Long Prototype irradiation with Ar/CO_2(80/20)

We have been examining the possibility of using Ar/CO_2(80/20) to replace the present COT drift gas. Kevin's simulation using Garfield and Magboltz showed that this mixture has a reasonable drift velocity (~58 um/ns), tolerable drift velocity saturation, and good Lorentz angle (near 35°) when operating at ~88% of our present high voltage settings (same gain, drift field drops from ~1.9 kV/cm to ~1.7 kV/cm). However, with the exception of recent reverse aging studies using a GMC, we have not attempted to operate with this gas mixture in a chamber resembling the COT. For example, David Khazins myriad aging studies were all done using Ar/Et(50/50), sometimes alone, mostly with isopropyl alcohol (like the COT), and sometimes with ethyl alcohol. Specific tests on components like the endcards and center supports were all done using Ar/Et(50/50) with isopropyl alcohol.

The long prototype is our most realistic mechanical prototype of the COT, so Aseet and I set up a gas mixing system for Ar/CO_2 and started irradiating the chamber using Sr90 sources. Unfortunately, the long prototype was never meant to test aging, so it was not assembled using great care for cleanliness and using only aging-tested parts. The Sr90 sources produced wire currents equivalent to ~3E32 to ~1E33, depending on the distance from the source. The test came in three parts, depending on the gas mixture and spot that was irradiated: 1) Ar/CO_2(85/15) at the ASD end card area, 2) Ar/CO_2(80/20) at the ASD end card area, and 3) Ar/CO_2(80/20) at the center support area. We clearly had some problems with linearity of the mass flowmeters, since the gain varied somewhat with flow rate. Figures 1 – 3 show the BiRa currents versus time for the three conditions.

The first test (80/15 at the ASD end card) had a flat dependence of current with time as shown in figure 1. The second test (80/20 at the ASD end card) showed current (or gain) steps when the flow rate was changed, but otherwise a flat dependence within a given flow rate (see figure 2). The third test (80/20 at the center supports) was done all at the same flow rate. It shows a steady decrease in current as a function of time, indicating the possibility of wire aging. About half way through the irradiation at the center support, we noticed that the exhaust bubbler oil was turning yellow. Of course, it may have started turning yellow earlier, but just became noticable at that time.

After the Sr90 irradiation was completed, an Fe55 scan was done as a function of position along the wire. Figure 4 shows some of these measurements, and they indicate a steady increase in pulseheight as the source moves from the HV end (z=0) to the ASD end (z=10ft.), with the exception of the measurement at the center support (z=5ft.). Although one expects a decrease within about ½" of the center support, the Fe55 source had a fairly large z extent (likely significant out to 3" from the centroid), and one would have expected some indication of a normal pulseheight for part of the spectra. When one irradiated 6" from the center support (figure 5), one sees a shoulder toward smaller pulseheights not present in spectra farther away, which is again an indication of wire aging "fading away" from the Sr90 source centroid. Figure 6 shows the Fe55 primary peak as a function of z position.

We set up the K&E transit to look at the planes near the center support. The sense wires near the center support were obviously darker than the neighboring potential wires,

while this was not the case 1ft. from the center. This direct evidence confirms the current and Fe55 evidence for growths on the sense wires. There are many topics to consider (this is a classic can of worms):

1. What about all the earlier aging tests on these components using Ar/Et + isopropyl alcohol? Is the present problem due to a) different components (we know of one additional component), b) different gas, c) some "advantageous" condition in the previous tests not now present? Should we redo the previous aging tests on the center supports using the present COT gas mixture?
2. What would the behavior be if we used our present COT gas in the long prototype?
3. Is the COT aging worse than expected near the center support? One could examine the pulled-out planes and look at Kevin's width data very close to the center support. Does the present (reverse-aged) width data in this region relative to other regions look different now than at the beginning of the run?
4. Should we pull a wire plane during the shutdown to examine the center support region?
5. Should we "reverse age" the center support section for a pulled-out plane and see if there is extra (different) stuff left?
6. Should we look near the center support section of the pulled-out planes with microanalysis?
7. We are planning to take a sample of the yellow bubbler oil for analysis. What should we ask the company to look for?

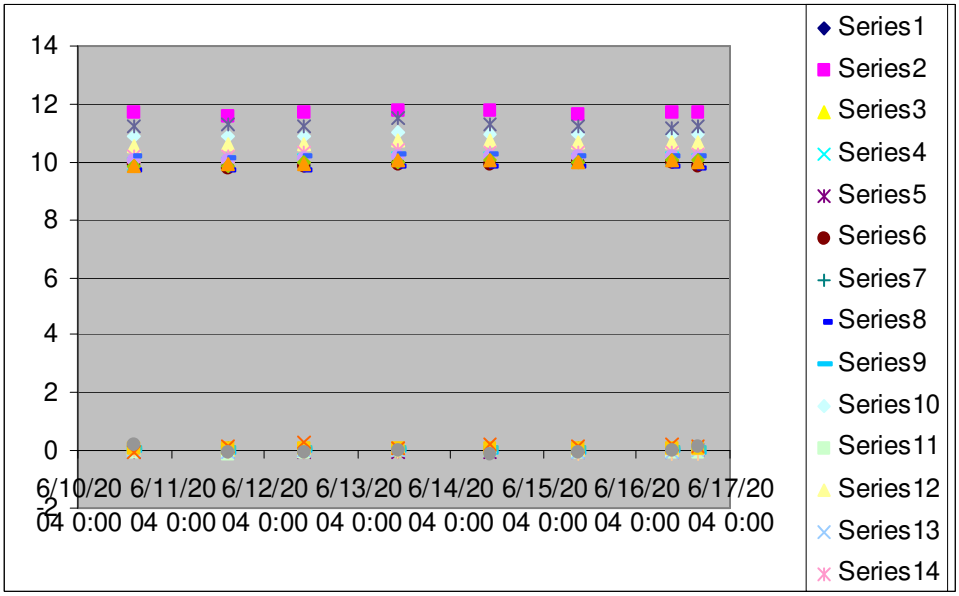

Figure 1 BiRa currents versus time for Ar/CO2(85/15) when irradiating near the ASD endcard. Note that Series 1 is P0; Series 2 is S0, etc.

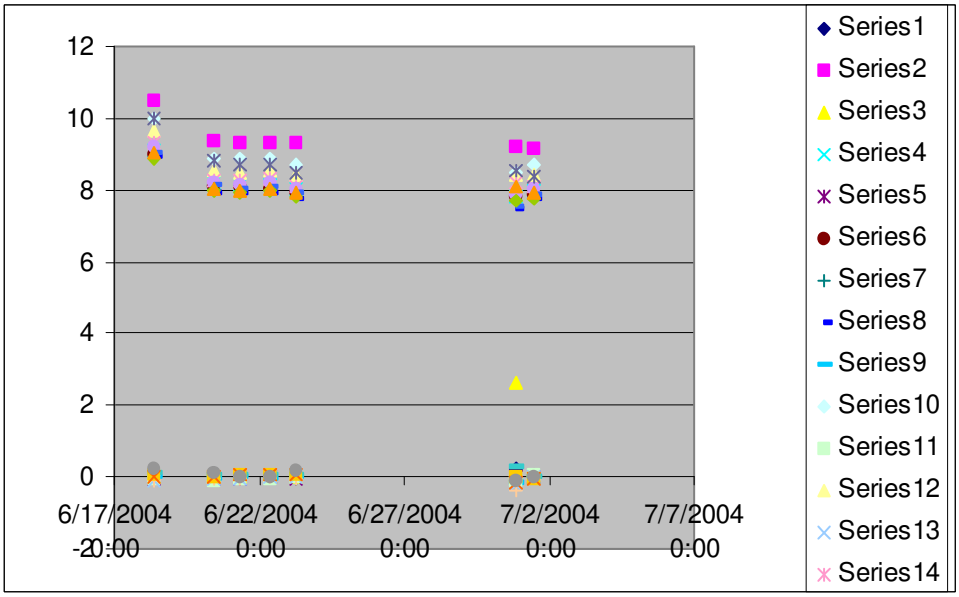

Figure 2 BiRa currents versus time for Ar/CO2(80/20) when irradiating near the ASD endcard. The gain steps correlate with changes in flow rate on 6/18 and 6/30.

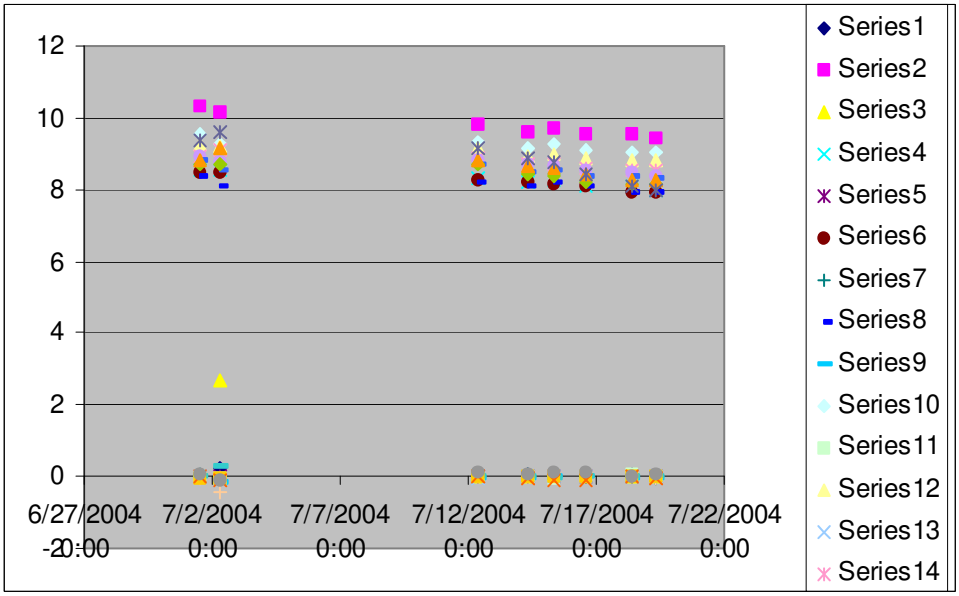

Figure 3 BiRa currents versus time for Ar/CO2(80/20) when irradiating near the center supports. The flow rate was constant during the test. Note the steady decrease in current with time.

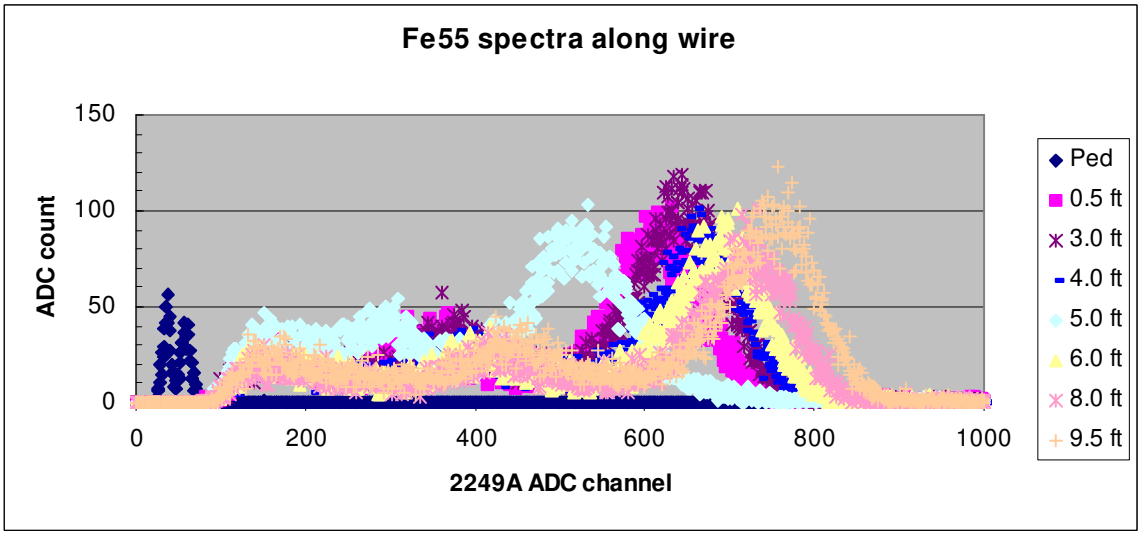

Figure 4 Fe55 spectra for several z positions along the wire. The pulseheight increases as one moves from the HV end (z=0) to the ASD end (z=10ft.), with the exception of z=5ft. , at the center support.

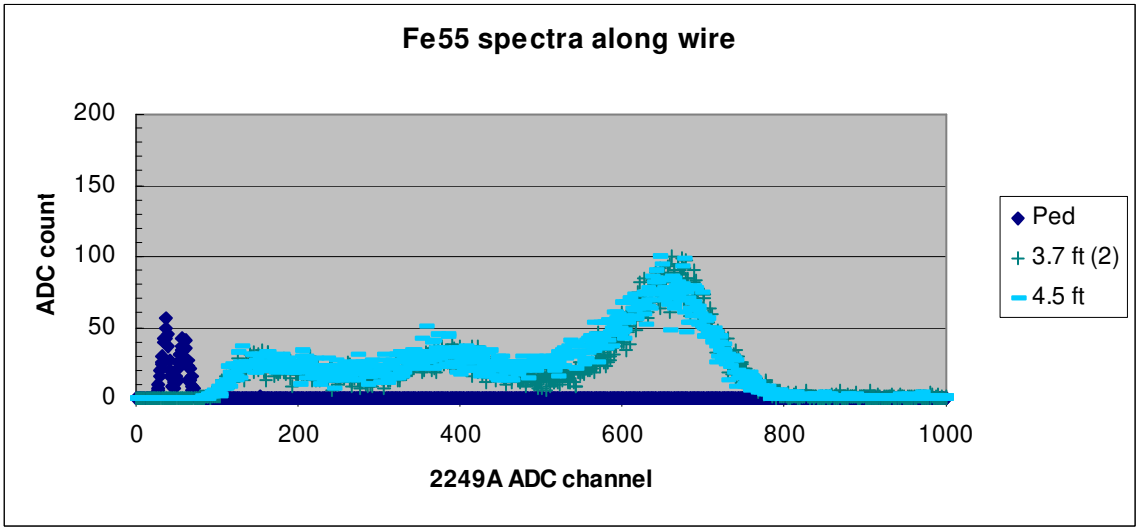

Figure 5 Fe55 spectra for z = 4.5ft (0.5ft from center support) and 3.7ft.. Note the enhanced shoulder toward small pulseheights for the spectrum near the center. This would not be expected for normal gain loss near the center support.

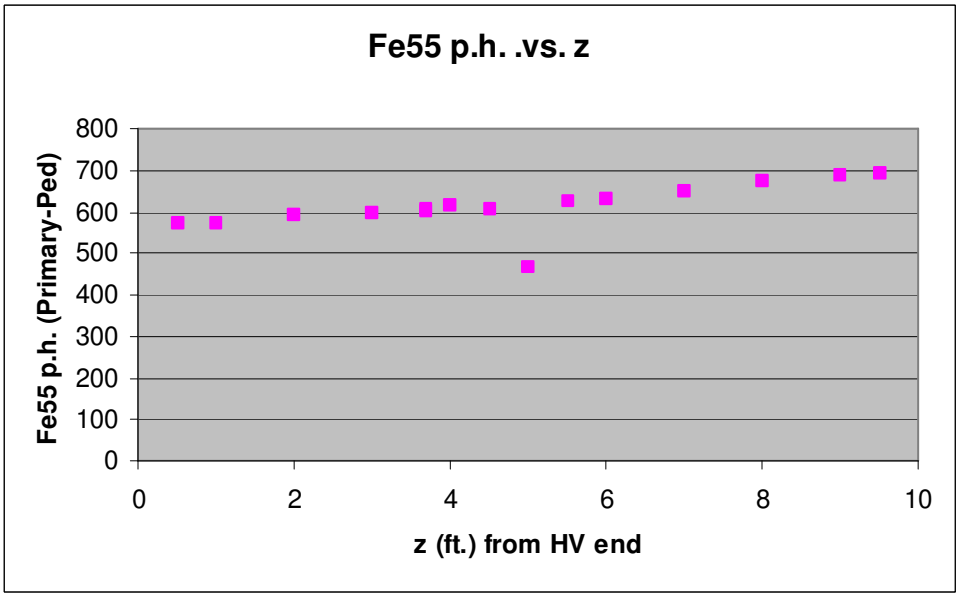

Figure 6 Fe55 primary peak versus z position. Due to the spread of the Fe55 source, one would not expect such a large reduction at the center support (z=5ft.).