SVD2.0 Beampipe Status

6/13/01 KEK-B IR meeting

1. Radius decision

EB meeting 5/12/01 → r=1.5cm.

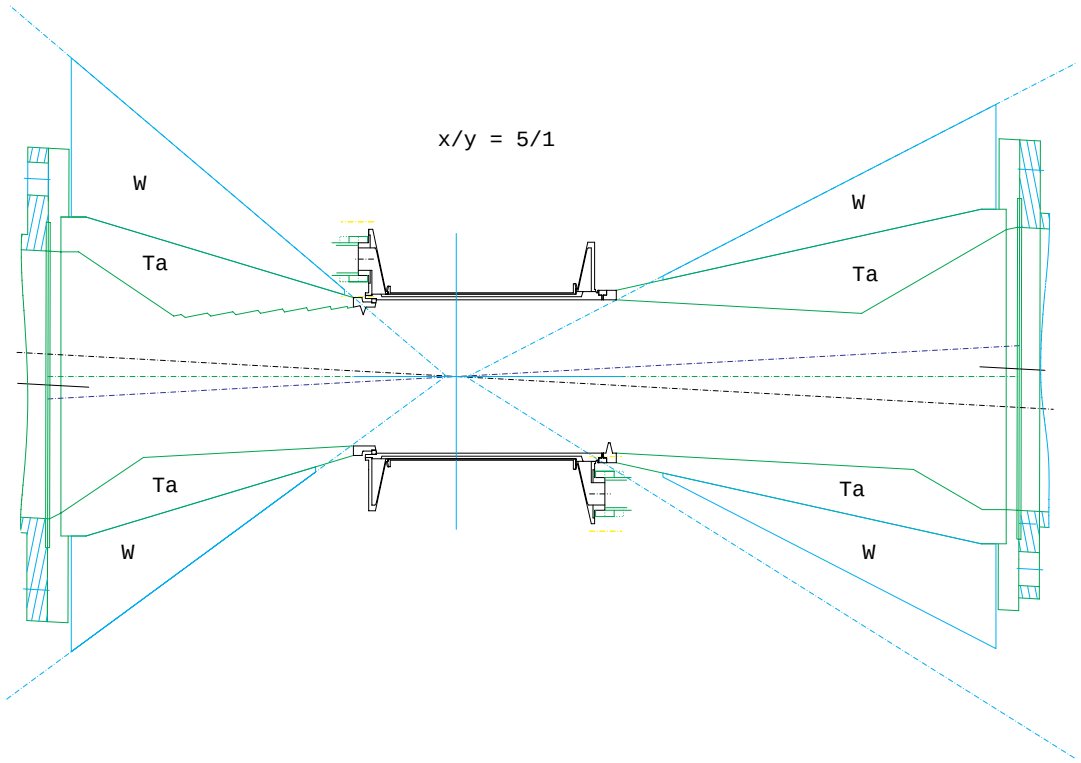
- Particle background risk.
- SR backgrounds OK.

2. Design is being finalized

- Particles mask designs (1week).
- Ta-SS-Be joint designs (1week).
  → ordering (2weeks).
- Be-AL EB welding test, Be-SS braze test to be performed.
- Au-coating SR test (on SS, Ta):
  radiation completed.

SVD2.0 IR beampipe

r=1.5cm version



Synchrotron Radiation

- **'Soft' SR background by HER** (Sanjay/HY)
  Dominated by QC1,2 Backscat.
  at Oho-side Ta mask
  0.5 kRad/yr (yoff = 0 mm)
  67 kRad/yr (yoff = 3 mm)
  - $\times 1/3$ if Ta is not Au-coated.

- **'Hard' SR background by HER**

  With Ta LER mask: small enough.
  If no Ta LER mask: $\sim$20kRad/yr
  ($\rightarrow$no resonance HOM)
  Use the LER mask anyway.
  (Resonance can be avoided - simulation by Kageyama)

- **'Soft' SR background by LER**

  If the weak bend SR directly hits (it is possible):
  1-80 kRad/yr for 2.5-3.5 mRad bending.

- Online SR alarm (T. Abe)

- All the above dominated by 11 keV Au L-edges.
  (Contribution to occupancy is small)

Particle Background

Simulation: (K. Trabelsi)

- Beam-gas scatterings from the entire ring.
  (Bremsstrahlung + Coulomb)

- GEANT simulation up to $\pm$7m of IP.
  (Up to QC2's)

- Touschek effect.
  Consistent with observed Touschek lifetimes and Touschek background (w/i x2).
  (about half of bkg is due to Touschek)

- Inner-mask optimization (r=1cm/1.5 cm)
  SR mask + beam-stay-clear $\rightarrow$ optimum shape.
  r=1.5cm significantly superior to r=1cm.

- Refinements of GEANT implementation.
  Flanges, masks etc.
  Stray field from QC1RE to LER.

Unit = kRad/yr (1yr = 10^7 sec)
(1.1A/2.6A, 1nTorr CO)

Data: SVD lyr 1

	dose
HER	24 kRad/yr
LER	82 kRad/yr

MC: SVD ly1 1

LER Particles entering GEANT just outside of b.p.
depends strongly on materials around b.p.
The numbers in (), such contributions set to 0.

	Brem/Coul	Touschek	total
HER	40.5	-	40.5
LER	35.2(23.3)	56.5(6.5)	91.7(29.8)

Data/MC agreement is reasonable.

MC Comparisons

SVD1.4 $r = 2cm$				
		$L1$	$L2$	$L3$
r		$3cm$	$4.5cm$	$6.0cm$
HER Brem		5.9	3.2	2.0
HER Coul		34.6	13.9	7.4
LER Brem		20.4(8.5)	9.0(3.1)	4.8(1.3)
LER Coul		14.8	6.3	1.7
Touscheck		56.5(6.5)	32.3(3.6)	16.9(2.0)
Sum		132(70)	65(30)	33(14)

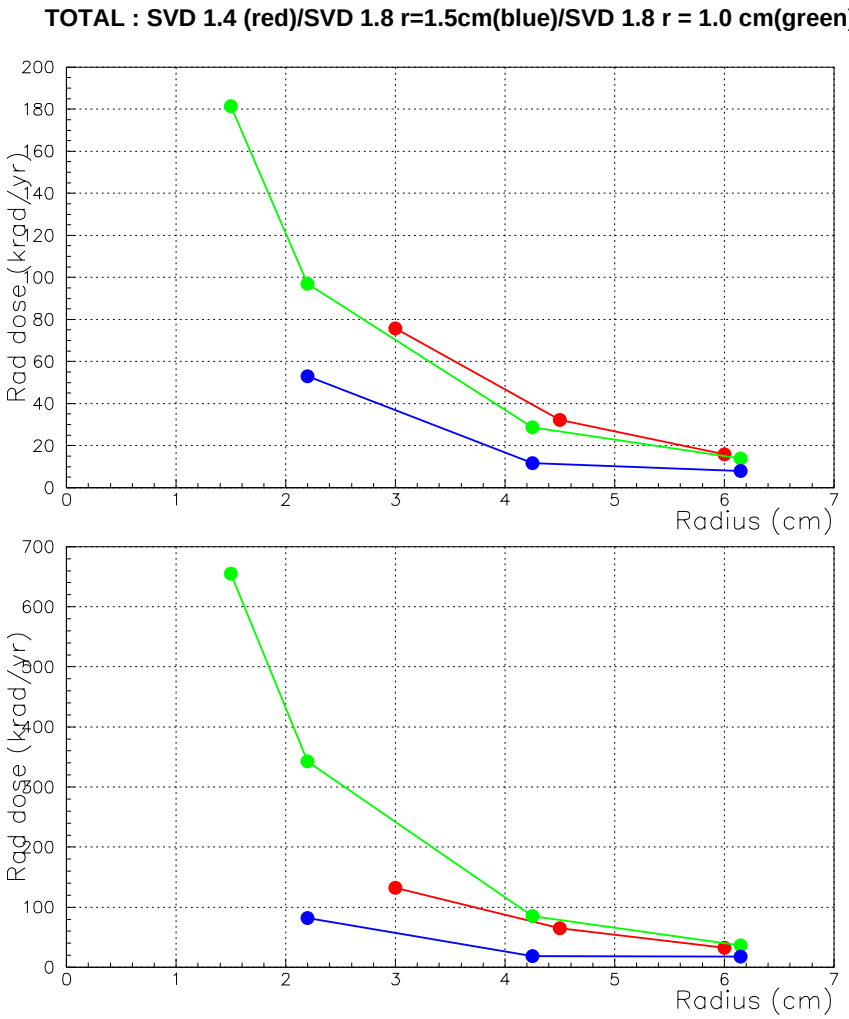
SVD2.0 $r = 1cm$				
	$L1$	$L2$	$L3$	$L4$
r	$1.5cm$	$2.2cm$	$4.25cm$	$6.15cm$
HER Brem	27.5	18.7	5.7	3.3
HER Coul	35.1	21.7	6.5	4.2
LER Brem	67.2(62.8)	38.2(36.9)	9.4(8.9)	4.2(3.1)
LER Coul	51.5	18.2	7.2	2.1
Touscheck	474(464)	245(239)	57(52)	23(18)
Sum	655(641)	361(335)	86(82)	37(31)

SVD2.0 $r = 1.5cm$			
HER Brem	12.5	3.0	1.9
HER Coul	13.4	3.9	3.5
LER Brem	13.1(9.0)	3.4(2.0)	1.6(0.6)
LER Coul	14.0	1.4	1.0
Touscheck	28.8(9.0)	6.7(1.3)	9.7(0.9)
Sum	82(58)	18(12)	18(8)

Particle Bkg Comparisons

Top: w/o Touscheck, Bottom: w/ Touschek

- SVD1.4 (r=2cm)
- SVD2.0 (r=1.5cm)
- SVD2.0 (r=1cm)



Choice of IR beampipe radius

- Occupancy ratio (Now→SVD2.0 design current):
  = (dose ratio)×3(I_{beam})×$\frac{1}{2}$(shaping time reduction)

SVD innermost lyrs:

$$\frac{\text{(r1cm)}}{\text{(r2cm)}} = 7.5(14)\,, \qquad \frac{\text{(r1.5cm)}}{\text{(r2cm)}} = 0.9(1.2)$$

( ): w/o 'just outside b.p.'

r=1cm is not promissing as it is (Touschek!).
r=1.5cm looks good

- CDC rates of innermost lyrs (at same currents)

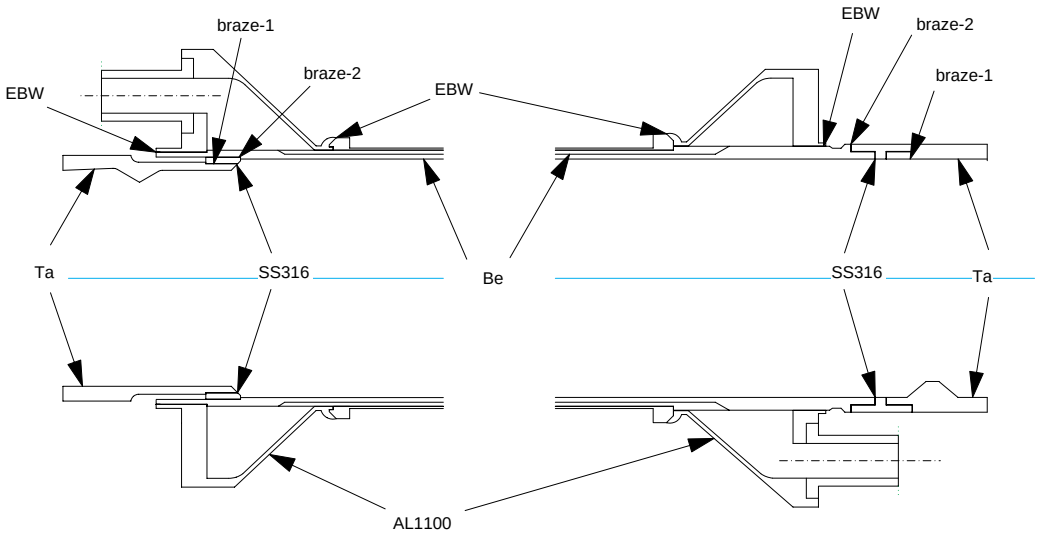
$$\frac{\text{(r1cm)}}{\text{(r2cm)}} = 1.2\,, \qquad \frac{\text{(r1.5cm)}}{\text{(r2cm)}} = 0.5$$

×3(current) < 8 **(OK)**

Executive Board Decision:
→ use r=1.5 cm for the 2002 upgrade.

1. 3 times more current, smaller radius, but about the same noise level.
2. ∼ 25% improvement in vertex resolution exptected.

Be pipe end section design



Make the SS piece small (attached to Ta)

1. No exposed SS → unlikely to have SR melting. Also better cooling.
2. Better HER backscat. shield (Ta>SS).
3. No need to build each Ta cone in two pieces. (Cooling tube connection: mess)
4. Au coating with the BW piece only.
5. Brush-Wellman: 'should work, but **need tests**'.

Cooling tube connection: try metal c-ring design first. (Cryofit is not detachable)

Stress analysis

Simply supported at flanges.
Analytical estimation.

location	moment (kg mm)	stress (kg/mm^2)	allowed (kg/mm^2)
Ta weld(L)	2235	1.96	3.4
Ta (thin)	2252	3.78	5.6
Be (max)	2447	5.73	8.3
Ta weld (R)	2502	1.81	3.4

- allowed = 1/4 (ultimate tensile strength)
- x 0.6 if welding joint.

sag = 0.4 to 0.5 mm at center.

IHI is performing more sophisticated FEA.