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Testing of the PIP Monitor

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Observations and Conclusions

The Pulsed Injection Parameter (PIP) monitor is injection instrumentation currently being developed which digitizes and analyzes the pulse trains from the horizontal or vertical plates of a given PUE (pick-up electrode) when a 1-2 μs wide bunch of protons is injected into the AGS and observed for approximately 40 turns around the machine. The analysis of the pulse trains yields, among other things, the position and angle (with respect to the equilibrium orbit) of the proton bunch on its first pass through the PUE. If one knows the transfer matrix from the foil to the PUE, one may then obtain the injected postion and angle of the bunch (W.R.T. the E.O.) at the foil.

The purpose of the present study was to test the ability of the PIP monitor to consistently determine the position and angle of the injected beam at the foil. Data obtained using PUE C2 (located downstream of AGS main magnet C2) are summarized in Figures 1-5 which show the positions (POS) and angles (ANG) at the foil determined by the PIP monitor under various conditions. Figure 1 was obtained by varying the horizontal LIN POSS increment within the ortho program. For each increment this program is supposed to select HEBT dipole (ND431, ND437) currents in such a way that the position of the H^- beam at the foil varies linearly with the LIN POSS increment while leaving the angle of the H^- beam at the foil unchanged. Figure 1 shows that the dependence of the position (determined by PIP) on the LIN POSS increment is basically linear, but the angle does not remain unchanged. We believe this is due to the fact that the ortho program does not take into account the effect of the NQ433, NQ444 quadrupoles whose settings vary from week to week.

Figures 2-5 were obtained by varying the horizontal and vertical ORB POS and ORB ANG increments which change respectively the position and angle of the equilibrium orbit at the foil using the "low field" dipoles in the ring to distort the equilibrium orbit. In Figure 2 we see that the position at the foil determined by PIP varies linearly with the horizontal ORB POS increment while the angle at the foil remains unchanged, and in Figure 3 we see that the angle at the foil varies linearly with the horizontal ORB ANG increment while the position at the foil remains unchanged. These are very encouraging

results which show that the PIP monitor can give a consistent determination of the position and angle of the injected beam (with respect to the equilibrium orbit) at the foil.

In Figure 4 we see that both the position and angle at the foil vary linearly with the vertical ORB POS increment while one would have expected the angle to remain fixed. This is not presently understood, but may be the result of the way we are extrapolating from the PUE to the foil. Further analysis with the BEAM program should indicate whether or not this is the case.

Figure 5 basically shows that the angle at the foil determined by PIP varies linearly with the vertical ORB ANG increment while the position remains unchanged. This again is an encouraging result.

In an effort to understand some of the apparent inconsistencies observed here (e.g. in Figures 1 and 4), we plan to calculate the effects of all magnets in the final steering section of the HEBT line, including the quadrupoles which are not taken into account in the ortho program. We also can re-analyze the PIP data using different models of the AGS injection region determined by the BEAM program.

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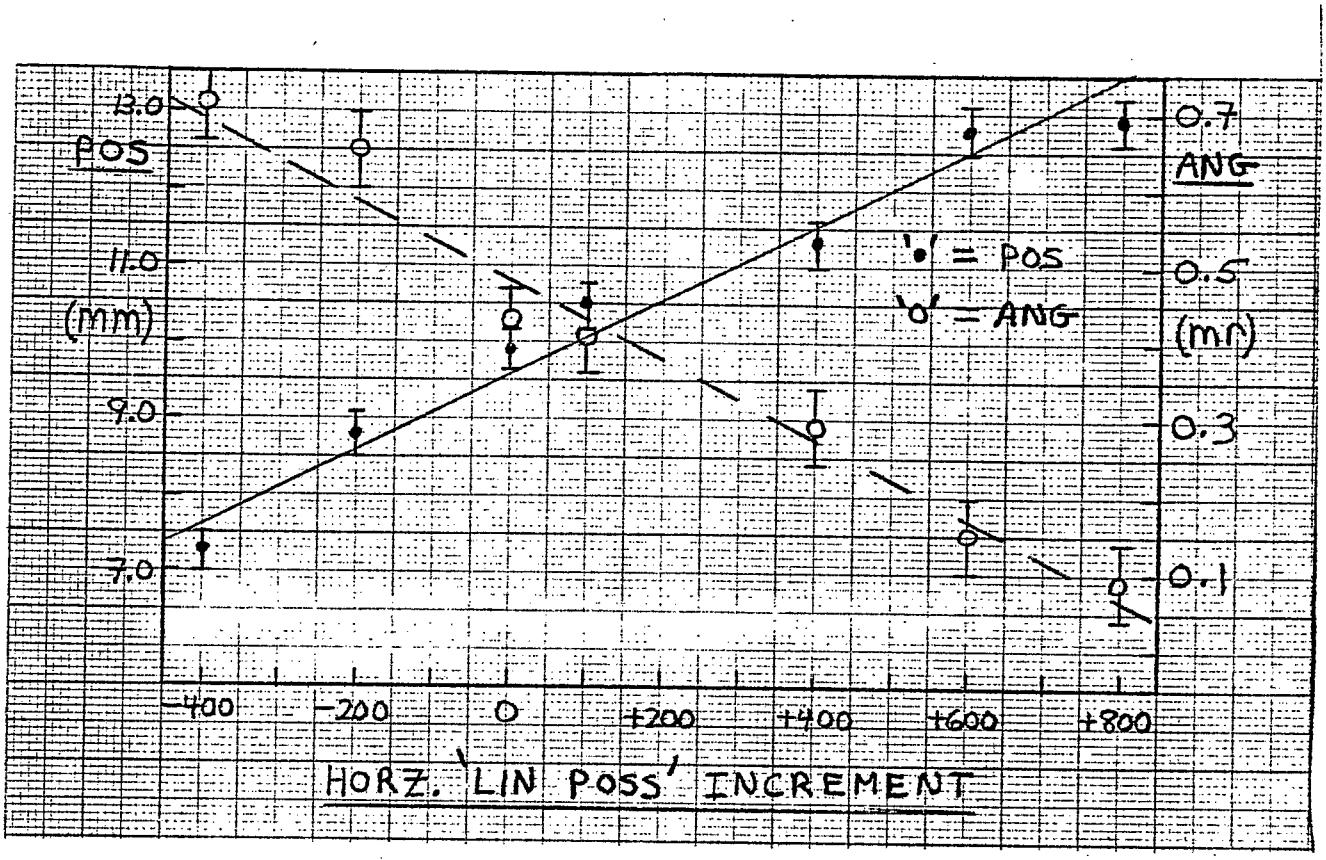

Fig. 1 : Position and Angle (with respect to equilibrium orbit) at foil as functions of the horizontal LIN POSS increment.

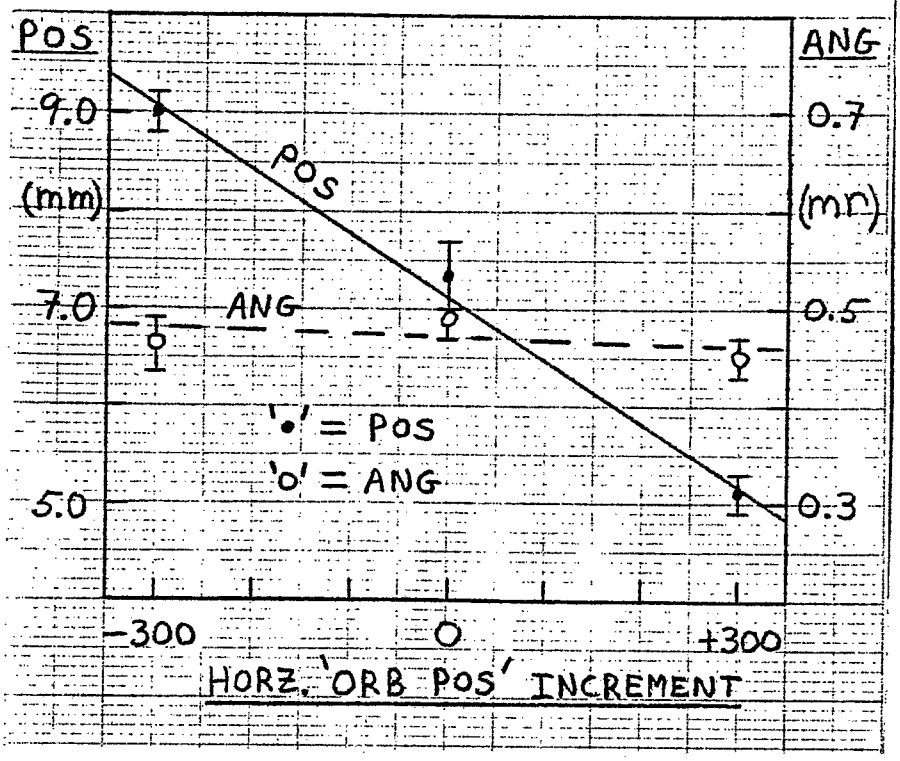

Fig. 2

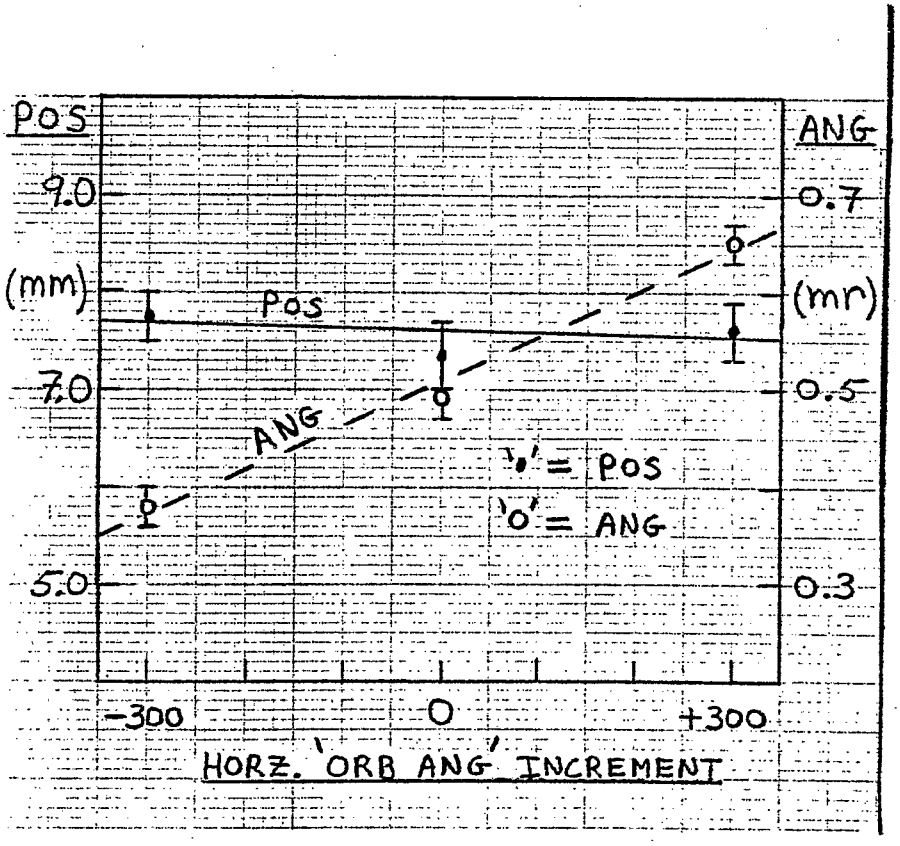

Fig. 3

Position and Angle at foil (with respect to equilibrium orbit) as functions of horizontal ORB POS and ORB ANG increments.

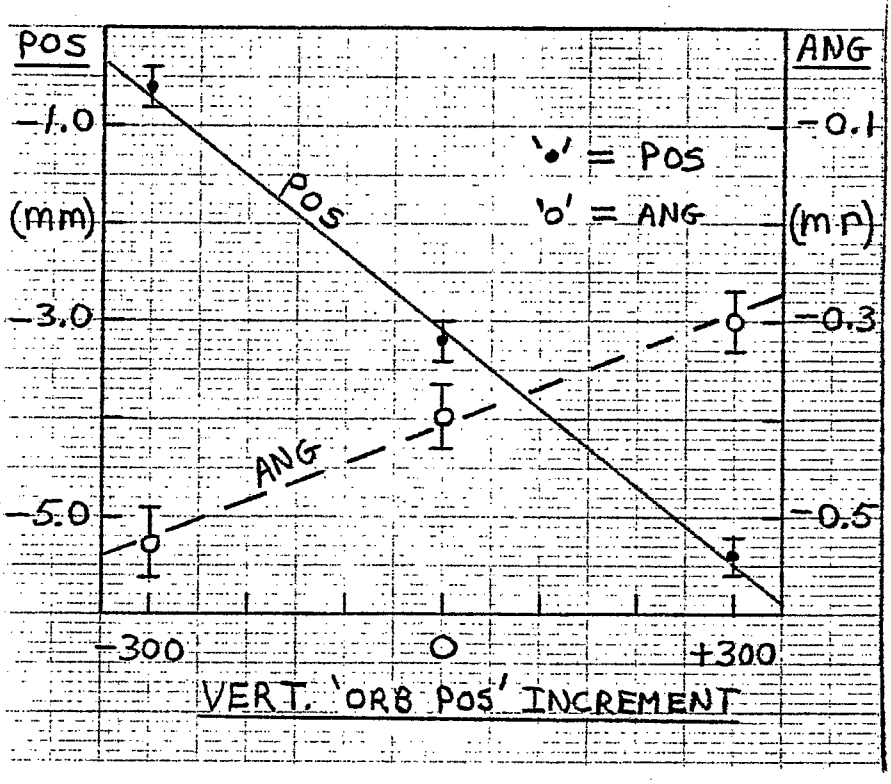

Fig. 4

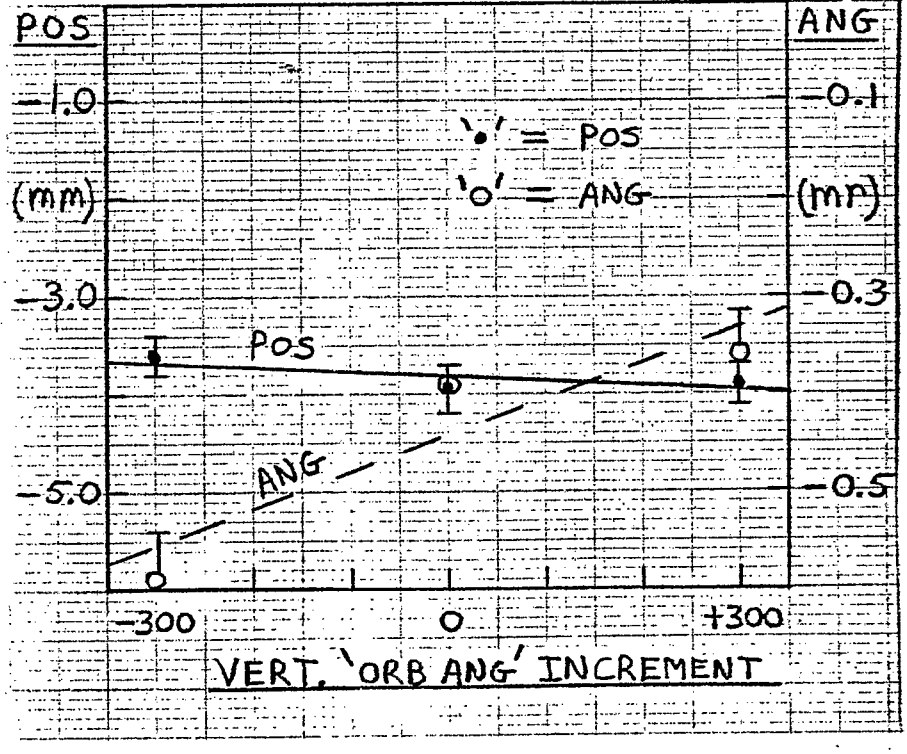

Fig. 5

Position and Angle at foil (with respect to equilibrium orbit) as functions of vertical ORB POS and ORB ANG increments.