SDC-91-00027

SDC
SOLENOIDAL DETECTOR NOTES

SUGGESTED MODIFICATIONS TO Si LAYOUT PROPOSED 4/15/91 BY H. ZIOCK

M. Strovink

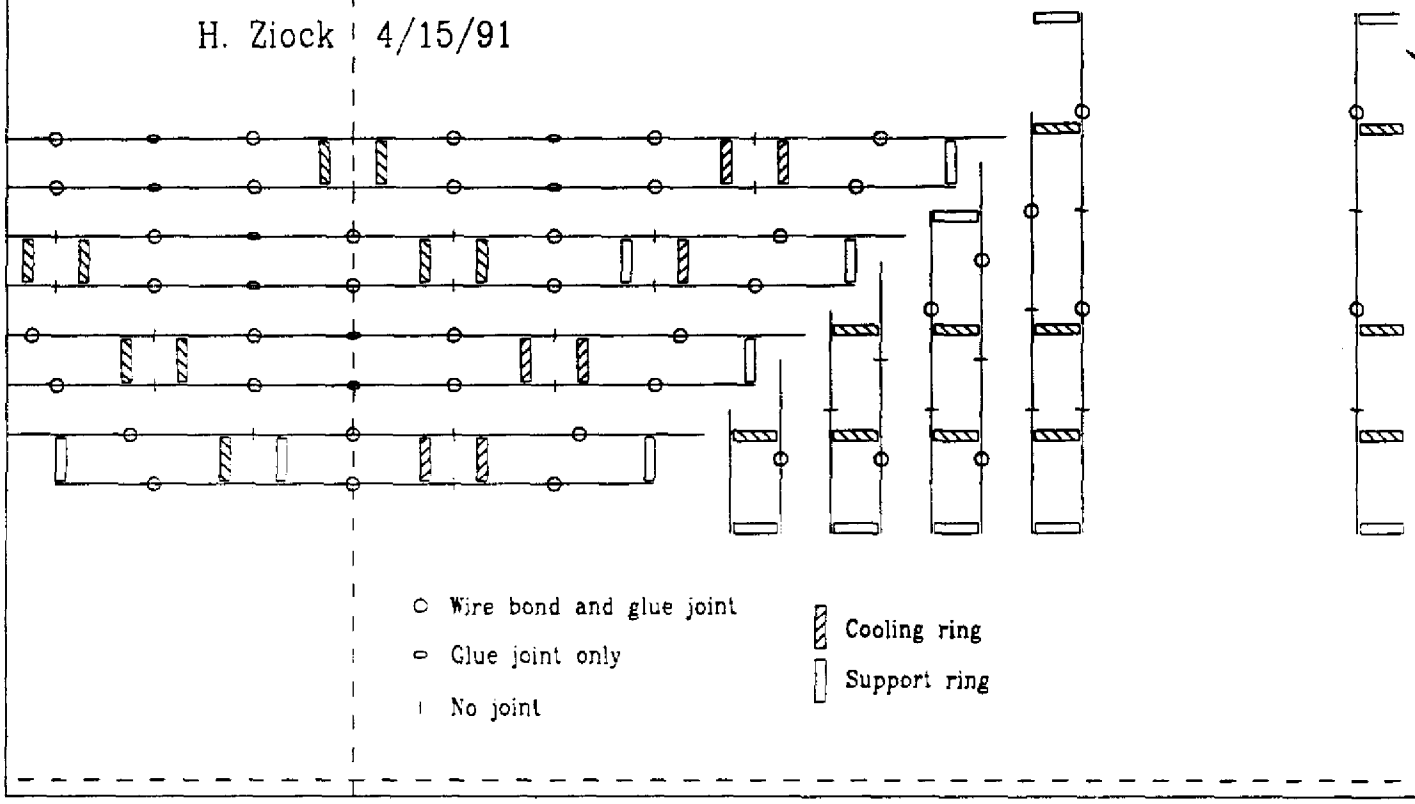
April 30, 1991

Suggested modifications to Si layout proposed 4/15/91 by H. Ziock

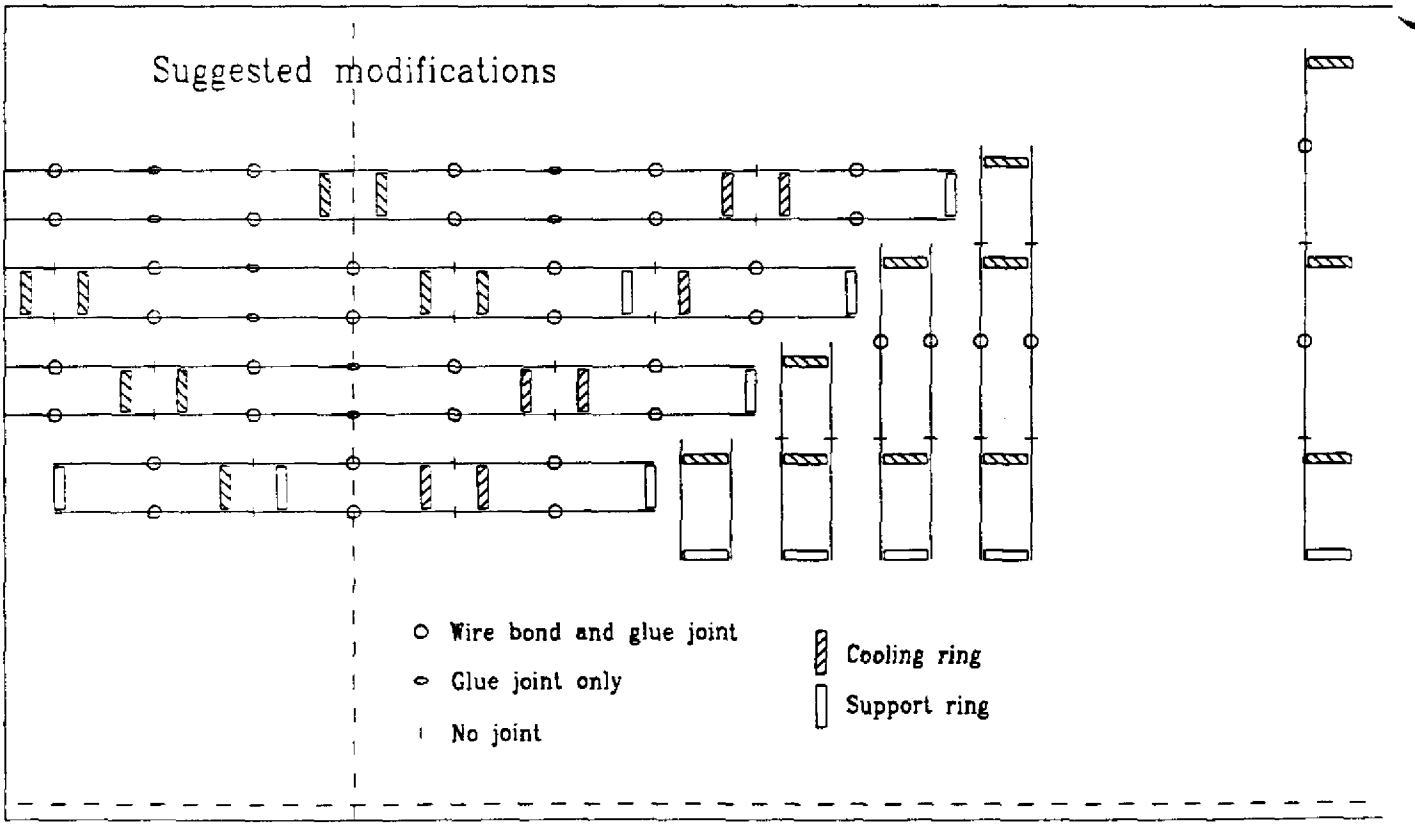
SDC-91-00027
M. Strovink
30 April 1991

- Suggested modifications
- Disk layout before modifications
- Modified disk layout
- Detector requirements in modified layout
- Performance improvements
- Simplifications in construction
- Uncomfortable aspects eliminated

H. Ziock 4/15/91



Suggested modifications



Suggested modifications

- Remove 3 cm from each end of the even barrel layers.
- Make disks 2, 4, 6, and 8 identical in inner and outer radii, respectively, to disks 1, 3, 5, and 7. Move the disk packages closer to z=0 by 3 cm.
- Read out the disks at 1, 2, or 3 of 5 radii (21.21, 27.27, 33.33, 39.39, 45.45 cm) rather than 1, 2, or 3 of 3 radii (20.9, 27.3, or 39.5 cm). Then every wedge is read out near $r_{\max}$.

Disk layout before modifications

Disk	$R_{\min}$	$R_{\max}$	Detectors	R_{readout}	N
1	15	22.5	A^*	20.9	46
2	15	25.5	a, b^*	20.9	46
3	15	28.5	A^*	20.9	46
			B^*	27.3	54
4	15	31.5	a, b^*	20.9	46
			c^*	27.3	54
5	15	34.5	A^*	20.9	46
			B^*, C	27.3	54
6	15	37.5	a, b^*	20.9	46
			c^*, d	27.3	54
7	15	40.5	A^*	20.9	46
			B^*	27.3	54
			C, D^*	39.5	78
8-22	$\geq$15	46.5	A^*	20.9	46
			B^*, C	27.3	54
			D^*, E	39.5	78

* Detectors with asterisks are connected directly to readout IC's; others are read out by being wire bonded to asterisked detectors.

Modified disk layout

Disk	$R_{\rm min}$	$R_{\rm max}$	Detectors	$R_{\rm readout}$	N
1,2	15	22.5	A^*	21.21	42
3,4	15	28.5	A^*	21.21	42
			B^*	27.27	54
5,6	15	34.5	A^*	21.21	42
			B', C^*	33.33	66
7,8	15	40.5	A^*	21.21	42
			B', C^*	33.33	66
			D^*	39.39	78
9-22	$\geq$15	46.5	A^*	21.21	42
			B', C^*	33.33	66
			D', E^*	45.45	90

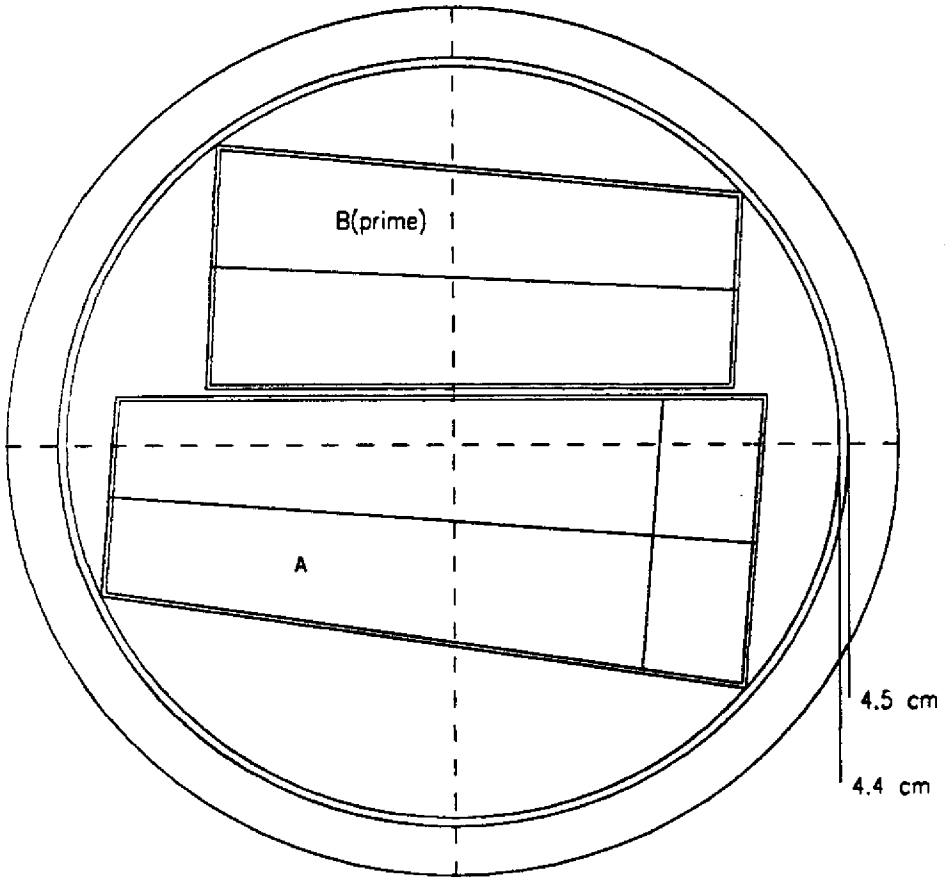
Notes:

- Detectors A, B, C, D, and E have the same inner and outer radii as detectors by the same name in the unmodified layout. The widths of B, C, D, and E are smaller since they are read out at larger radii. The width of A is larger since it is 3.2 rather than 2.88 cm wide at $R_{\rm readout}$, in order to accommodate an integral number of 128-channel (SVX-like) IC's.
- Detectors B' and D' have the same inner and outer radii as detectors B and D; but they subtend the same $\Delta\phi$ as detectors C and E, respectively, so that they may be wire bonded to those detectors.
- For the readout radii indicated, the detector overlap is 210 μm instead of the nominal 200 μm.
- Nowhere on any wedge detector is the strip pitch larger than 52 μm. In some places it is considerably smaller (down to 34 μm).
- At $R_{\rm readout}$, the active width of all detectors is 3.2 cm, compatible with (5) 128-channel IC's at 50 μm pitch.

Detector requirements in modified layout

Detector	# of disks where used	N	# detectors/end
A	16 (1-16)	42	672
B	2 (3-4)	54	108
C	16 (5-20)	66	1056
D	2 (7-8)	78	156
E	14 (9-22)	90	1260
B'	14 (5-18)	66	924
D'	14 (9-22)	90	1260
			5436

For the mask pairing (A, B'); (B, B'); (D, B'); (C, C); and (D', E), requiring 5 different wedge detector masks, there would be only 12 "extra" detectors per 5448 produced.



Performance improvements

- Minimum S/N is increased by 25% due to a reduction in maximum strip length from 15 to 12 cm.
- The pitch of wedge detectors that are read out by being wire bonded to other detectors is always <50 μm, not >50 μm. At some radii, the accuracy and track pair resolution are significantly improved.
- Hermeticity near 45° is enhanced by more overlap between barrel and disk elements. *In situ* relative alignment of barrel and disk assemblies is facilitated.
- Since the disks have the same number of cooling rings but fewer support rings, they have less material.

Simplifications in construction

- Pairs of barrel layers that share the same cooling rings have the same length. Pairs of disks that share the same cooling rings are identical.
- The # of different barrel detectors is reduced from 2 to 1. The # of different disk detectors is reduced from 9 to 7.
- The # of different barrel detector masks is reduced from 2 to 1. The # of different disk detector masks is reduced from 6 to 5.
- The # of different disks (among disks 1-9) is reduced from 8 to 5.
- All ladders (both barrel and disk) have the same number (5×128) of readout channels.
- A wider path between the barrel and disk assemblies is available for cables, pipes, supports, and services.

Uncomfortable aspects eliminated

- 0% rather than 20% of barrel detectors are produced 1 per wafer.
- 0 rather than 1 disk readout ring has a number of detectors around the circumference (46) that is indivisible by 6.
- 0 rather than 1 wedge detector exceeds the 4.5 cm radius limit when produced 2 per wafer.
- The maximum number of channels per readout IC is 128 (like the SVX) rather than 64 (though 64 still could be adopted).
- 0% rather than 50% of barrel layers have 3 cm of unsupported Si cantilevered at the ends of the assembly. 0% of disks have $\geq$3 cm of unsupported Si cantilevered at the outer radius.