

P Quad - E.O. Position. Measurement II.

L. Ahrens

March 1988

Collider Accelerator Department
Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-AC02-76CH00016 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

4/19/88

Number 239

AGS Studies Report

Date(s) 3/25/88 Time(s) 1200 - 1600
Experimenter(s) L. Ahrens, L. Ratner

Reported by L. Ahrens
Subject P Quad - E.O. position. Measurement II

Objectives

This parasitic study measured the amount by which the Ferrite Quads (10 of these, located in the No. 15 straight sections) were offset from the Equilibrium Orbit. This is essentially a repeat of the measurements reported in SN 230.

Procedure

The procedure is described in that document. In summary, the Equilibrium Orbit (E.O.) acquisition system is used to measure the change in E.O. when a given quad is energized. From the orbit distortion, the quad-E.O. offset is derived.

These measurements were made at 21000 Gauss clock counts (~10.5 GeV/c) at a radial position (average of the 72 PUE values) of -0.33 cm which corresponds to "R0", the nominal quad survey position, to within 0.1 cm. Each quad was pulsed in both polarities with 2000 A. Difference orbits were taken in each situation and these fitted to the expected distortion from a dipole kick. The free parameters in the fit were amplitude, tune and an overall offset. The amplitude of that distortion (A) is proportional to the undistorted quad-E.O. offset (X_0), namely

$$X_0 = A \cdot (F)$$

where F depends on the tune, momentum, quad current, and quad geometry (see S.N. 230). The PUE data was analyzed (fit) on line using the "hook" Agnes Abola has built into NORB ("F") and picking up the fitting program FTC from Ahrens' area. If the tune found in the fit did not lie between 8.5 and 9.0, the data was refitted fixing the tune at 8.75.

Results

The tunes were not explicitly measured (an oversight) but can be derived from this or past measurements. In the following we take (using S.N. 182 and the measured radius) the nominal tunes to be $\nu_H = 8.70$, $\nu_V = 8.76$ and the tune shift due to the quad to be ± 0.02 horizontally and ± 0.04 vertically. Table 1 gives the fit amplitude for the two signs of quad current. Table 2 gives the calculated amplification factor F. Table 3 gives the final results - the offsets - this should be redundant information for each plane and can be used to estimate the accuracy of the procedure. The results are also given in Figure 1.

Conclusions - Summary

The independent measurements of quad - equilibrium orbit offsets agree to about 0.5 mm. To reduce this error a larger quad pulse, a lower momentum, or cleaner PUEs are necessary. However the data is good enough to provide input for repositioning these quads. The planned procedure is to repeat this study somewhat prior to the next polarized proton run and carefully reposition the quads.

TABLE 1: Amplitude (cm)

	Horizontal		Vertical	
	$+\Delta\nu_H$	$-\Delta\nu_H$	$+\Delta\nu_H$	$-\Delta\nu_H$
A	-0.033	0.035	-0.014 ^{a)}	+0.019
B	-0.03 ^{a)}	0.021	-0.011 ^{a)}	0.037
C	+0.031	-0.018 ^{a)}	-0.007 ^{a)}	0.004 ^{a)}
D	+0.052	-0.046	+0.017	-0.02 ^{a)}
G	+0.096	-0.075	-0.026	+0.053
H	+0.048	-0.036	+0.007 ^{a)}	-0.022
I	-0.032	+0.033	+0.026	-0.03 ^{a)}
J	+0.018	-0.025	-0.032	+0.067
K	-0.018	-0.003	-0.028	+0.042
L	-0.062	+0.037	-0.005 ^{a)}	+0.034

^{a)} 3 parameter fit gave unphysical tune; refitted with tune fixed.

TABLE 2: Amplification Factor

Plane:	Horizontal		Vertical	
Current (A)	Δv_H	F	Δv_V	F
+2000	+0.02	-4.65	-0.04	3.67
-2000	-0.02	+5.03	+0.04	-3.10

TABLE 3: Offsets (cm)

	Horizontal		Vertical	
	+ current	- current	+ current	- current
A	0.15	+0.18	-0.05	-0.06
B	0.14	+0.11	-0.04	-0.12
C	-0.14	-0.09	-0.03	-0.01
D	-0.24	-0.23	+0.06	+0.06
G	-0.45	-0.38	-0.10	-0.16
H	-0.22	-0.18	+0.03	+0.07
I	+0.15	+0.17	+0.10	+0.09
J	-0.08	-0.13	-0.12	-0.21
K	+0.08	-0.02	-0.10	-0.13
L	+0.29	+0.19	-0.02	-0.11

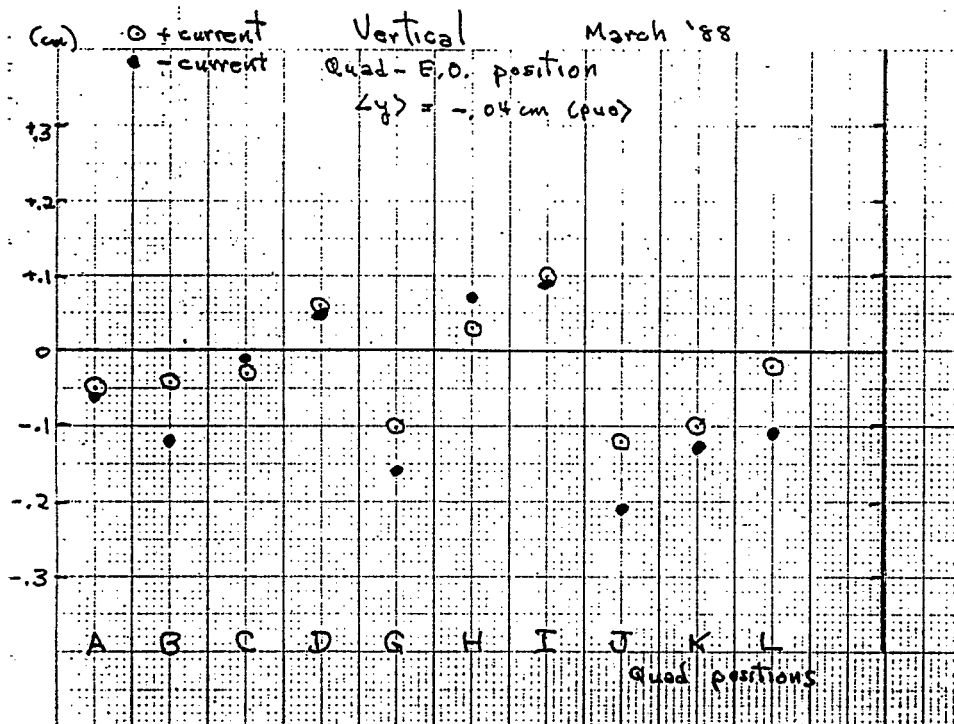
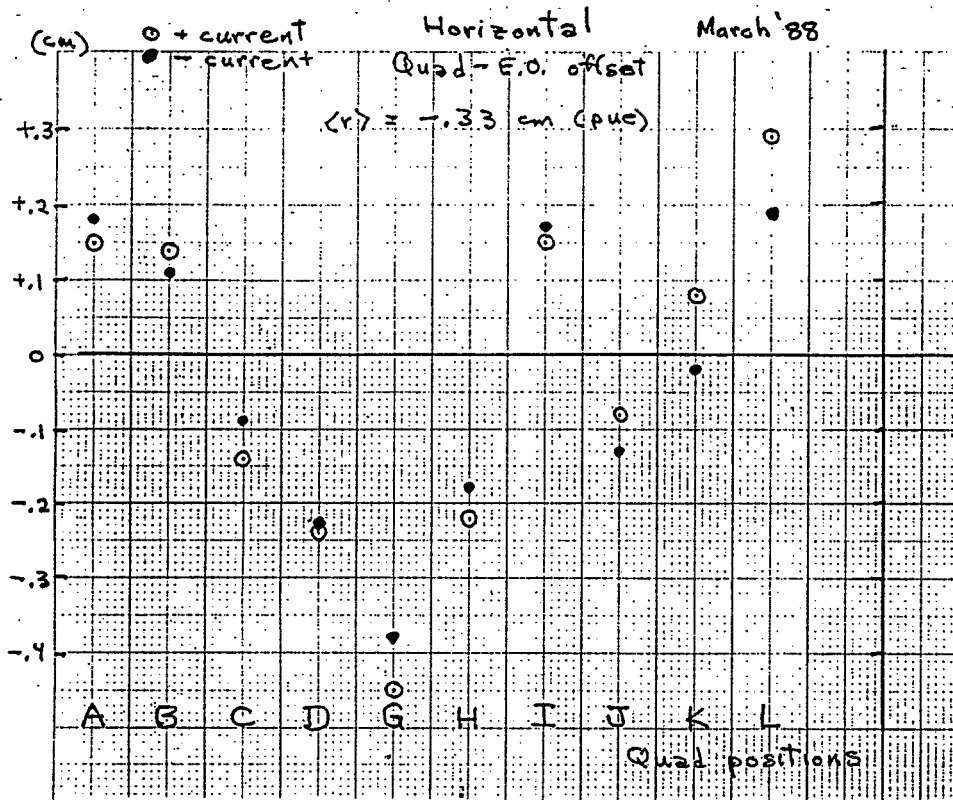


Fig 1