Cell Comparison-2 Nesting of Babar and of Cleo superlayers

Robert Henderson (TRIUMF)
rhend@triumf.ca
SuperB Canada group
Posted 07 June 2009

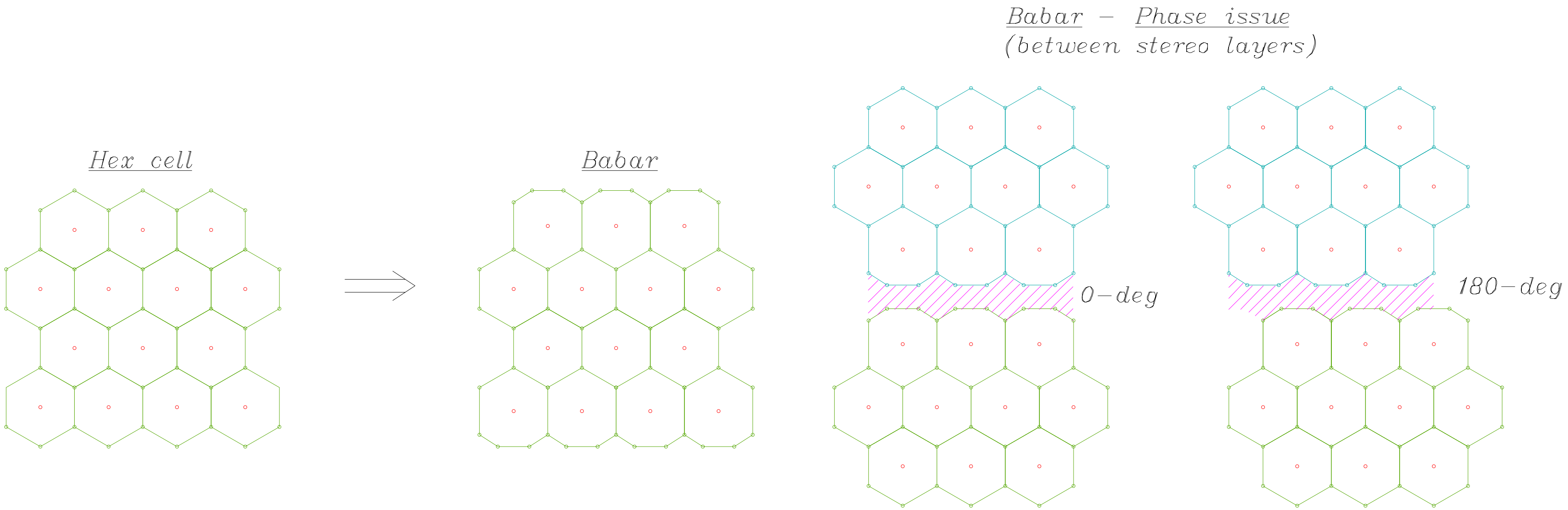

Figure 1. At left an ideal hex-cell geometry is shown. Next to that I show how the first and fourth cell layers of the Babar superlayers were modified to try to reduce the interface problem between superlayers. To the right, I show the issues of the phase change between + and – stereo superlayers. The magenta hatch regions are poor field area, that are dead for tracking, yet 'bleed' electrons into adjacent cell layers. With only four cell layers per superlayer, 50% of the cells are quite different from an axial cell.

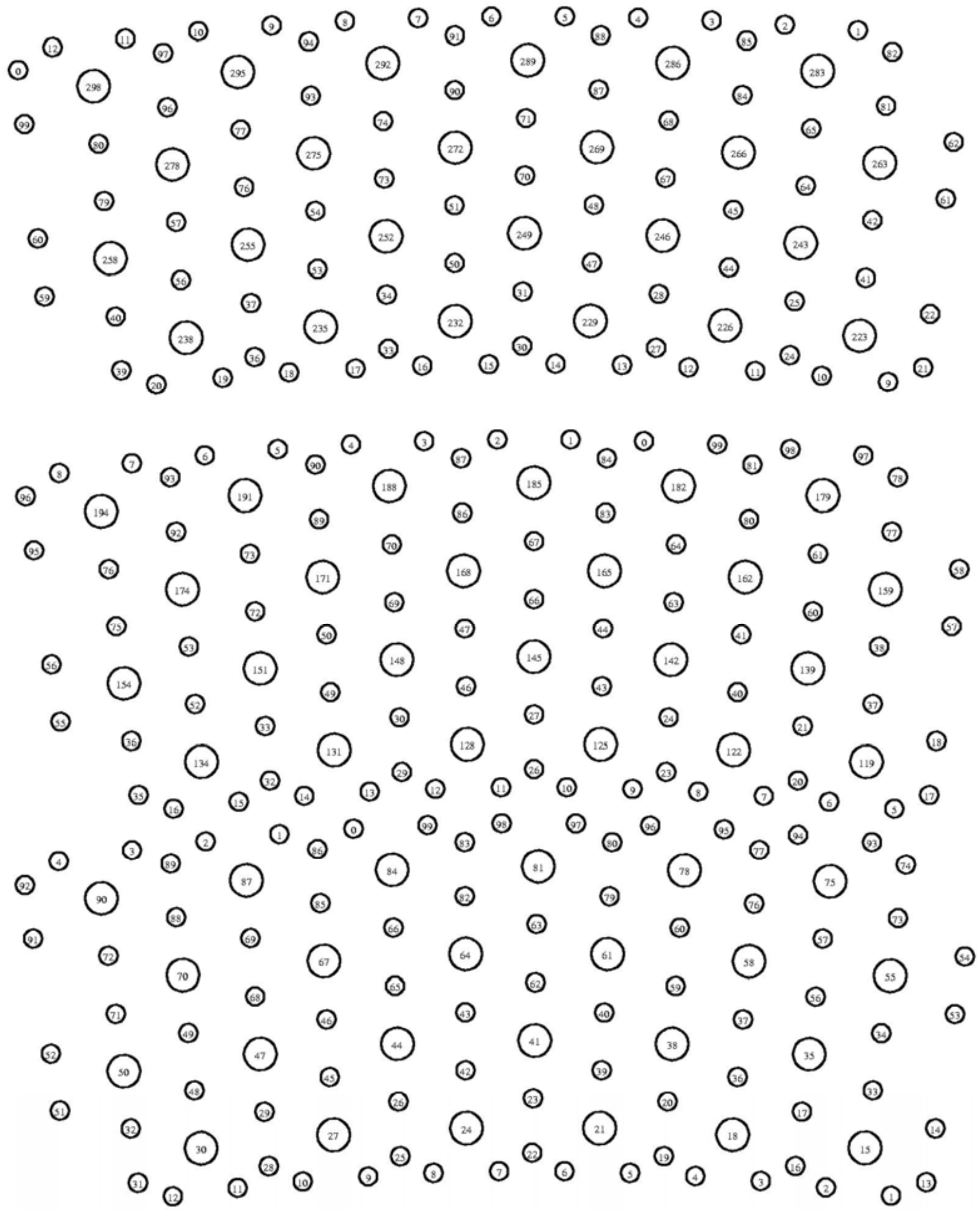

Figure 2. Here three Babar superlayers are shown (near the center of the chamber). The lower two superlayers are stereo +/- and the top one is axial. The situation shown is as described in Figure 1. The deeper dead region between the axial and stereo is because of the conical shape of the stereo superlayers (their radii drops towards the center of the chamber).

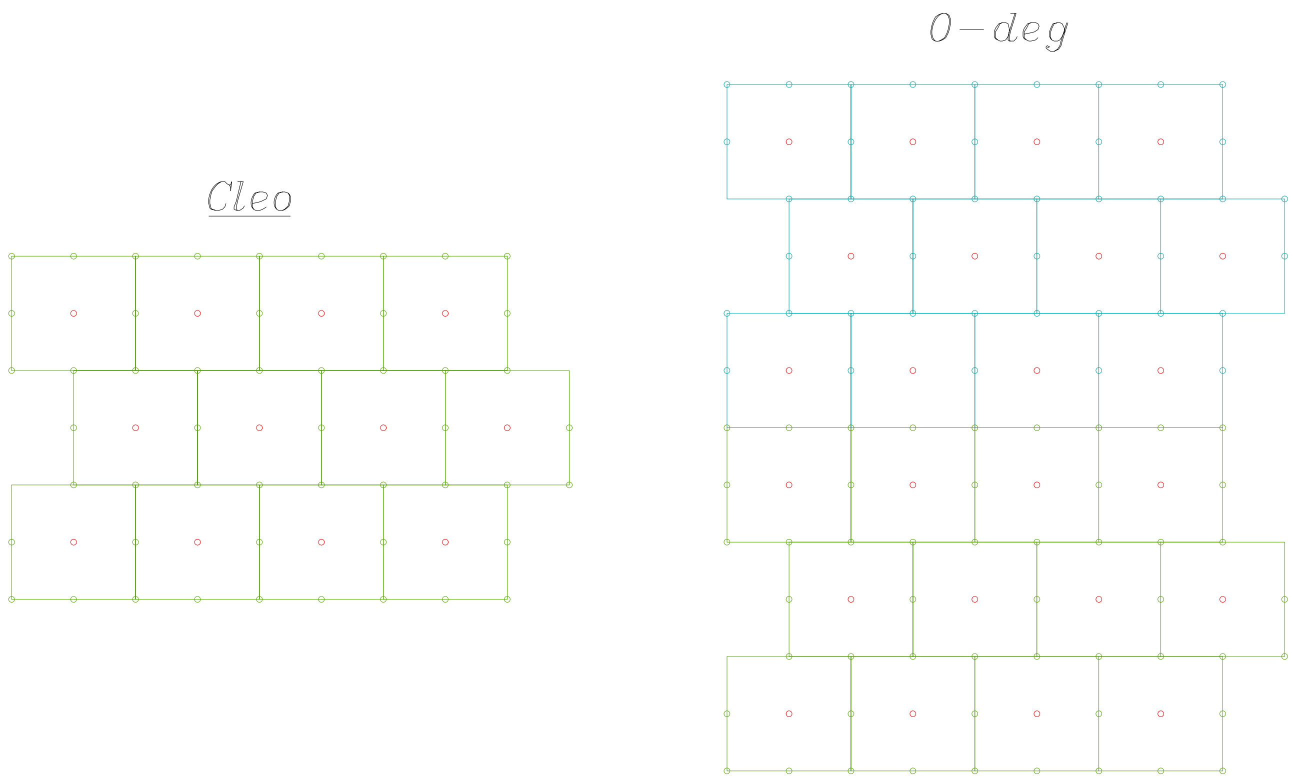

Figure 3. At left the cell geometry of Cleo is shown. On the right I show how two superlayers join (one shown green the other cyan). If both are stereo or both axial, there is no “dead region” between them and no slow electrons “bleeding” into cells. There is still phase change between + and – stereo superlayers, this will be shown in Figure 4.

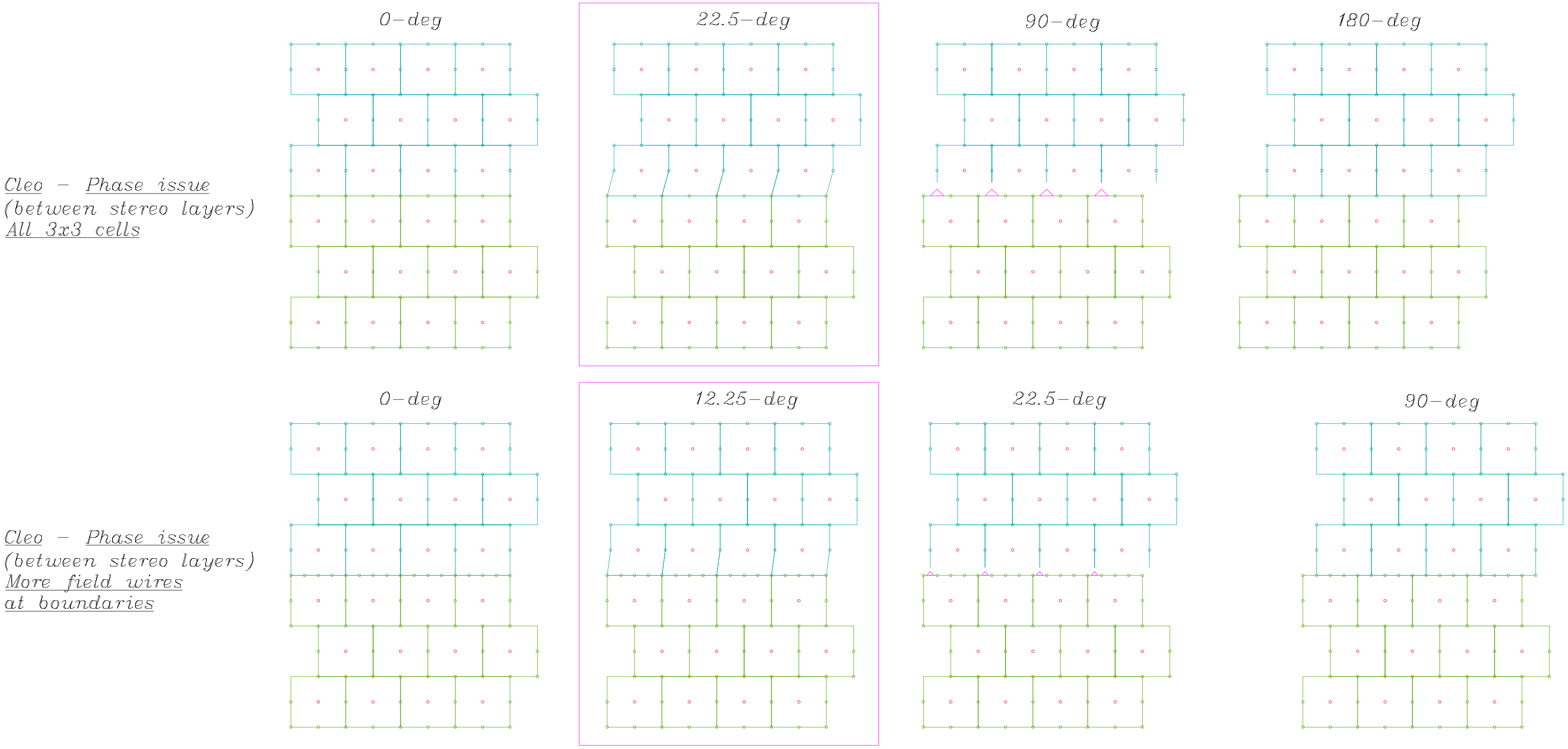

Figure 4. The top four figures show the phases between two stereo superlayers. This is for the 'regular' Cleo cell design. The magenta box shows the case for maximum cell distortion at 22.5 degrees of phase (The boundary layer of cell stays aligned with the green superlayer). The small magenta triangles shows areas of poor drift field.

The bottom four figures show the situation is more field wires are added to the boundary layer. The maximum cell distortions a less (magenta box) and the poor field regions (small magenta triangles) are even smaller.

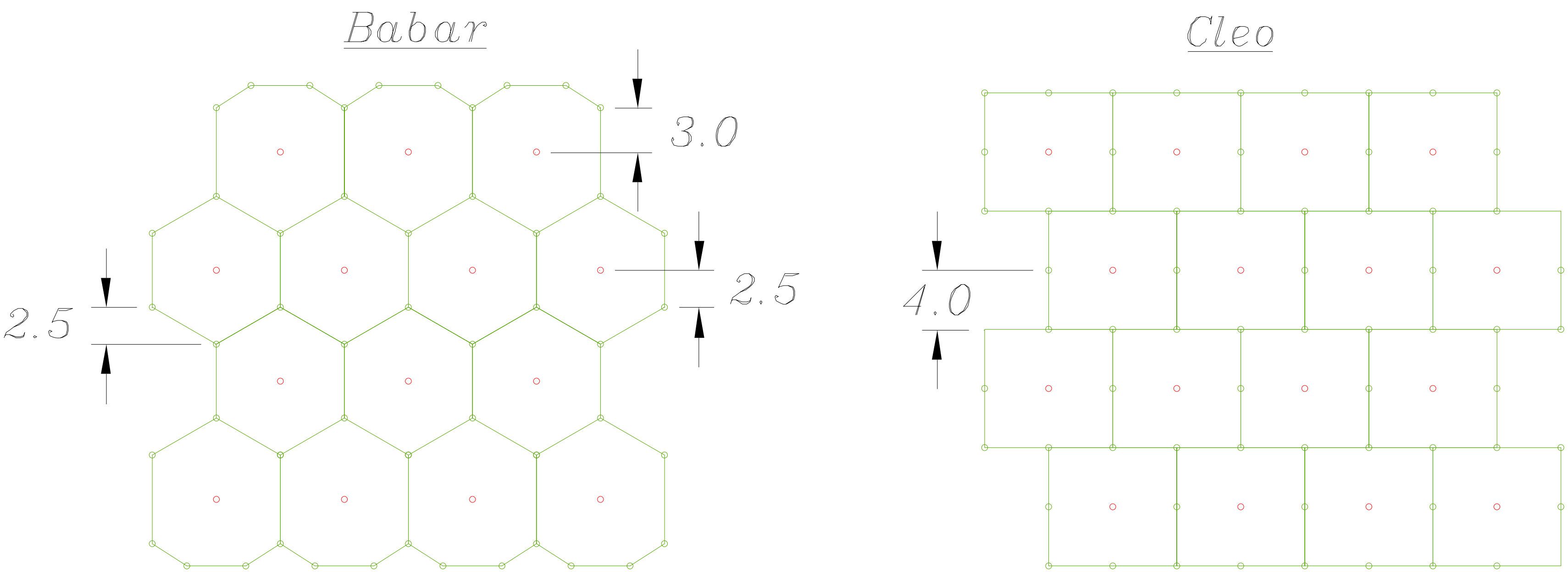

Figure 5. The dimensions of this side-by-side view of a Babar superlayer and a Cleo superlayer illustrate another issue. If the SuperB drift chamber has a steeply staggered endplate (wedding cake), there will need to be ‘breaks’ within cells. These ‘breaks’ are places where the flat ring of a wedding cake layer must end, connecting to a piece of axial cylinder, then continuing on the next flat ring. These breaks require space, and the insulated crimp pins take considerable space. At right is a Cleo-type cell structure (scaled to same radial size). As this figure indicates, the nested hex-cell shapes of the Babar chamber have a lot less space for these breaks, too little in my opinion.

Table-1: Cleo DR3 Drift Chamber

	Cells/layer	Diff	
Wedding Cake	64		* Added - Stereo
(2-SW layers)	72	8	* Added - Stereo
(div by 8)	88	16	Rest axial
(cells/SL by 16)	96	8	
	112	16	
	128	16	
	136	8	
	152	16	
Outer 4-SW SLs	180		All Stereo
(div by 4)	204	24	
(cell/SL by 16)	228	24	
	252	24	
	276	24	
	300	24	
	224	24	
	248	24	

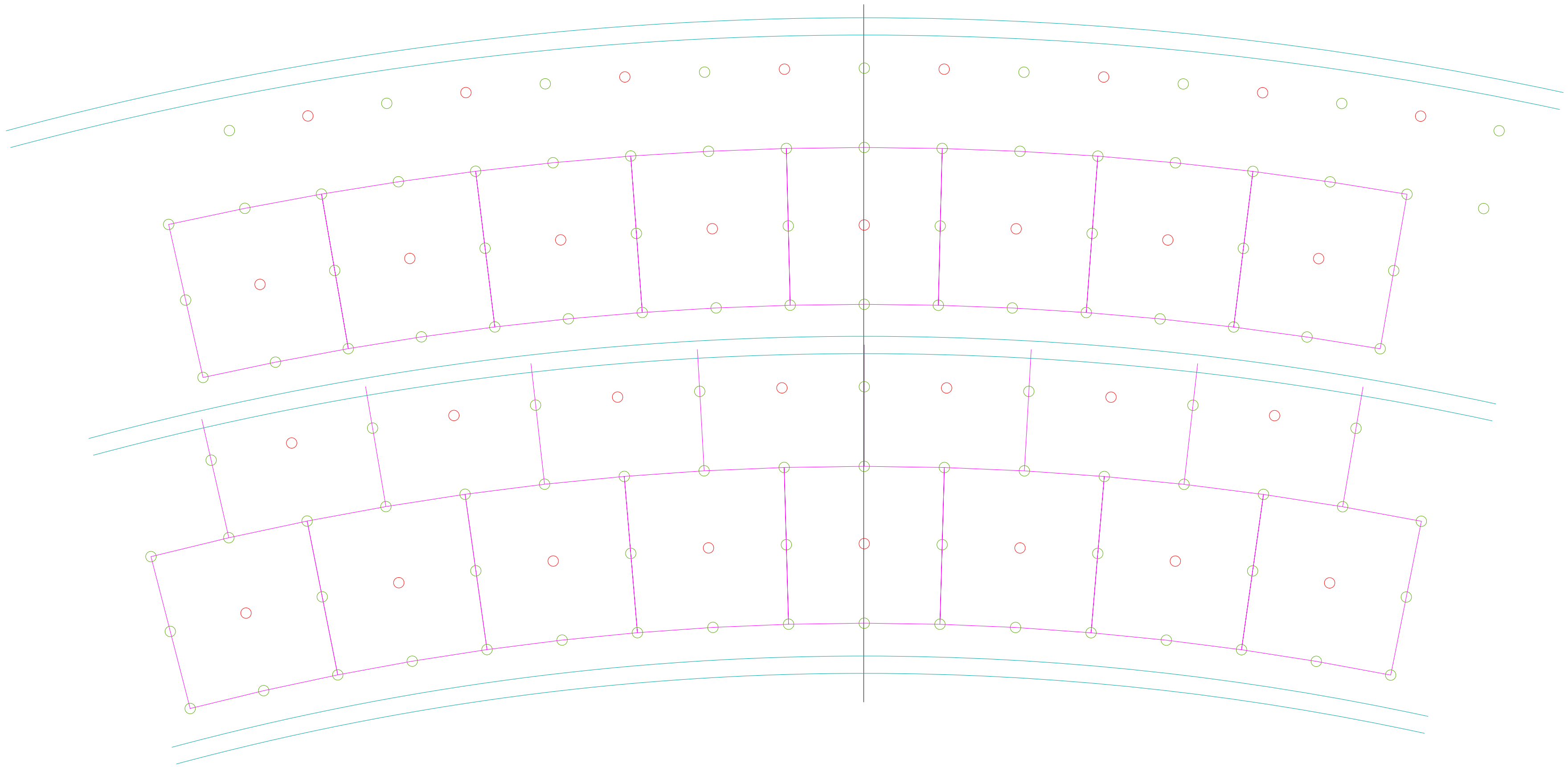

Figure 6. This figure shows how the ‘wedding cake’ part of the Cleo chamber has ‘breaks’ every two cells (radial) for the insert of a piece of cylinder (cyan). They also increase the cell count at these breaks, producing an inevitable small field-wire phase issue. The magenta lines help illustrate this. The alternative is to keep the cell number and let the cells get bigger (scale), perhaps doing cell number increases every four cell layers. Then the boundary layers might have more field wires if this is physically possible.

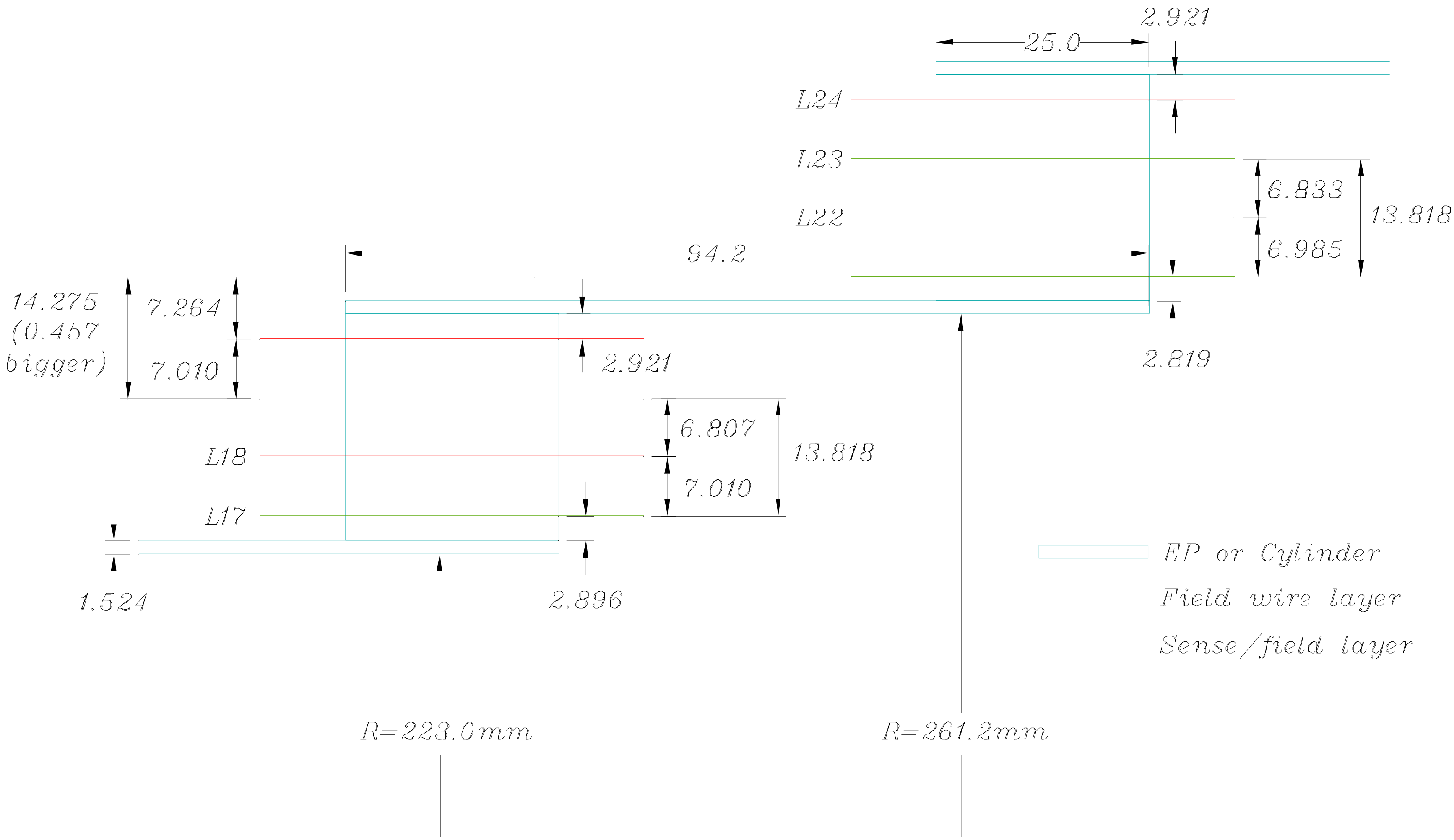

Figure 7. This figure shows a side section view of the same parts of the Cleo wedding cake as Figure 5. The dimensions show how the cell size (radial) is 13.818mm for the cells on either side of the break, but 0.457mm bigger (14.275mm) for the cell layer where the cylinder piece is needed. Note also that for the adjacent layers the sense wire is slightly offset outwards to compensate for the wedge-shape of the cells. For the break layer, the space is not enough, so the voltage on the field wires after the cylinder (and the position/voltage of the next sense wires layer) had to be 'tweaked'.

My Comments

I don’t see a good reason for using a hex-cell design like Babar. As I’ve indicated in this short document, a simpler cell geometry as used in Cleo has far fewer superlayer boundary issues.

Figures 6 and 7, indicate some of the extra complications produced when the drift chamber has a steeply staggered endplate (wedding cake), and Figure 5 shows that a lot less space would be available for the needed ‘breaks’ for a wedding-cake type endplate.

I suggest we try to minimize the number of steps in the SuperB wedding cake. Cleo had EIGHT stepped rings before the outer gently conical region began, each ring only having two sense wire layers. I’d suggest four or less stepped rings, each having a full superlayer (4 sense wires deep). This obviously depends strongly on the shape of the SuperB detector.

IF Garfield indicates there would be a problem due to field-wire ‘phases’ at the boundaries between superlayers, there are two approaches:

1) Give each superlayer it’s own begin/end field wire layer and perhaps increase the wire number in these boundary layers. (** We must do this at the boundary between axial and stereo superlayers). The downside of this is that it creates more dead regions and their electrons ‘bleed’ into adjacent cells.

2) Share boundary field-wire layers (between two axials, or two stereos), but increase the wire number in these boundary layers (if possible).