BNL-105804-2014-TECH

EP&S No. 89;BNL-105804-2014-IR

Performance of the C1 Beam

P. Yamin

July 1979

Collider Accelerator Department

Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

DISCLAIMER

Accelerator Department

BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.

EP&S DIVISION TECHNICAL NOTE

NO. 89

P. Yamin

July 27, 1979

PERFORMANCE OF THE C1 BEAM

Performance of the C1 Beam

Introduction

The C1 high intensity beam was first put into operation at the AGS during the fall of 1976. Its design characteristics have been described elsewhere.[1] The beam was successfully used in a series of dimuon production experiments by the Rochester/BNL/FNAL/NSF (hereinafter to be called "Rochester") group and, with the exception of intensity, its performance was consistent with its design. Nevertheless, the intensity proved to be greater than the Rochester apparatus could handle, and no attempt was made to investigate the problem exhaustively at the time. However, it was observed that several of the quadrupoles just downstream of the momentum slit had to be run at substantially different currents than calculated in order to avoid steering, so the reduction in achievable intensity was attributed to mis-alignment of these magnets.

Since the C1 beam is about to be rebuilt for another experiment, it was considered advisable to study its performance in more detail before beginning reconstruction. This is a report of these studies.

Procedure

Three counters were installed near the final focus: C, 2" x 2" x ¼", was the furthest upstream; C', 1" x 1" x ¼", directly downstream; and H, ½" x ½" x ¼" on remote-controlled, moveable stage behind C'. Singles rates in these counters and the coincidences CC' and CH were scaled.

The beam was turned on with the magnets set to the best 22 GeV/c values determined by the Rochester group. After the usual power supply faults and polarity reversals were corrected, a stable, well-focused beam was established.

It was immediately determined that counters C and C' could not sustain the high rate ($\sim 10^7$/sec) and sagged. However, because of its size, the rates in H were $\sim 10^6$/sec. It seemed a reliable measure of the beam intensity, and with the final dipole off, the singles rate in H was negligible.

The purpose of this study was to verify that quadrupole mis-alignment, indicated by the aberrant set-points of two magnets, was responsible for the reduced intensity in C1. Therefore, no attempt was made to fine-tune the beam, and with the exception of the quadrupoles being studied, all the magnets were left at the Rochester values.

Results

Figure 1 shows the horizontal and vertical profiles obtained using the Rochester set-points. The maximum intensity in the peak was $\sim$800K π^-/pulse in the ½" x ½" counter, H.

Table I gives the Rochester and computer-determined set-points for the quads whose steering effect was in question.

Table I

Magnet	Rochester	Computed
Q78	250 Amps	1700 Amps
Q10	2172 Amps	1500 Amps

First, we studied Q78. Its current was increased to 1000 Amps. With the horizontal position of H set at the point of maximum intensity, as shown in Fig. 1, we scanned vertically. There was no apparent shift in the position of the center of the vertical image, though the maximum intensity was reduced by about 30%. Next, H was set at the vertical peak and a horizontal scan was performed. The results are shown in Fig. 2. The arrow indicates the previous position of the peak. The shift is 0.5".

The same procedure was followed for Q10. With the set-point moved to 1900A, the peak was found to shift (in the same direction as Q78) by 0.4". Again, there was no vertical steering.

Conclusion

We observed that both Q78 and Q10 shifted the beam horizontally when moved toward their design currents. For Q78, the displacement at the final focus was 0.5"/(1000A - 250A) = .67"/kA. For Q10, the displacement was 0.4"/(1900A - 2172A) = 1.5"/kA. Using these ratios, we can extrapolate the steering to the design set points for each magnet (1700A and 1500A, respectively). It is 1" for each.

Both quads were located almost immediately following the first focus, and the de-magnification of that point at the final focus was 1.5. Therefore, we conclude that the magnets were mis-aligned horizontally by about 1.5". This introduces a geometric occlusion of about 40%. The beam had a peak intensity of about 800K π^-/pulse in a ½" x ½" counter, so within a 1" spot the intensity would be about $3 \times 10^6 \pi^-$/pulse. For our running conditions of $\sim 2 \times 10^{12}$ protons on C target, the beam should have yielded $\sim 6 \times 10^6 \pi^-$/pulse at 22 GeV/c.[2] The 40% geometric occlusion can almost completely account for the observed intensity reduction.

During a shutdown period, the vacuum pipe was opened and the magnet alignments were checked visually. Q7 (the first half of Q78) was, indeed, displaced to the East by about 1.5". It appeared that the magnet had been sucked towards a dipole in an adjacent beam, as indicated by marks in the paint.

Figures

1. Horizontal and vertical profile using "Rochester" set-points.
2. Shifted horizontal image.

References

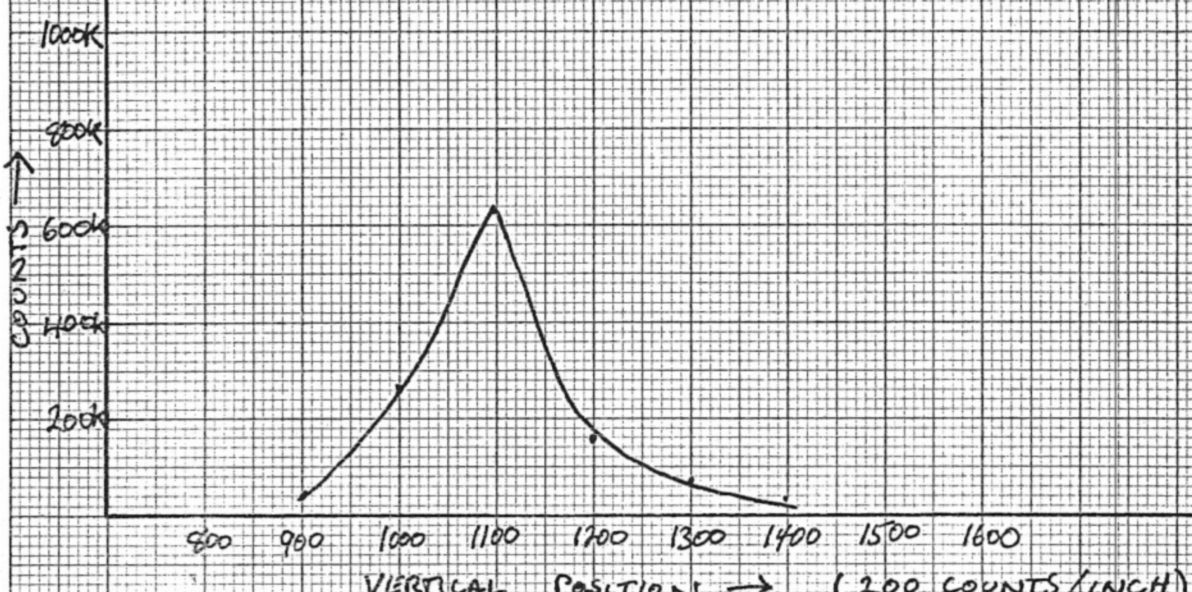
1. S.P. Yamin, "Converting the AGS Muon Beam to Pions", BNL 21490, April 28, 1976.
2. G. Bunce, "AGS Beams - May 1978", BNL 50874.

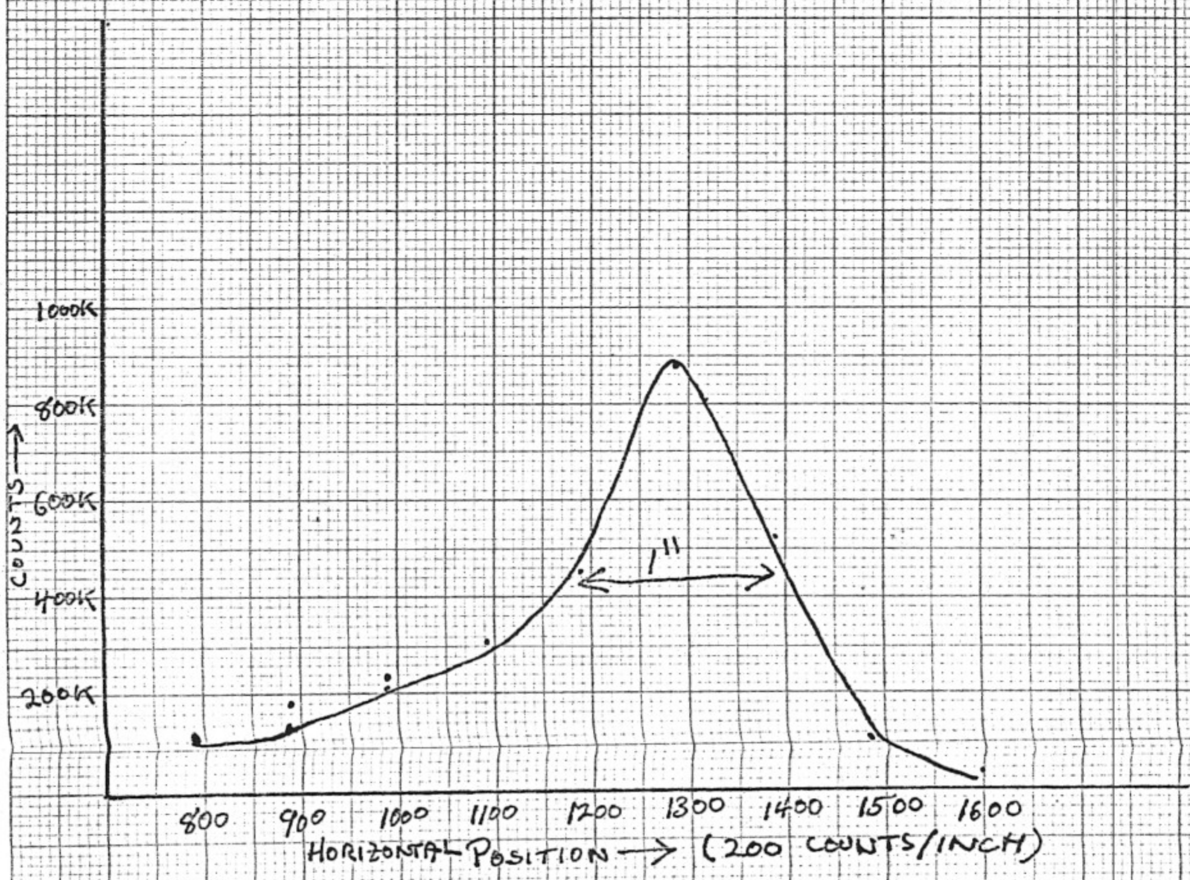
SP/ag

7/27/79

Dist.: Scientific

FIG. 1. HORIZONTAL & VERTICAL PROFILES USING ROCHESTER SET-POINTS.





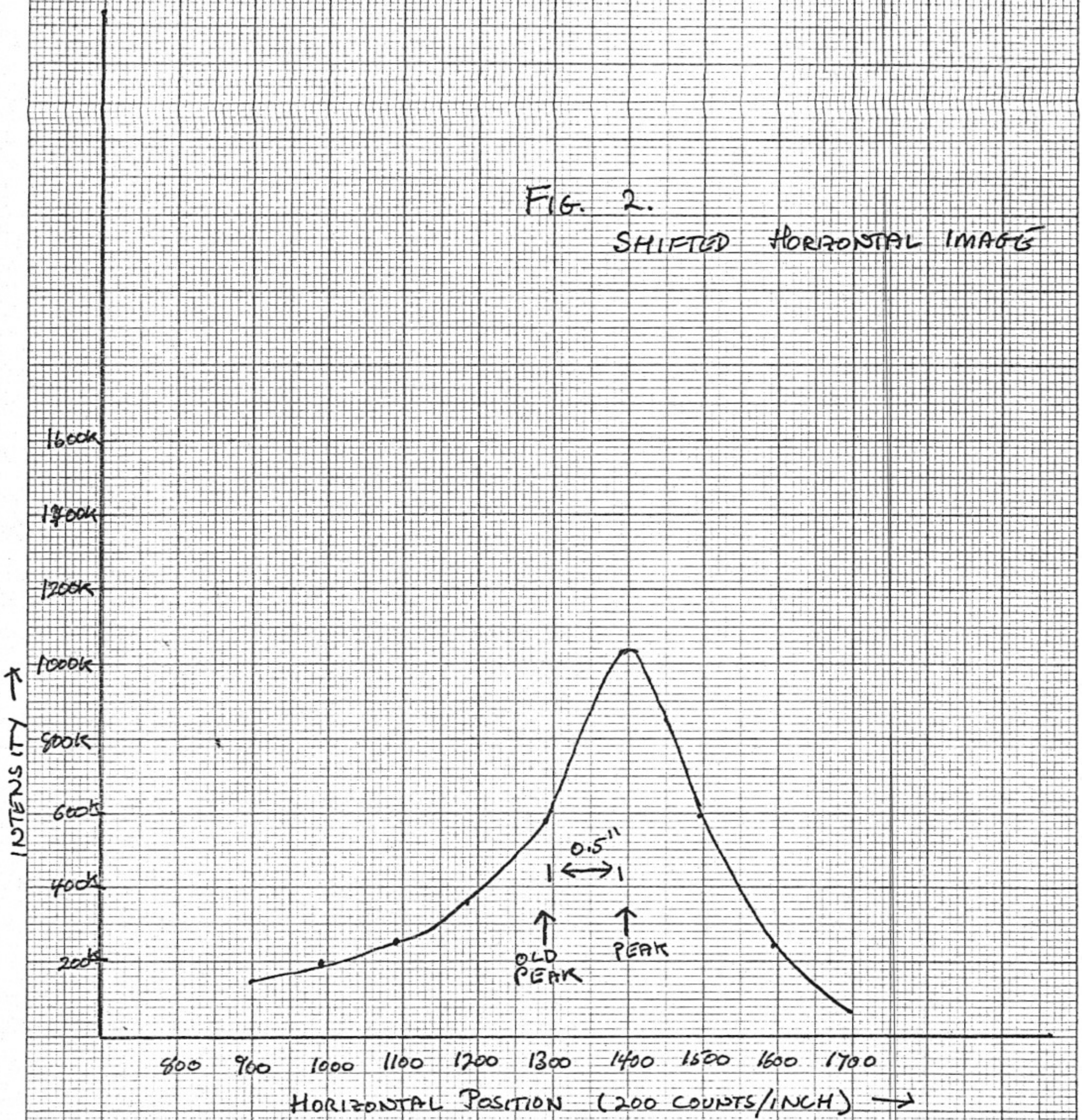


FIG. 2.
SHIFTED HORIZONTAL IMAGE