# EVALUATION OF THE HP C-11 TARGET ON THE GE PETTRACE CYCLOTRON


Tim Tewson[1], Colbin Erdahl[1], David Dick[1], John Sunderland[1], G. Leonard Watkins[1]

[1]Positron Emission Tomography Imaging Center, University of Iowa Hospitals & Clinics, Iowa City, IA. ¶Corresponding author email address: timothy-tewson@uiowa.edu


**Introduction:** We recently installed a GE PETtrace cyclotron to replace our 22 year old Scanditronix MC17 machine. The PETtrace was delivered with a C-11 "HP" target, which can run at higher pressures and higher beam currents than that on the MC17. However, the initial production of $^{11}CO_2$ from the HP target was disappointing. It produced about half as much $^{11}CO_2$ at about 15% of the specific activity that we achieved with the MC17. We decided to measure the target characteristics to evaluate the source of the problem.

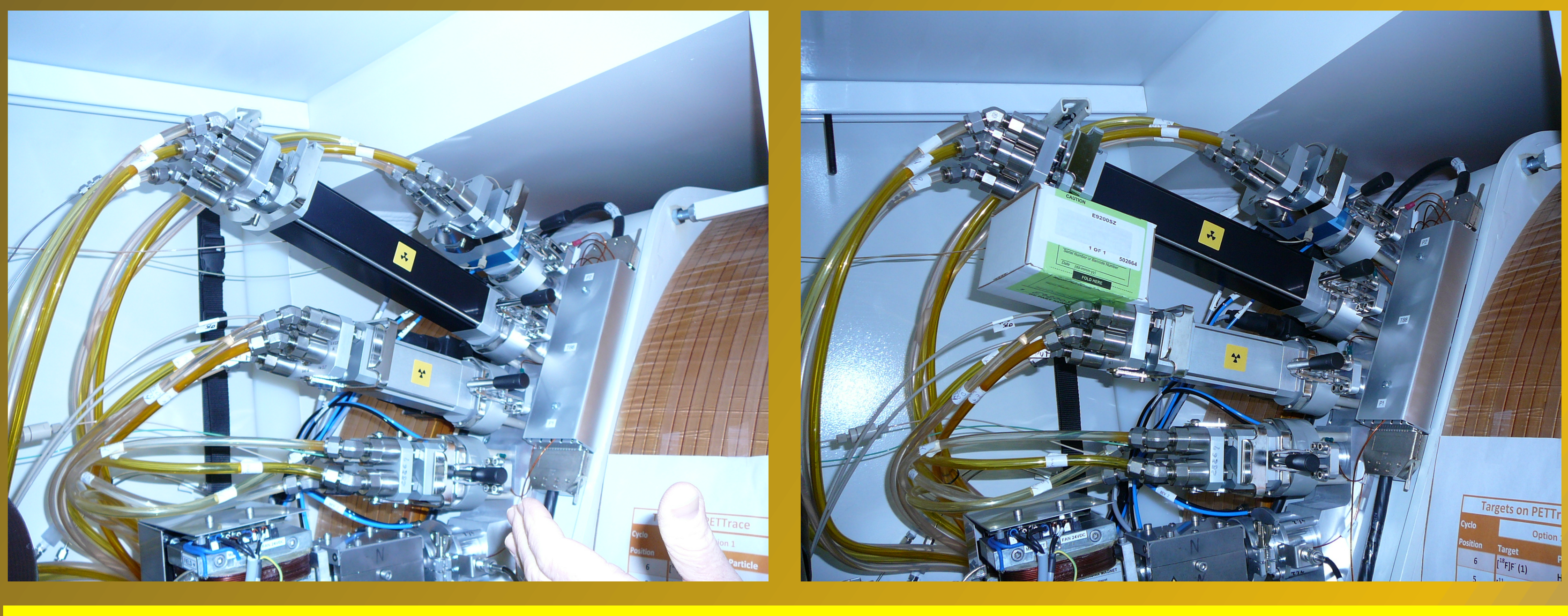
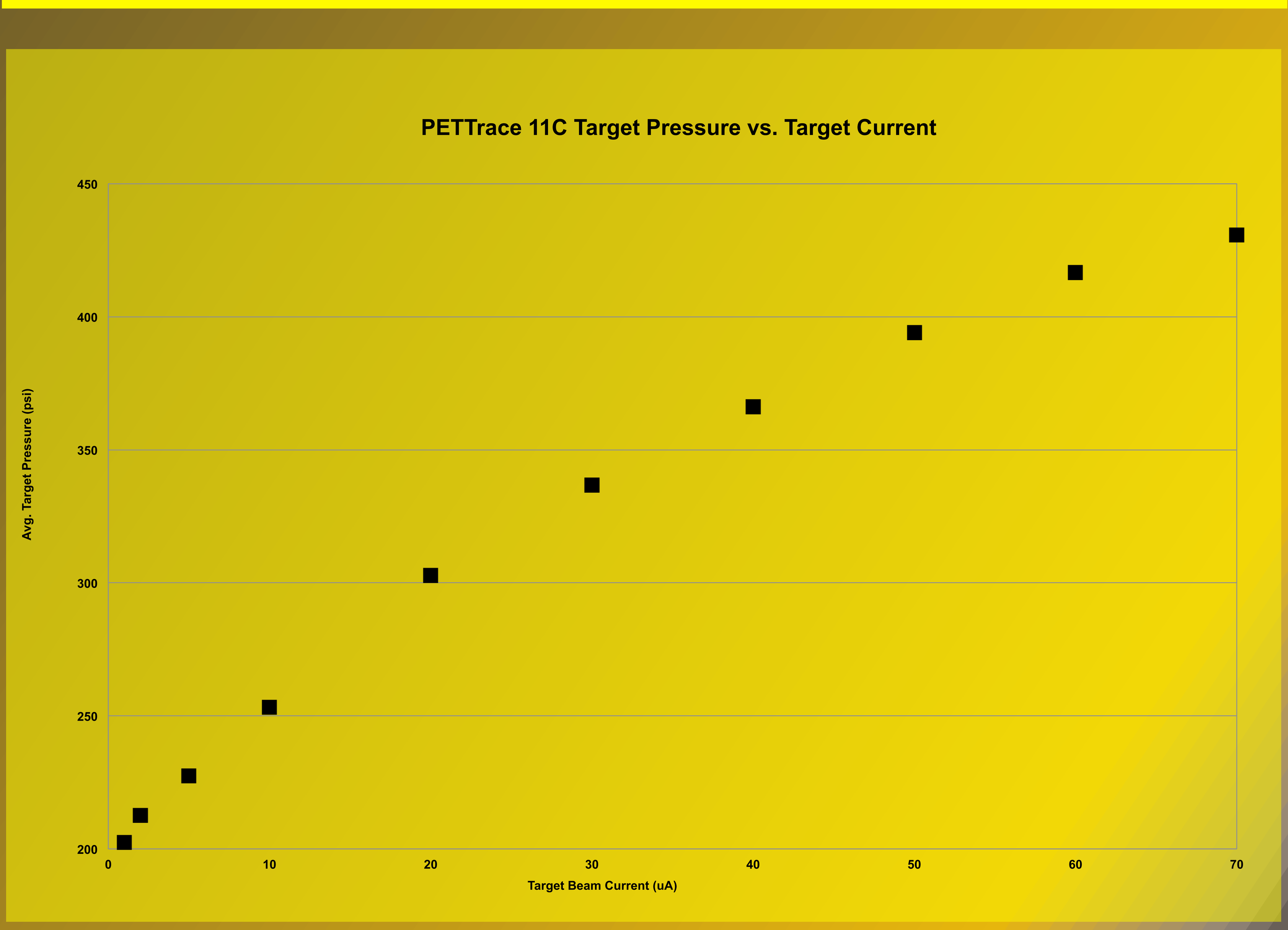


**Figure 1:** HP target before (left) and after (right) mechanical adjustment. The box is a temporary fix until a more permanent solution is engineered!

**Methods:** The change in gas pressure as a function of beam current was measured, sweeping from 10 to 70 microamps. The yields of $^{11}CO_2$ and $^{11}CO$ were measured by directly emptying the target through an ascarite and cuprous chloride/charcoal trap, each of which were in a dose calibrator. Bombardments were performed from 10 to 70 microamps for 30 minutes each. The yield of $^{11}CO_2$ was converted into an S value and expressed in mCi/μA-hr. Yield calculations, particularly at low beam current, were complicated on the PETtrace due to the beam optimization isochronous hunt. This "hunt" essentially bombards the target at 10-13 microamps for 3 minutes before starting the "true" bombardment. Specific activity was measured by synthesizing C-11 PIB and measuring the product's specific activity. After the initial runs were completed the incident angle of the beam on the target was changed by adjusting the internal collimators and mechanically raising the back end of the target (Figure 1). These modifications attempt to correct for the effects of the magnetic fringe field on the beam in the target.

**Results:** The pressure/current plot indicates that the target is thick at high currents (Figure 2). The initial S values were ~96 mCi/μA-hr and independent of current. After adjustment for the effects of the fringe field, the S value has risen to 110 mCI/μA-hr. This compares to 140 mCi/μA-hr for the MC17. The $^{11}CO_2/^{11}CO$ ratio was independent of current. The specific activity of C-11 PIB was initially ~1.2 Ci/μmol at 32 minutes post EOB. After ~100 runs on the target, the specific activity has improved to ~6 Ci/μmol. This compares to ~7 Ci/μmol from the MC17. This is also evident looking at the mass data in Figure 3.

**Figure 2:** Pressure inside the HP target as a function of beam current.



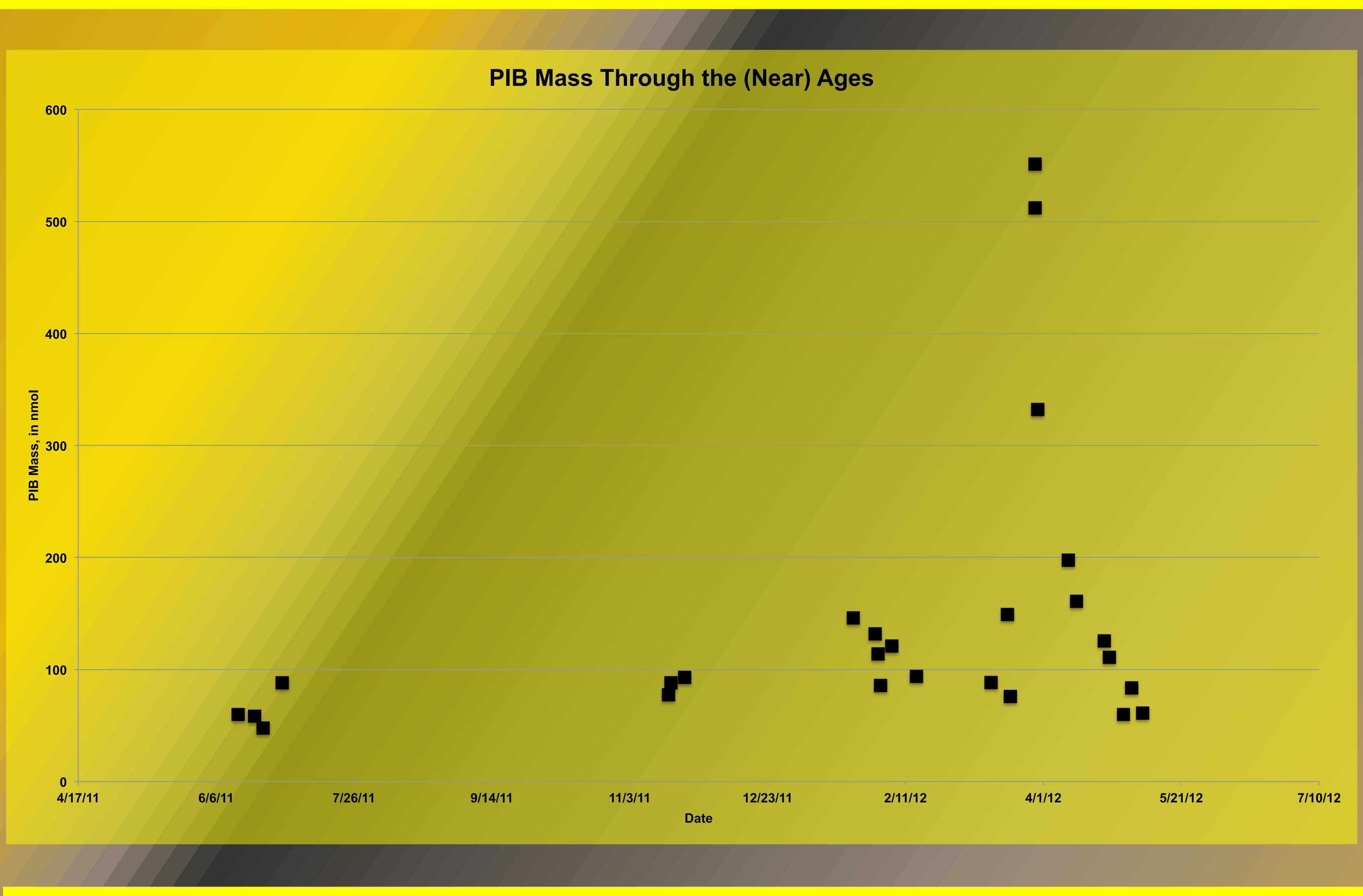




**Figure 3:** PIB mass over time. The four values on the far left are using the MC17 and the remaining values are from the PETtrace. The values above 300 nmol are from a period where we were having issues with the molecular sieve not being heated properly during conditioning.

**Conclusion:** There is a high likelihood that some beam is striking the target walls before the energy drops below the threshold for the $^{14}N(p,\alpha)^{11}C$ reaction, as the target is still thick at the highest beam currents and the S value shows to be independent of beam current. Worries about the length of the target and the magnetic fringe field led to repositioning of the beam, resulting in a modest increase in S value. The narrow, cylindrical internal diameter (~2 cm) of the target could lead to beam loss due to small angle scatter. The cold mass in our drug products is still slowly decreasing, indicating that the target is still conditioning and modest gains in specific activity may still be achieved.