

Results of the accumulation on the X arm at LLO on Dec 14-18, 2013

T. Lewis, S. McCormick, H. Overmier, K. Thorne, R. Weiss Dec 19 2013

The accumulation of nitrogen is 5.8×10^{-8} torr liters/sec while the accumulation of hydrogen is 1.8×10^{-6} torr liters/sec. Hydrogen accumulation corresponds to an outgassing rate 1.2×10^{-14} torr liters/sec cm^2 . The average tube temperature during the accumulation was 10C. The hydrogen accumulation measured both in August 2013 at an average tube temperature of 23C as well as in 2001 at the same temperature was 5.4×10^{-14} torr liters/sec cm^2 . The difference is consistent with the doubling of the hydrogen outgassing with each increase of 6C.

The nitrogen accumulation indicates that there is a small leak in the x arm. About 1/20 of the leak rate measured in August 2013. In September 2013 a leak was found and repaired in a double "O" ring annulus space attached to the X arm. When the tube was accepted from CB@I in 2001, the upper limit for the leak rate was less than 10^{-9} torr liters/sec. Even though the current leak exceeds the initial specification, it is challenging to find it with either the fluid dynamics localization techniques or the direct helium leak hunting that have been recently developed for LIGO. If the leak is in the middle of the tube, the worst place for causing forward scattering phase noise, the nitrogen pressure would be 4×10^{-10} torr. About a factor 4 below the value that could limit the performance of advanced LIGO with only end pumping on the x-arm. We should consider placing a 500 liter/sec ion pump at the mid building on the x arm for insurance.

Data:

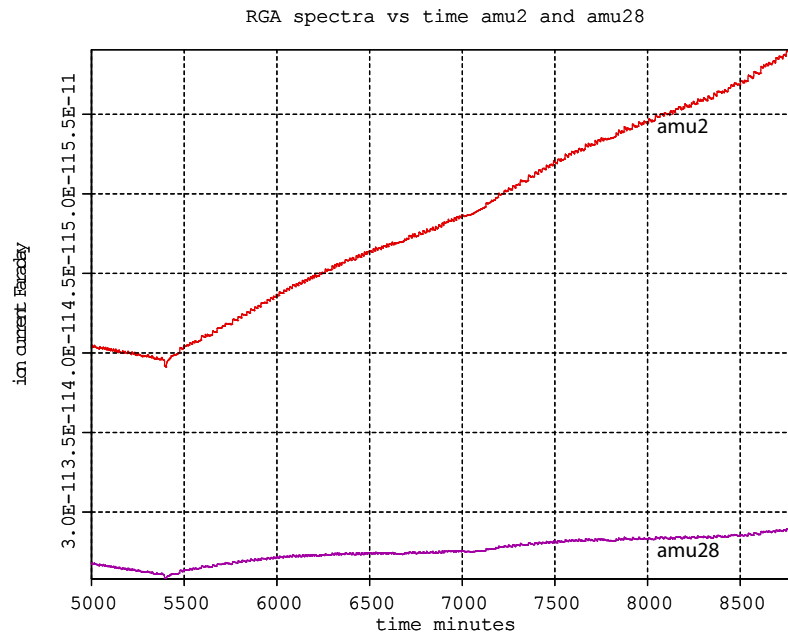


Figure 1 The accumulation of amu2 and amu28. The RGA calibration against the average of the discharge gauges gives 4.7×10^3 torr/amp for hydrogen and 2.13×10^3 torr/amp for nitrogen.

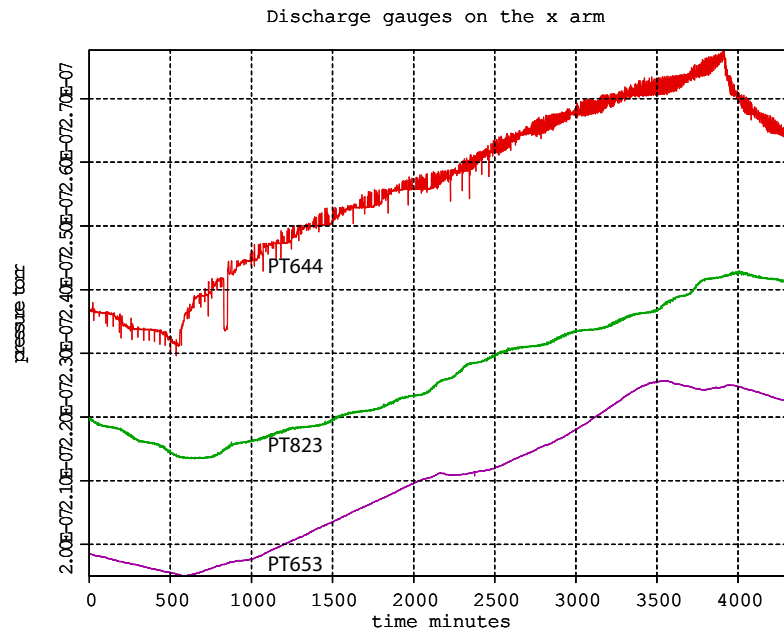


Figure 2 The accumulation as measured by the discharge gauges. The dominant component is the hydrogen which shows the temperature dependence of the outgassing. The variance in slopes dp/dt is about 15% of the average dp/dt .