ANSWERS TO CRYOGENIC QUESTIONS

Wes Craddock SLAC

June 18, 2012

Question 1:

The circled item is the current lead. However, this is probably from a early ILD design.

Question 2 (Flow diagram questions):

a) **Dewar A is the same as Dewar 1.**
b) **Dewar C is equivalent to Dewar 2.**
c) **Dewar B is the water cooled dump resistor.**
d) **The solenoid current lead is the item that was circled. Current leads and cryogenic lines exit at opposite ends of the detector and do not extend into the iron doors of the detector. The solenoid current lead exits at an angle (it is NOT vertical).**
e) **The current lead is independent of the valve box. The current lead is gas cooled meaning that it will use some Lhe that eventually exits as gas near room temperature.**

Current leads and the cryrogenic plumbing port were placed at opposite ends to minimize the stray fields and to balance the axial magnetic force and fields. They were also placed at opposite ends to make room for all the connections required at the ends of the solenoid. Connections between the cryo port and the current lead port are all made inside the solenoid vacuum shell.

Question 3:

The cross section that you show for the flexible transfer line is correct. I have not made the calculations yet (depends on the final length and heat load), but I estimate that the inner liquid helium line would be about 15 mm inside diameter. The helium gas will return starting about 5 K and end up in the 10 K to 15 K range. For BaBar the gas returned to the second to the bottom liquefier heat exchanger at about 11 K. The remainder of the gas from the current leads and the thermal shields will be returned at room temperature to compressor suction.

Question 4:

For our BaBar transfer line we measured 175 W (from 5 K to 11 K) and approximately 3 W into the liquid helium line. This line was 60 meter long thus gives heat loads of 2.9 W/m and 0.05 W/m. These heat loads include the heat loads from the bayonnet connections at both ends. A shorter line would therefore have a slightly higher heat W/m heat load for the gas return.

We have no data on the reliability of these transfer lines for multiple bending cycles. I imagine that one could do a finite element (or hand calculation) to make sure that the peak stresses are well below the yield stress of the material. From a practical point of view, I would be much more concerned that the bayonnet connections were rigidly secured to prevent all motion and stress at the two locations.

Question 5:

The three other return lines (current lead, thermal shield and cooldown line) are separate from the flexible helium transfer line. The three lines would most likely be combined on the detector into one flexible low pressure line (~ 40 mm OD) that would be next to the flexible transfer line in the same cable tray. They would join the compressor suction line at the liquefier. This gas flow is a very small percentage of the total compressor suction flow.