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OFFICE MEMORANDUM

TO : Biomed Controls Committee

DATE: November 7, 1975

712901

FROM : M. A. Paciotti

SUBJECT : BIOMED TARGET CONTROL AND BEAM PROFILE MEASUREMENT

SYMBOL : MP-3

MAIL STOP: 844

REPOSITORY LANL/ARC
COLLECTION MP-DO
BOX No. A-91-011
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We are initiating a new requirement for computer control of the biomed target and for a sample and hold readout of the 5ALM02 (previously LM03) beam on target monitor. The vertical beam profile at our target will be directly measured by scanning the target across the beam and measuring the intercepted beam with 5ALM02. The scheme is entirely analogous to conventional wire scanner operation.

We have long been negligent in not availing ourselves and the Line A physicists of the excellent profile information obtainable with our versatile target mechanism. In the past this profile measurement was a beam time consuming, hand-operated task. With the target controller in manual mode and the safety system thereby defeated, the target position is continuously adjustable with an up-down switch. The beam-on-target monitor 5ALM02 is read out on the scope as a pulsed voltage and then plotted as a function of the meter position on the target controller. We either assume the beam is constant in time or normalize to 5ACM02 current. The measurement involves two people on headsets and was considered too slow to be instituted as a routine check. The biggest concern about automating this measurement is that it was not done long ago.

The first difficulty encountered is that although the target mechanism is driven by a stepping motor, the control chassis is a servo control system that can only drive the target to predetermined set points. The set points correspond to "target out" plus each of three target positions. An approach might be to have another set point that would be a variable voltage under computer control. The scan rate would be slow enough so that the servo could maintain nearly perfect tracking with the variable voltage. A second approach would be to let the target be positioned in the normal way by the controller and then to switch to manual mode for making the scan. Somehow stepping motor pulses would have to be patched in at the appropriate point. The problem then encountered is that automatic target retraction in event of loss of "pion run permit" would be defeated. Even worse, we might open up a mode for the target to be driven in while people are in the treatment room.

Despite the safety objections, it is attractive to handle the target motor like an ordinary stepping motor. It would be interesting to see how "MOTOR TEST" would work on this mechanism. Very rapid target

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insertion and retraction will not be needed for some time, and the servo might be replaced with special stepping motor control programs. The present target controller offers no possibility for a redundant check of the target position. We believe that the present system has operated faithfully in the past, but it is a matter of faith only. The servo chassis is difficult for us to maintain, and our increased concern over maintenance might indicate the need for an alternate mode for target control.

Timed data would be introduced to the biomed control system via the sample and hold circuit. Hopefully, we could pick up a cast-off chassis from the accelerator emittance gear. The timing is set with a hand-operated pot and is triggered from the front edge of beam gate. Another technique might be to fan out the 5ALM02 signal and to integrate one of these low impedence outputs. The ADC would read out this integrated voltage sometime before it is shorted to ground just before the next beam pulse. At a few hundred picoamps peak proton current the 5ALM02 signal becomes rather noisy, and the integration scheme becomes more suitable. However, the average of a dozen sample and hold data takes would also be fine.

To make this measurement effective we must get the data to CCR where all of the harp data is available for comparison. We are expecting that all of the spill monitor signals be available in CCR when beam comes on. So the timed data is already in the bag; however, we are <u>not</u> proposing that the biomed target be taken under CCR control. So the measurement must really be accomplished with the biomed control system, and we should only plan to provide a rapid transmission of the scan to CCR. A polaroid shot of a scan taken concurrently with harp profiles would already be useful to the Line A physicist.

The first target assembly to be used at biomed includes a 1 mm high, 2 cm wide, and 8 cm long tuning target. With some careful attention to the absolute scale of the scan, this target can provide systematic - free vertical profiles. The target in/target out ratio for 5ALM02 was at least 1000:1, and we are hoping that the backscattering collimator 5ACL03 does not ruin this performance. We also believe the spill monitors give linear response but would like to hear about other opinions or measurements. We cannot guarantee providing such a fine target on a permanent basis, but as long as it is useful it should occupy one of the three positions on the target ladder.

Software will be specified once some hardware plan is conceived. The general display format will be somewhat like a conventional wire scanner display. The vertical scale will read directly in microamps of intercepted beam. We will apply the gaussian fitting routine written by Ken Klare that puts out the mean and standard deviation as well as superposing the curve on the scan.

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If questions should arise concerning the necessity of a careful vertical profile measurement, let us add the following information about the biomed channel. With the introduction of helium into the channel the measured resolution at the focal plane is between 0.5 and 0.7 percent $\Delta P/P$ rms using a 3 mm high tuning target. The design vertical beam size on our target of 0.3 cm rms adds a contribution to the resolution width of 0.5% $\Delta P/P$ rms. Loss of resolution due to improper beam spot size on target will be reflected in the pion dose distribution. While the Be wedge is being used, the width of the depth dose curve will be variable and uncertain. While SLIT 2 momentum defining jaws are in use, loss of edge definition on the downstream side of the pion dose distribution will occur.

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