Further Exploration of C-11 HP Target on PETtrace

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Introduction

At WTTC 14 we presented data on the target yields of our GE PETtrace C-11 HP target in comparison to the target yields we had been getting on the MC17 prior to its decommissioning[1]. Discussion with other attendees alerted us to the fact that the target may be too "thin", allowing the beam to spread out and interact with the walls, which could result in a lower target yield. Additionally, a GE service engineer indicated that we could be striking the top of the target with some of the beam, due both to target thinning and the "banana" effect from the magnetic fringe fields. Experiments were carried out to determine the potential magnitude of this effect and the efficacy of potential solutions.

Material and Methods

All experiments were performed on a GE PETtrace cyclotron. The first set of experiments was performed on the C-11 HP target in its natural mounting state (no aids). The change is gas pressure as a function of beam current was measured, from 5 to 70 microamps for three different gas fill pressures: 210, 230 and 250 PSI. The second set of experiments was performed after mechanically lifting the back end of the target with a box, changing the target angle from 23.9 degrees past horizontal to 25.2 degrees past horizontal. While this change in angle does not seem drastic, it did pick up all the slack in the target mount due the sagging of the target from its longer length than other GE targets. The change in gas pressure as a function of beam current was measured, from 5 to 80 microamps for four different gas fill pressures: 190, 210, 230 and 250 PSI. (Note that the box is a temporary solution and the target will sag over time without a more permanent solution for supporting the back end of the target.)

Results and Conclusion

The graphical results of pressure rise as a function of beam current are shown in FIGURE 1. Note that measurements were stopped when the pressure approached 470 PSI, based on advice from GE engineers. There is some flattening out for the 190-PSI data, even with the increase in angle as an attempt to counteract the banana effect (note that GE's recommended fill pressure is 187 PSI). Increases in the fill pressure helped in keeping the target thick, but with the tradeoff that less beam can be put onto the target before reaching the maximum specified pressure. Finally, using a lifting mechanism to raise the back of the target also helped to prevent thinning, as seen in the r-squared values for the linear fit, shown in TABLE 1. The data presented indicate that a shorter target that can withstand higher pressures could be beneficial for the PETtrace cyclotron, allowing the beam to fully stop before striking the walls, be it through target thinning or the "banana" effect while still allowing the user to run high beam currents.

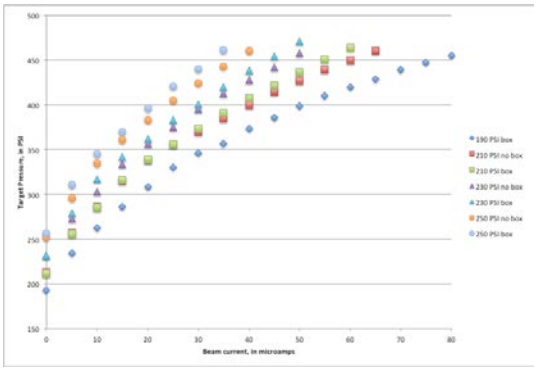

FIGURE 1. Pressure rise as a function of beam current for different fill pressures

Target fill pressure	*No box*	*With Box*
190 PSI	N/A	0.972
210 PSI	0.980	0.986
230 PSI	0.987	0.997
250 PSI	0.996	0.997

TABLE 1. R-squared values for linear fit to pressure vs. beam current data.

References

1. T. Tewson, C. Erdahl, D. Dick, J. Sunderland, L. Watkins: *WTTC14 Abstract book*, p. 60, 2012.

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