Silicon sensors layout for LumiCal

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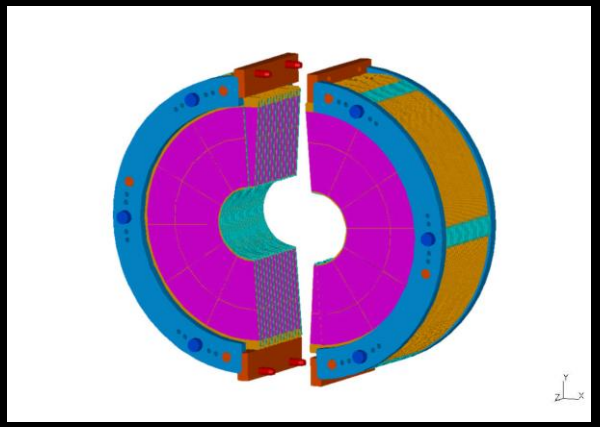
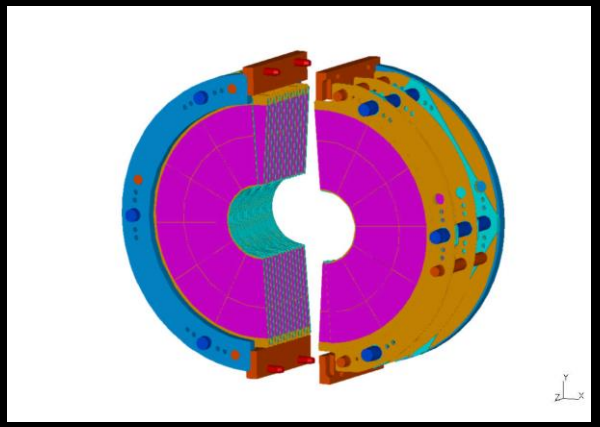
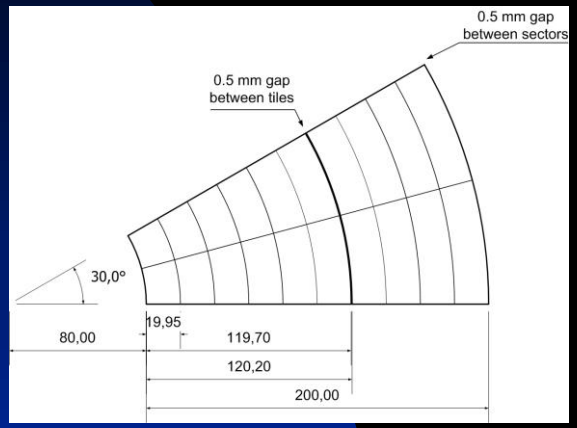
Mechanical design of Lumi Cal

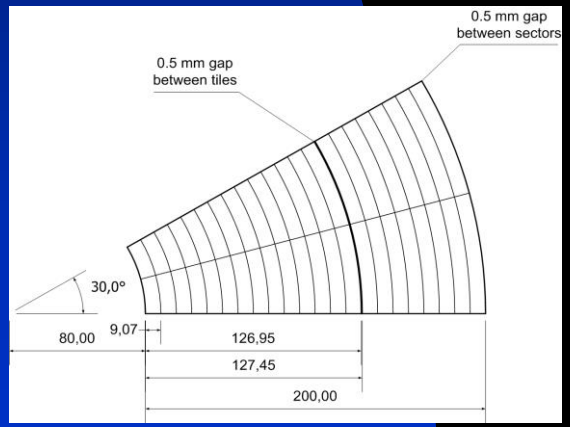
- Segmented silicon sensors interspersed into the tungsten half disks
- Two half barrels to allow for mounting on closed beam pipe
- The blue bolts support the heavy part of the detector, tungsten half disks
- The red bolts carry only the sensors
- Holes for precision survey the sensors position



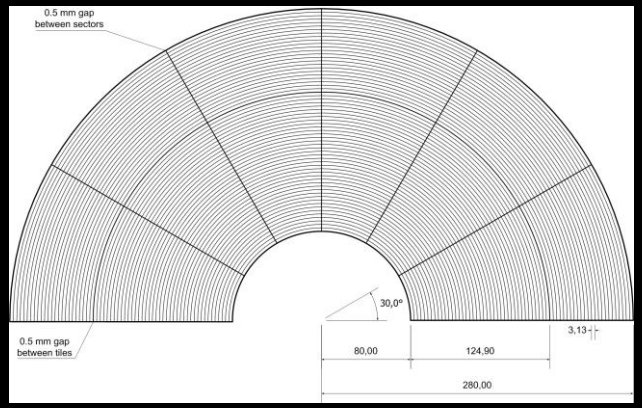


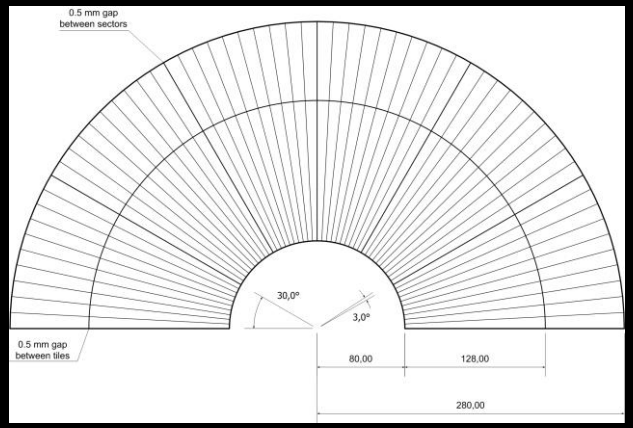
The layout of a silicon sensors





Pads

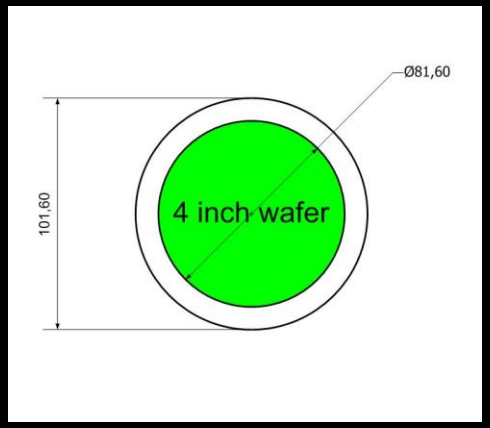


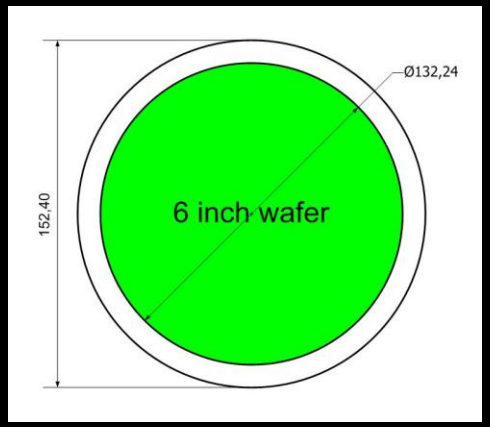


Strips

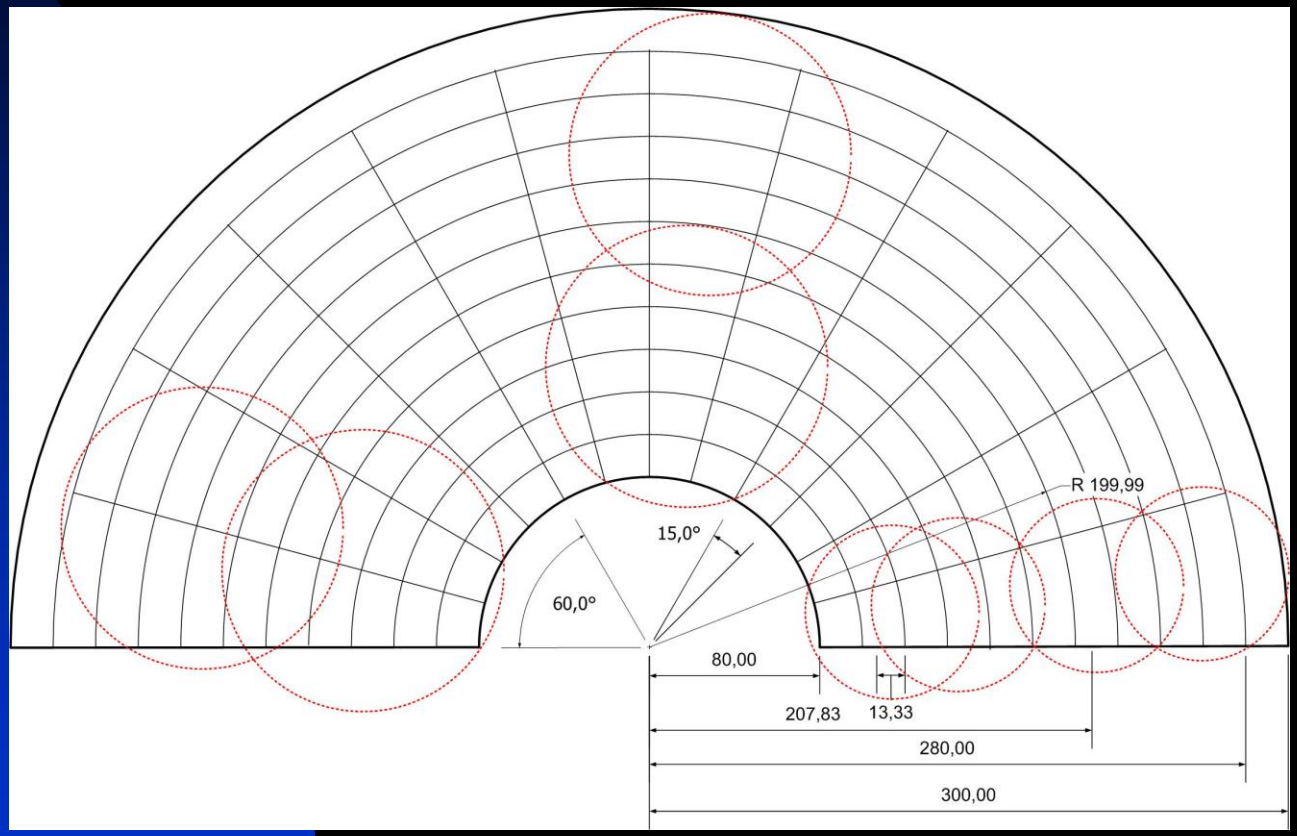
Wafer size

- 6 inch or 4 inch wafers can be used
- Usefull space of wafer is reduced of approx. 1 cm in radius

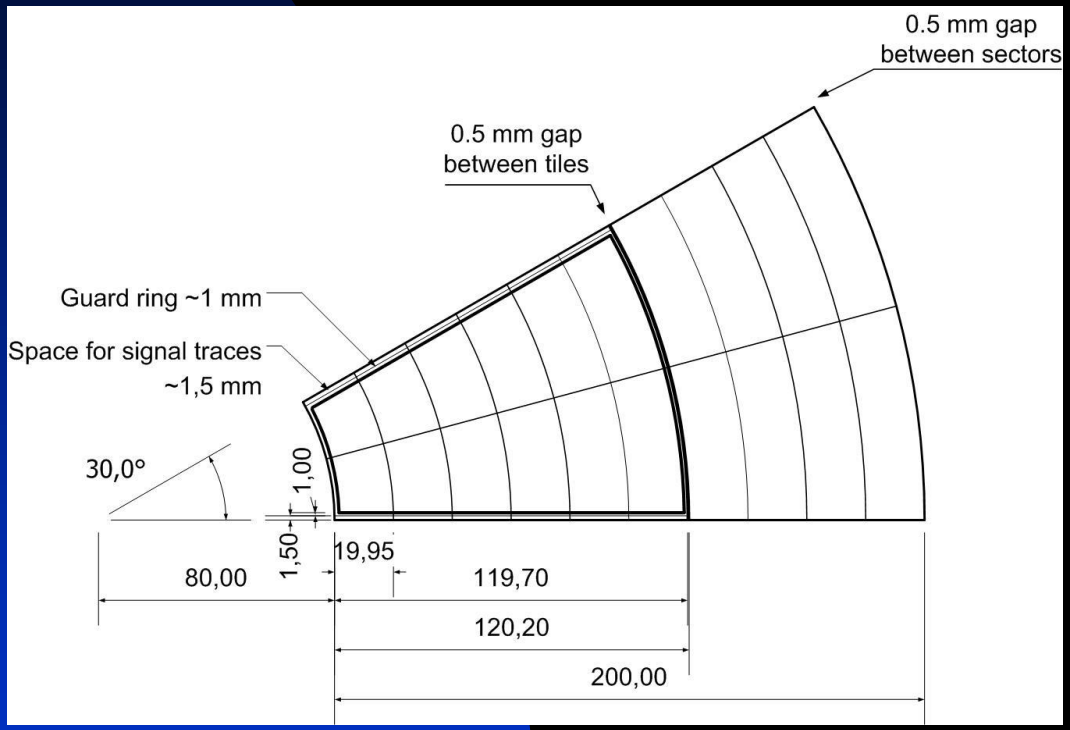




Effective wafer size – more detector tiles

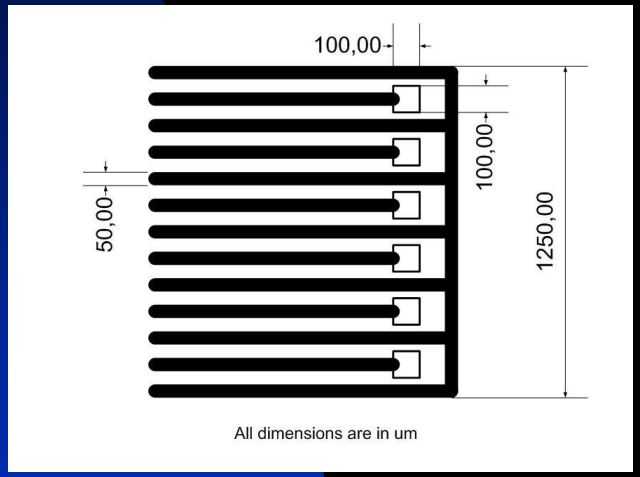


Guard rings & space for readout traces



- Guard ring reduces the aktive sensor surface by ~1 mm on each side of a tile
- Traces will take ~1.5 mm on radial side of a tile

Traces and pads for wire bonding on silicon



- Pads for wire bonding should be at least 60 um x 60 um
- Width of traces can be small as 1 um, but the impedance will be high
- Grounded lines between signal traces will reduce the crosstalk

Costs of silicon sensors

- Startup 500-1000 €
- Set of masks (5 x 1000) ~5000 €
- Different shapes of tiles 4
- Detector tiles (~300€, 24 tiles x 22 layers) ~160 k€

- Total cost 4 x 6000 + 160 k = ~184 k€

Conclusions I

- More questions than answers, but:
- Smaller tiles (15° to 20°)
- Dead area of detector (guard rings, space for traces) have to be implemented in MC
- Readout traces on silicon or on support ceramics?

Conclusions II

Traces on ceramics

- More space, low impedance, lower crosstalk
- No dead area on detector
- Pads for wire bonding can be 0.5 mm x 0.5 mm (precision of pads positioning not important)
- The gap (0.5 mm) between the tiles looks sufficient for wire bonding

Conclusions III

From the technical point of view, the strip version looks very promising

- Easy to feed out the signal traces
- Radial strips have equal capacitance
- Bonding the concentric strips to subsectors can minimize the capacitance ratio (>3 for pads) but increases the number of channels. Additional granulation in φ can be usefull