D. Beavis

2/29/96
DB

Minutes of RSC Meeting

Meeting Held February 22, 1996

Subject: E910 in the A1 Beam Line and MPS Area

Present: D. Beavis, H. Brown, G. Bunce, B. Cole, A. Etkin, J.W. Glenn, S. Musolino, R. Thern

Experiment 910 will use a secondary proton beam in the A1 Beam Line. The experiment would like to start with a negative secondary beam to test counters until the approvals and interlocks have been completed to allow the use of the positive secondary beam.

Negative Beam to MPS

E910 will operate under the conditions used for the running of E852 last year at the MPS. A few minor changes are made which will make the changeover to the positive beam easier.

1. E910 will use dual NMCs for the negative beam. (CK-A1-E910-NEG-01, G. Bunce) The NMC paddles will be located downstream of A1Q6 which is the usual location.

2. The MPS magnet will be RSC LOTO in the off state. (CK-A1-E910-NEG-02, G. Bunce)

3. A beam intensity limits of less than 3 x 10^6 negatives/spill. (CK-E910-NEG-03, G. Bunce)

4. A minimum energy of 6 GeV/c will be required in the dipoles A1D5-7 even though the MPS magnet is RSC LOTO off. (CK-A1-E910-NEG-04, G. Bunce)

Comments: No changes have been made to the beam line, MPS area, or adjacent areas that should create any unsafe running conditions. The beamstop has been modified since the E852 run, but the stop has been increased in size. Negative running with the E852 conditions with the above Items 1-4 approved.

Positive Secondary Beam

A written discussion of the potential difficulties with a secondary positive was provided to the committee by G. Bunce.

If A1D1 and A1D2 are substantially mismatched in current, then a large fraction of the proton beam can be lost in the beam transport between A target station and A1D4 at the downstream end of the target cave. If this occurs for an extended period of time, there could be substantial induced activity in the transport elements that might cause increased dose to personnel during maintenance. It was suggested that MCR be contacted to see if the magnets that are controlled by MCR can be monitored to ensure they are properly matched. (ACT-078, J.W. Glenn, G. Bunce.)

The primary concern for positive secondaries is the potential to accept a portion of the primary proton beam (which is at 24 GeV/c and 10^{13} p/spill).

Positive secondary beam to the MPS was approved with the following constraints:

1. Quadrupoles A1Q1-4 RSC LOTO in the off state. This reduces the potential intensity by a factor of 200 for secondary beam and prevents quadrupole steering of the primary beam. (CK-A1-E910-POS-01, G. Bunce)

2. Personnel prevented from the E864 experimental cave until surveys are conducted for positive running. (CK-A1-E910-POS-02, G. Bunce)

3. Surveys of the A1/D3 roof, E865 area, E864 area, and adjacent shield walls for each increase in positive beam momentum. (CK-A1-E910-POS-03, G. Bunce)

4. The F10 extraction energy check must be set to greater than 90% of 24 GeV/c. (A1-E910-POS-04, G. Bunce)

5. The magnets A1D3 and A1D4 must have current limits that are only 10% higher than the allowed nominal maximum momentum. Each magnet must have dual hardwired failsafe devices and the interlock logic must be dual independent. (CK-E910-POS-05, G. Bunce) (S.G. for interlocks)

6. A2D1 will be RSC LOTO in A polarity and A1D2 will be RSC LOTO in B polarity. (CK-A1-E910-POS-06, G. Bunce)

At the initial startup and at each increase in positive energy, a fault study will be conducted to measure the influence of D1/D2 on the possible fault conditions. The fault study will require D1 on and D2 with reduced current (field) and D2 off with D1 reduced. (CK-A1-E910-POS-07, G. Bunce)

A subcommittee will evaluate the results of the fault studies to determine the long-term requirements on D1 and D2 for positive running in the A1 beam line.

A subcommittee will be assigned to consider any increase in the momentum limit above 16 GeV/c.

7. The maximum momentum of 11 GeV/c can be used for the initial operation and radiation surveys. This can be increased up to 16 GeV/c in increments of 1.5 GeV/c with surveys conducted at each momentum change. When the limit is raised, the E864 experimental cave must have personnel removed until the surveys are complete. (CK-A1-E910-POS-08, G. Bunce)

8. The magnets A1D5-7 will have energy limits requiring at least 80% of the operating energy of the beam line or 6 GeV/c, which ever is greater. (CK-A1-E910-POS-09, G. Bunce)

It was noted that the P1 8 mr aperture in the horizontal plane represented a tighter constraint on the primary proton beam 3 sigma (12 mr) which was used in the fault analysis. This provides an additional margin of safety.

H. Brown presented some estimates of the radiation coming out of the beam pipe into the A1 primary cave which is caused by the primary beam cascade in the shielding next to the beam tube in the wall between the A cave and the A1 primary cave. Three cases were considered using CASIM. The proton beam has a 1 sigma size of 10 cm and 4 mradians. Dose equivalent rates are at the exit port in the A1 primary cave upstream of A1D5.

1. Proton beam 28 cm from beam port with angle of 0 mradians
   7000 rem/hr/tp

2. Proton beam 28 cm from beam port with angle of 20 mradians
   400 rem/hr/tp

3. Proton beam 38 cm from beam port with angle of 0 mradians
   200 rem/hr/tp

Although these numbers are large, they are only over the area of the beam tube. There is substantial shielding at the downstream end of the A1 primary cave (8 feet of shielding) and the transport magnets provide additional shielding. Substantial reduction is also expected from the distance to the end of the A1 primary cave. Surveys should examine the penetrations to the A1 primary cave especially the A3 beam port into the E864 area for possible radiation levels.

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Attachments (file only)

1. G. Bunce Description
2. CASIM Figures from H. Brown

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Attachment #1

20 Feb. 1996
G. Bunce

***Note that there is one difference from the Feb. 15 draft: with D1 on and D2 off, or vice-versa, the primary beam will hit magnets in the upstream A1 line, which is not desirable. We should require D1 and D2 to be within a certain ratio. This is the case for positive or negative beam in A1.

To: Radiation Safety Committee
Subject: Positive beam in A1

The A1 Line has been approved for negative beam, but not positives. Experiment 910 wants positive beam, as high a momentum as possible, 10^4 per pulse. This presents a study of the requirements necessary to run positives in A1, and the maximum momentum. Don Lazarus described the A1 changes when the line was modified for E865 with A2D1 and A1D2 added to create the A2 line. Don discussed the effects for negative beam in A1, and warned that positives would require a new study. Don's memo was from April 30, 1993.

The difficulty with positives in A1 is to prevent the primary beam from entering the A1 primary cave, except possibly for fault conditions. A1D3 and D4 bend a 0 degree beam 72 mrad thru a 6" diam. pipe to momentum selection jaws K5/6. The primary beam must hit the iron dump which starts roughly half way to the jaws. At this point, the deflection of the A1 line is 26.6". By far the main constraint on p_max for A1 comes from the size of the primary beam at the dump. I have used a half angle (sigma) of 4 mrad, where I assume that the 4" quad which focuses the primary beam onto the A target is full (3 sigma), and that the primary beam multiple scatters through a 1 interaction length copper target. I assume that the A1 quads are off. The dump is at 1000" from the A target, so the beam size at the dump is 4" (sigma). If we then set the 3 sigma point of the primary beam at the edge of the 6" diam. hole in the dump, the center of the primary beam must be 3 x 4" + 3" (radius of hole) = 15" from the center of the hole. This gives a maximum A1 positive momentum of 10.5 GeV/c. This is the proposed maximum. I now describe the requirements, and fault conditions.

Requirements:
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1. p_AGS > .9 x 24 GeV/c.
2. p_T(D2) > .9 x p_T (D2) normal. We should also require a ratio with D1 to protect upstream A1 line magnets. (A1 positive or negative.)
3. Q1/2/3/4 off.
4. p_T(D3/4) < 1.1 p_T (D3/4) normal.
5. Horizontal jaws K5/K6 set and locked off according to a fault study.

This then gives a p_max (A1) = 10.5 GeV/c.

Fault discussion:

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1. p_AGS lower by 10%: displacement of primary beam at the dump is closer to the hole by 1.2". This is 1/3 sigma of the primary beam.

2. D1 p_T lower or off. (It is already at its maximum normally for A2.) The primary beam displacement is further from the hole in the dump. With D1 off and D2 at its normal setting, the primary beam will hit Q1-4/P1--the trajectory is 14" east of the center of D3/4. The half-apertures of Q1-4 and P1 are 4". (If D1 is on, and D2 off, which is permitted with A1 off or A1 set up for negatives, the primary beam will also aperture on the upstream A1 magnets, which is not desirable. If D1 is on, D2 should be on.)

3. D2 higher than normal. The primary beam is displaced further from the hole in the dump.

4. D2 10% lower than normal. The primary beam moves 1.2" closer to the hole in the dump, as in (1).

5. D3/4 lower than normal or off (it is used as the A1 security switch). The primary beam moves further from the hole in the dump.

6. D3/4 10% higher than normal. Same as (1).

7. AGS steers primary beam 3 mrad toward west. (The P1 aperture is 8 mrad (4" half aperture/500").) The primary beam moves closer to the hole in the dump by 3 mrad x 1000" = 3", or .75 sigma of the beam size. This is probably acceptable, but requires a fault study.

Additional comments:

-Hugh Brown will use CASIM to study what escapes the hole for different incident positions of the primary beam.

-The A1 quads (1-4) off reduce the acceptance of the A1 line by a factor of 200, with the K5/6/7/8 jaws at an opening of 1.4" V x H. This would give, for example, 2.5 x 10^7 protons at 18 GeV/c. The experiment would need to set the jaws to about 1 mm to reach 10^4. The potential fault condition for taking all the secondary beam is therefore acceptable.
(The A1 line is approved to take 3 x 10^6 secondaries for E852.) The virtue of requiring the quads off, besides reducing the secondary beam intensity, is to avoid steering faults for the primary beam. Woody Glenn emphasized this approach.

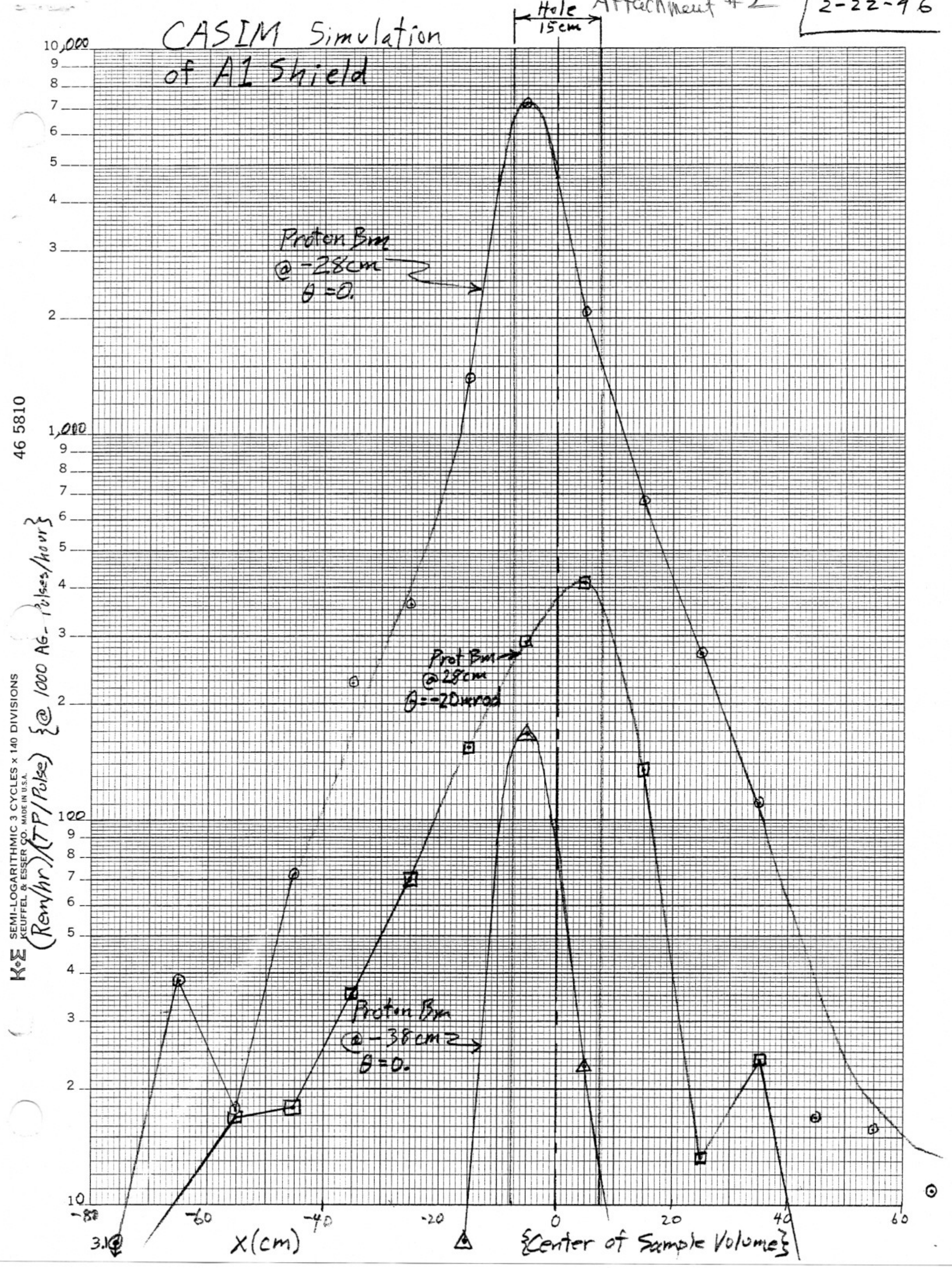
-Obviously this requires fault studies changing the primary beam steering, size, and moving the flagged magnets to their limits.

-The experiment desires a higher momentum max than this. I propose that we start here and study other ways to get a higher momentum to the MPS.

Attachment #2

2-22-96

CASIM Simulation of A1 Shield



CASIM Simulation of Al Shield