1 Arrangement of Barrels and Wedges

Each barrel of SVX II will be 32 cm in length, with four layers of silicon grouped into ladders and arranged in 12 wedges in azimuth. Each ladder will consist of four silicon detectors mounted together into a single mechanical unit and wirebonded electrically in pairs which are read out at each end of the ladder. In order to reduce the dead space between barrels, the kapton readout hybrids will be attached to beryllium substrates and mounted on the surface of the outer detectors of a ladder. The kapton/beryllium combination should have good cooling performance and lower mass than standard thick film hybrids. The ladders themselves are mounted between two precision machined beryllium bulkheads which have a staggered radii geometry and allow for overlap between neighboring ladders.

2 Ladder Design and Cooling Models

The SVX II ladder design has evolved from that used for SVX and uses a structure formed out of boron-carbon fiber and Rohacell foam to couple 2 two-detector half-ladders together to form a complete 4 detector ladder. Significant engineering effort has gone into designing the ladder support to have the same thermal expansion coefficient as silicon in order to minimize stresses in the silicon during temperature changes. The ladder support structure should maintain detector-to-detector alignment to within ± 5 microns in the $r - \phi$ direction. Since the double-sided detectors in the present SVX II design have an orthogonal stereo angle to optimize the $r - z$ vertex resolution, a tight tolerance on the radial uncertainty of the detectors is also required. This is because for tracks at large incident angles, there is a strong coupling between the radial and z position uncertainties. The z position uncertainty in the placement of the detectors during the ladder construction process should be $\sim \pm 10$ microns.

3 Space Frame and Alignment

In order to achieve the 100 μradian alignment of the detector $r - \phi$ strips to the beam required by the SVT trigger to avoid high rates from fake impact parameter triggers, the three barrels will be mounted in an external space

frame. Early designs of the space frame consist of a structurally strong, low mass web of carbon fiber strips molded into a half cylinder. The space frame is estimated to weigh less than 0.5 kg and have a deflection of $< 20\mu$m when fully loaded. The space frame will also provide mounting support for the portcards, cables, and cooling pipes.

Table 1.2 shows a comparison between the SVX and present baseline SVX II detector parameters. We see that the most dramatic difference is the doubling of the length, which has tripled the number of $r - \phi$ readout channels. The addition of the $r - z$ readout nearly doubles again the number of channels.

Table 1.2: Comparison of the SVX and SVX II detector geometries.

Detector Parameter	SVX	SVX II
Readout coordinates	r-ϕ	r-ϕ;r-z
Number of barrels	2	3
Number of layers per barrel	4	4
Number of wedges per barrel	12	12
Ladder length	25.5 cm	32.0 cm
Combined barrel length	51.0 cm	96.0 cm
Layer geometry	3° tilt	staggered radii
Radius innermost layer	3.0 cm	2.4 cm
Radius outermost layer	7.8 cm	8.7 cm
r-ϕ readout pitch (4 layers)	60;60;60;55 μm	60;62;58;60 μm
r-z readout pitch (4 layers)	-	150;133;133;150 μm
Length of readout channel (r-ϕ)	25.5 cm	16.0 cm
r-ϕ readout chips/ladder (4 layers)	2;3;5;6	4;6;10;12
r-z readout chips/ladder (4 layers)	-	4;6;6;8
r-ϕ readout channels	46,080	147,456
r-z readout channels	-	119,808
Total number of channels	46,080	267,264
Total number of readout chips	360	2088
Total number of detectors	288	576
Total number of ladders	96	144
Silicon area (m^2)	0.68	1.5
Diode length (miles)	7.3	17.5