the A-Line was upgraded for 50 GeV, magnets essentially identical to this one were modified by adding iron plates under the pole pieces, reducing the gap from 60 mm to 46 mm. With this reduced gap, an excitation of 1000 amps gives an integrated field strength of approximately 56.7 kG·m. This higher field would yield an order of magnitude reduction in the number of muons in ESA,

compared to the 51 kG·m option. Calculations indicate that at the higher field, this source of background becomes negligible.

Power Supply

The sweep magnet will be installed in the A-Line near the present location of quadrupole Q38 (which is not needed for the photon beam). Q38 is connected to an Inverpower power supply, which is rated for 120 volts and 1200 amps and is a good match for the new sweeping magnet. Note that whenever the sweeping magnet is in use, there is no need for quadrupole Q38; therefore, no functionality is lost by using the Q38 power supply for this purpose.

DC Cables

Eight 350MCM cables connect the power supply to the Q38 magnet, four in each leg of the circuit. Conductors of this size have a resistance of 0.0367 ohms/1000 feet. Therefore, if four conductors are run in parallel over a round-trip distance of 1000 feet, a 1000 amp current will result in a voltage drop of 9.2 volts. We believe the connectors at the Q38 end of the cables will mate with the bend magnet connectors if there is enough slack in the cables. This will be verified when the BSY becomes accessible.

Summary

We propose to extract the B34 bend magnet from the B-Line and refurbish it for use as a sweeping magnet for the new A-Line photon beam. We propose to reduce the gap from 60 mm to 46 mm to increase its field strength and make it identical to the other bend magnets that were previously modified for use in the 50 GeV A-Line. With this modification, the magnet will provide a sweeping field of 56.7 kG·m when operated at 1000 amps. The existing Q38 cables and LCW connections can be used, and the total circuit voltage drop will be approximately 100 volts.

Where do we go from here?

1. The design effort for the support structure should proceed.
2. Procure suitable iron plates for the magnet pole modifications.

During the coming downtime, we should:

2. Remove the B34 dipole magnet from the B-Line.
3. Confirm that the Q38 cables and water lines will reach the new sweep magnet position, and that the connectors are compatible.

As resources become available, we should:

4. Refurbish the magnet while reducing the gap to 46 mm.
5. Locate spare A-bend trim coils and add them to this magnet to make it interchangeable with the A-Line magnets.
6. Add Klixons at critical points, as was done for the other A-Line magnets.
7. Test and measure the finished magnet.