B and machine parameter dependence of R_{VTX}

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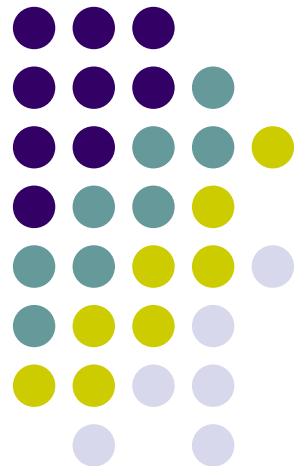
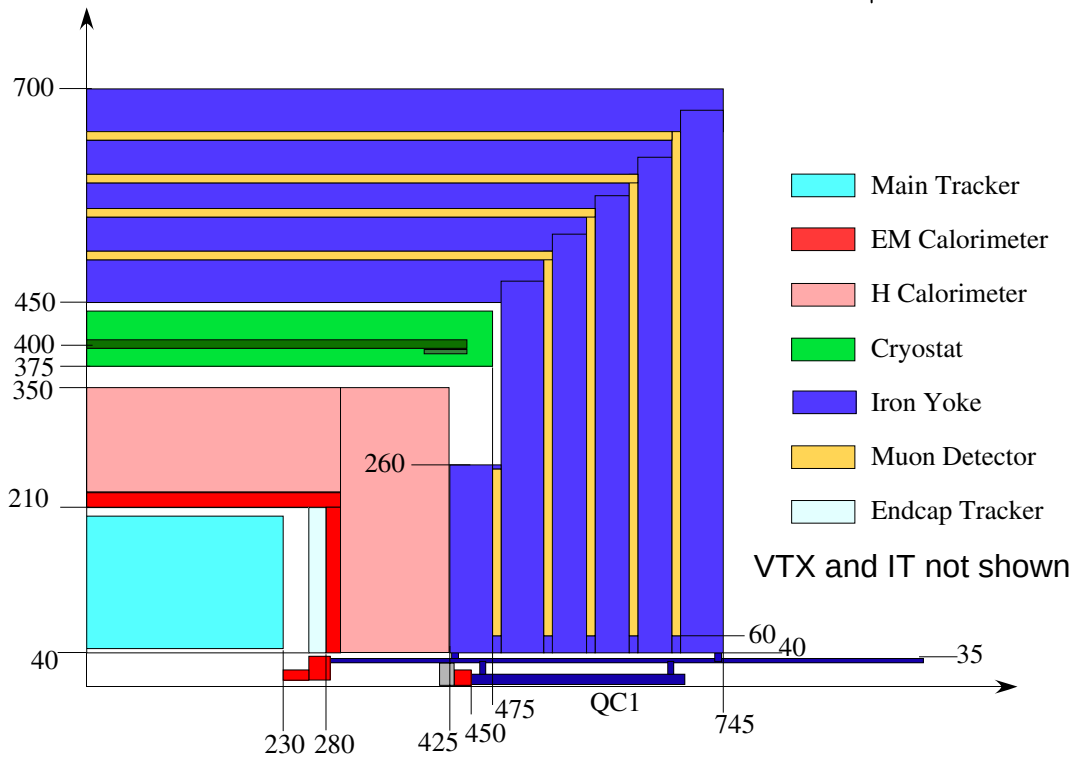
@Snowmass



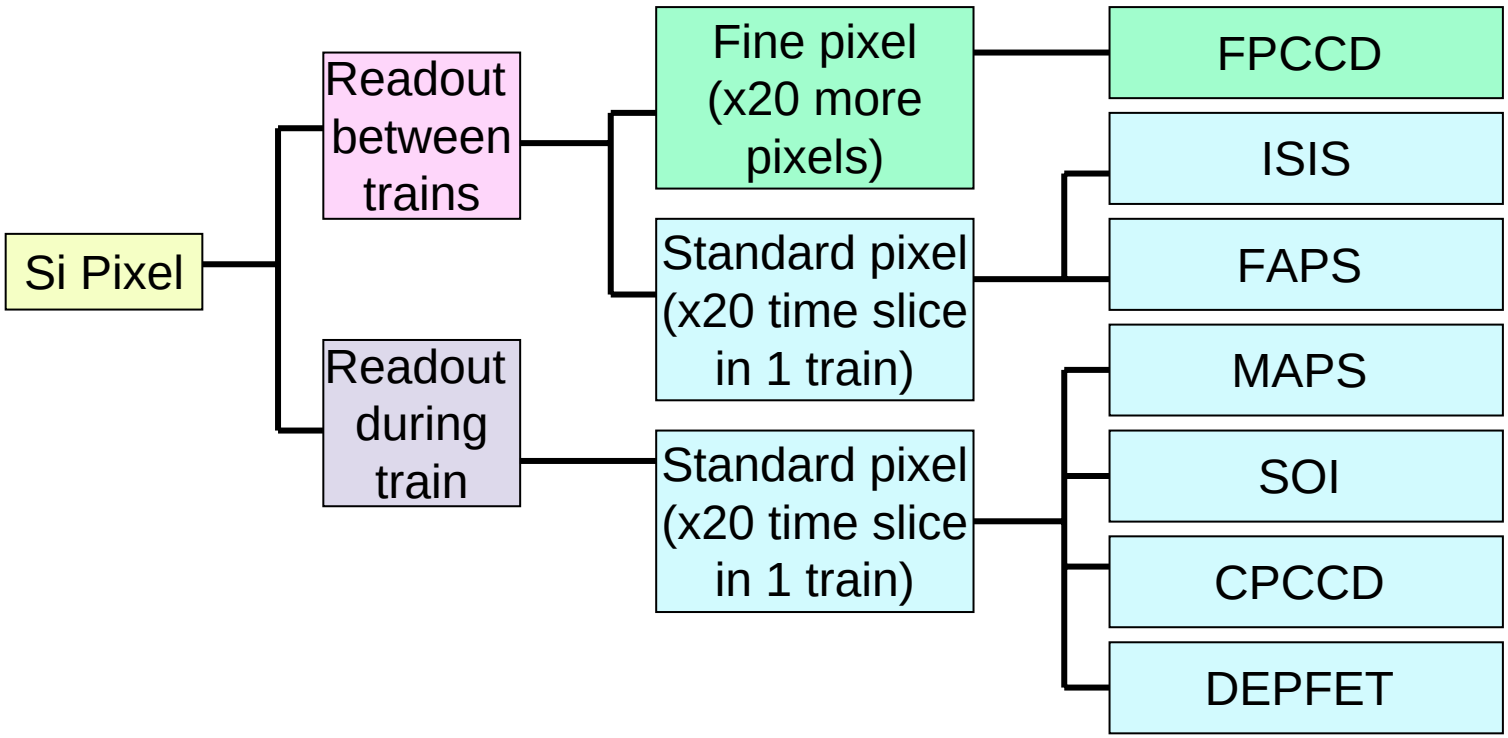
GLD detector concept

- Moderate B field
  - GLD: 3 T
  - LDC: 4 T
  - SiD: 5 T
- Large radius TPC
  - Excellent p_t res.
  - PID by dE/dx
- Large radius CAL
  - Good PFA performance
  - PID by TOF possible

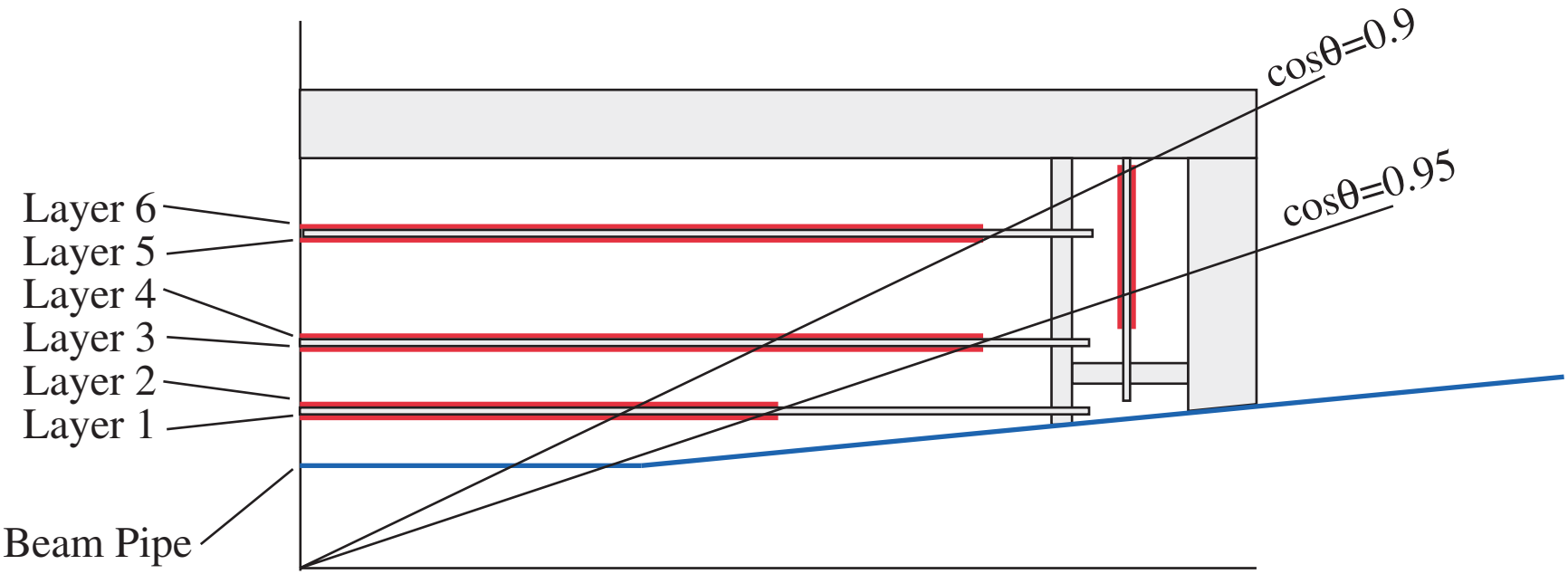


Baseline design of GLD VTX

- A lot of sensor technologies are proposed but none of them has been demonstrated to work at ILC
- For the moment, we assume “Fine Pixel” option as the baseline design of GLD just because it is unique (different configuration from standard pixel options which are assumed in SiD and LDC)

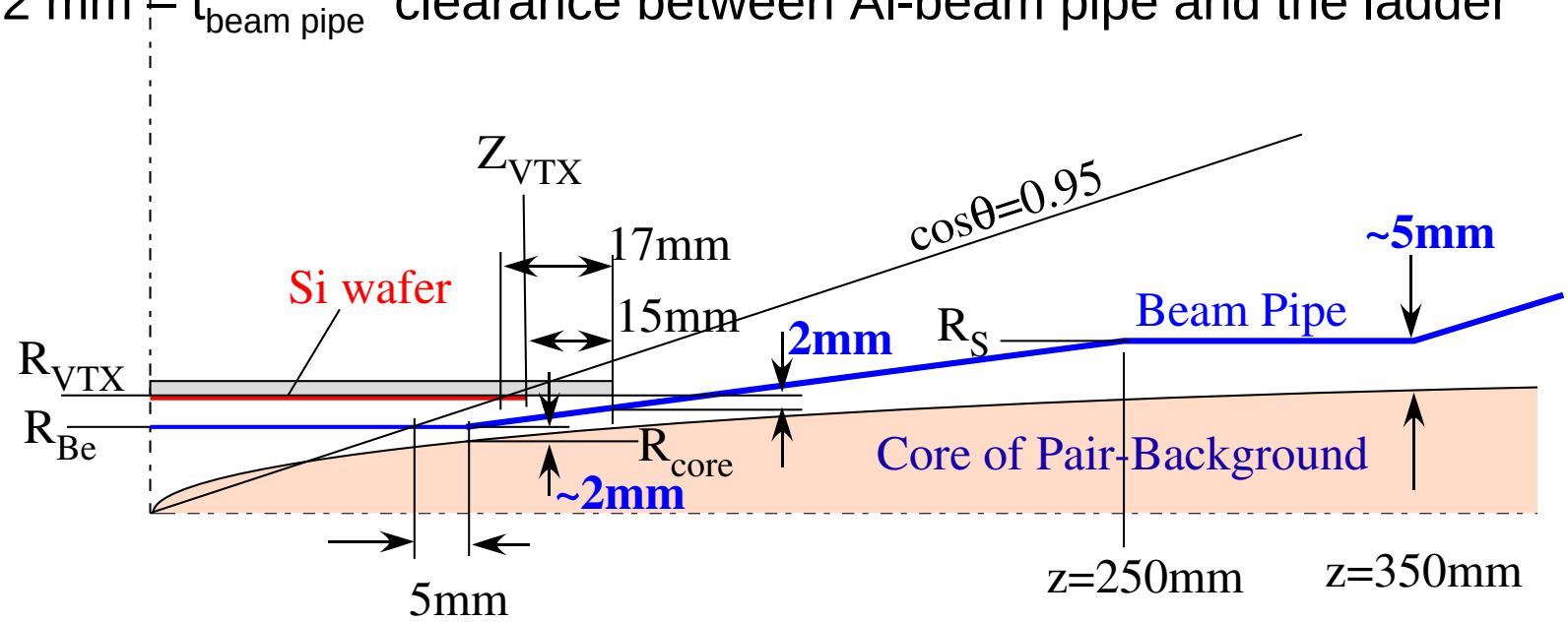


Tentative baseline design



A model for R_{VTX} determination

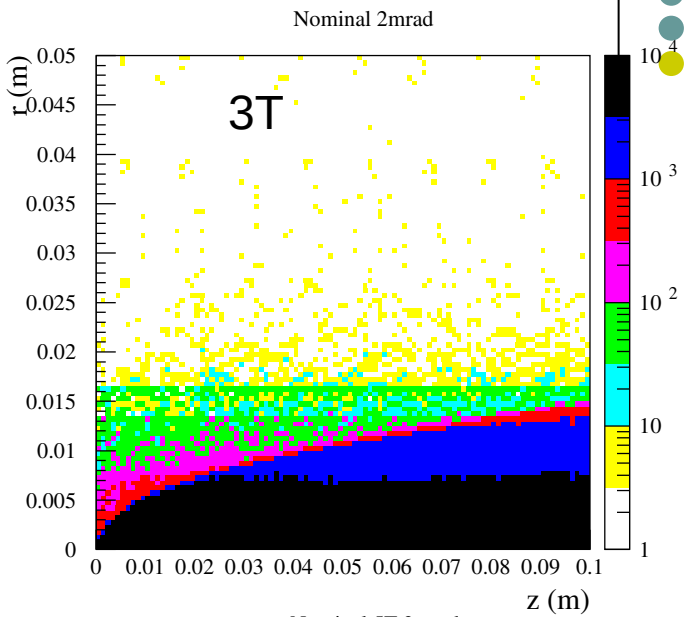
- Pair-background core should not hit the beam pipe
  - ~5mm clearance at Z=350mm
  - ~2mm clearance at Be-Al interface
- Si wafer length = $|\cos\theta| < 0.95$ + 2 mm
- Ladder length = Si wafer length + 15 mm
- 2 mm – $t_{beam\ pipe}$ clearance between Al-beam pipe and the ladder

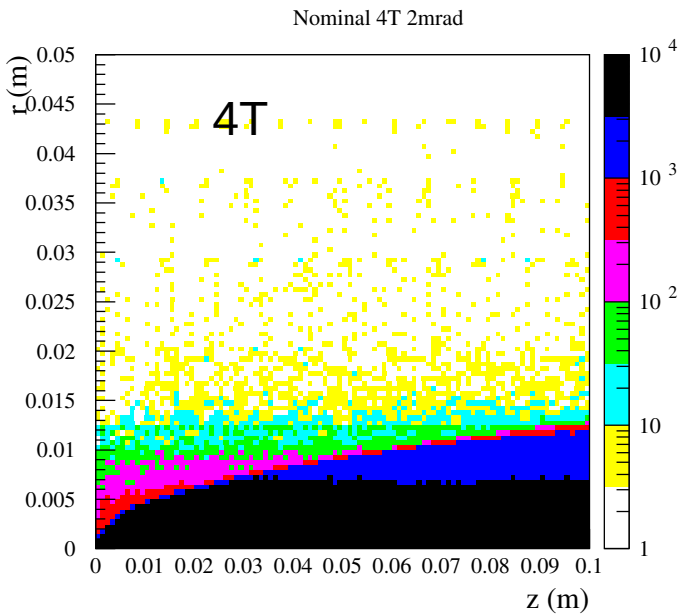


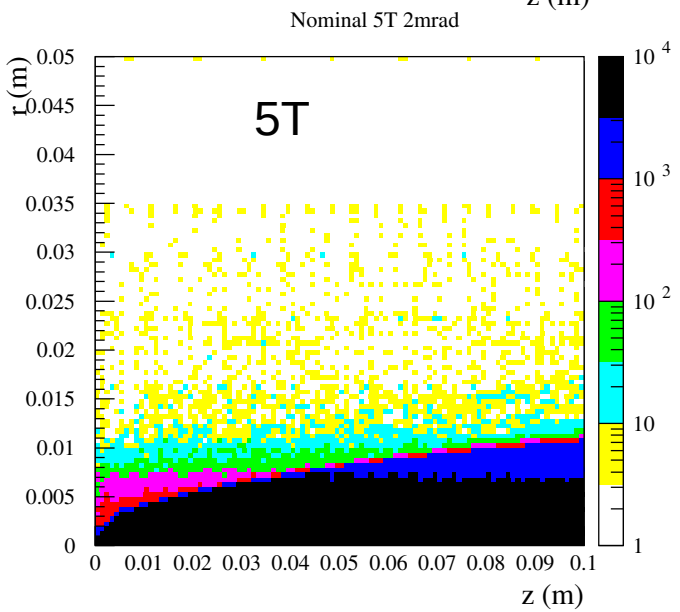
Pair background

- Simulation by CAIN
- B-dependence

  (Track density: /cm^2/BX)

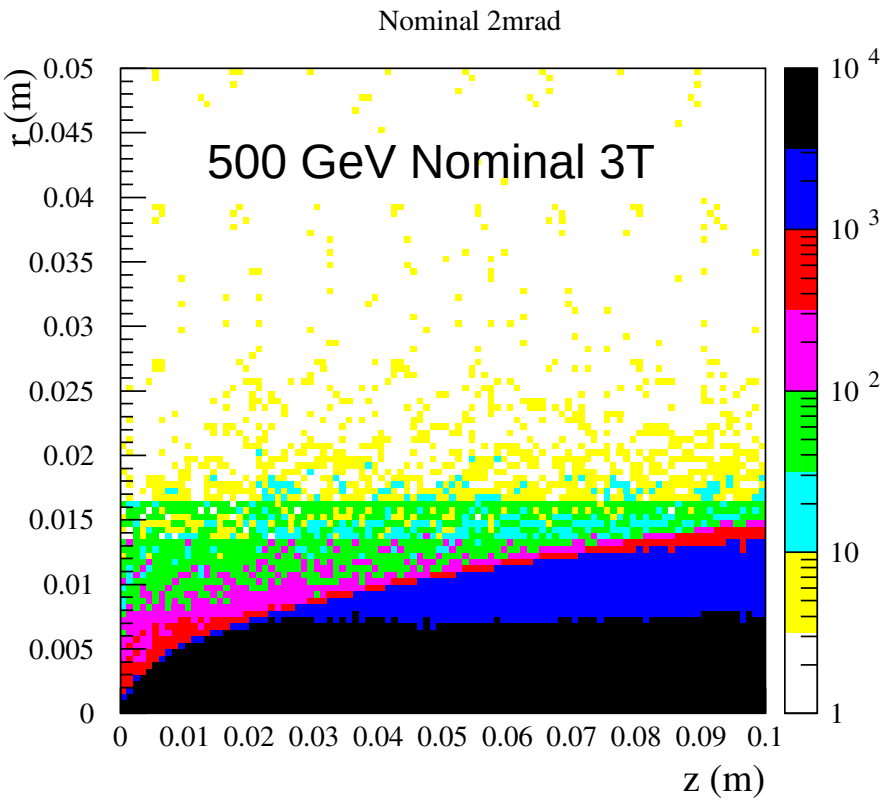


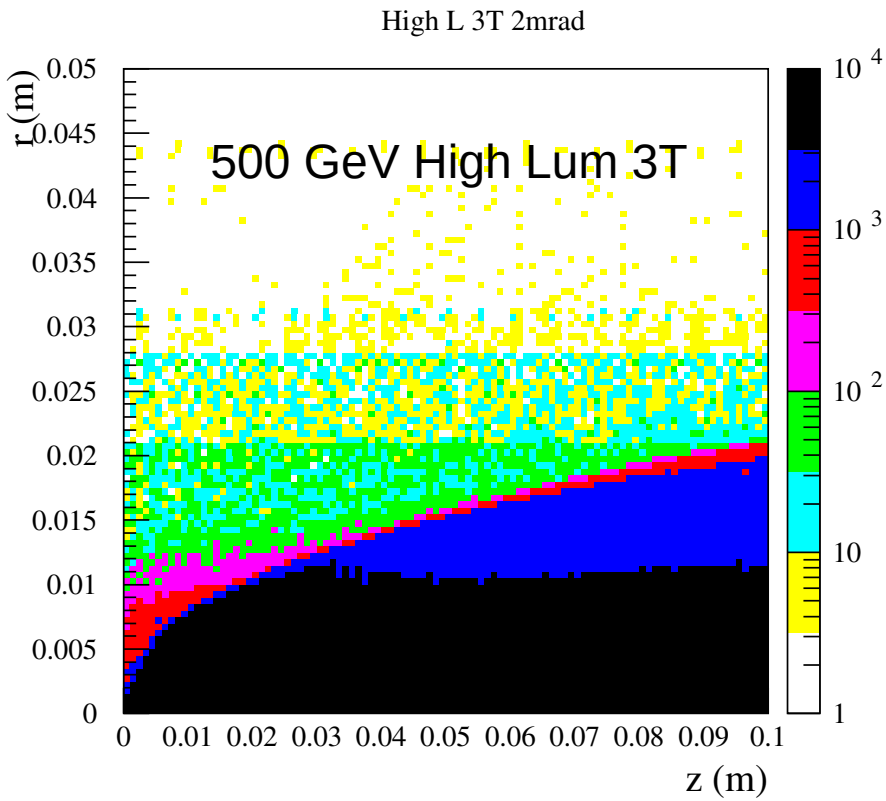




Pair background

- Machine-option dependence (1)

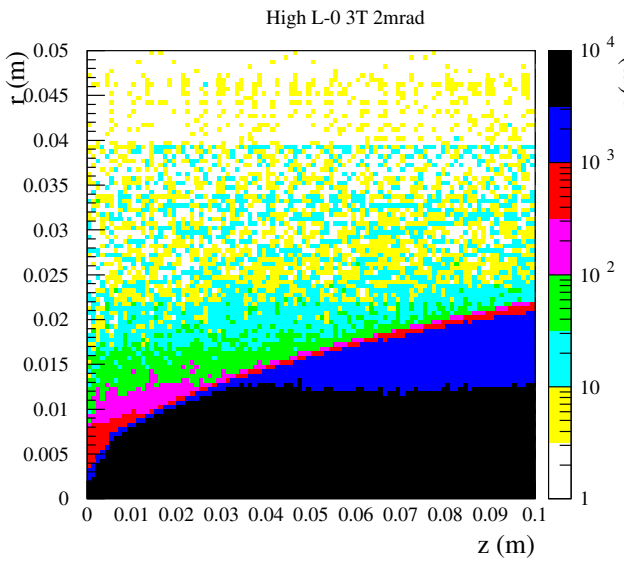




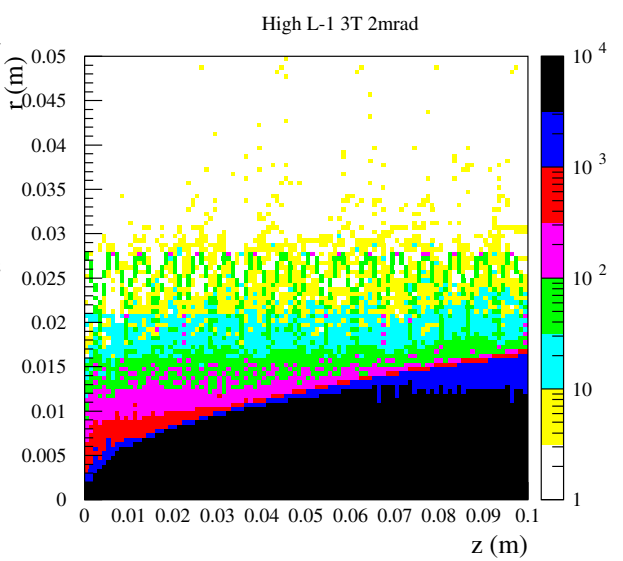
Pair background

- Machine-option dependence (2)
  - Comparison of Tor's parameter and Andrei's parameter at 1TeV

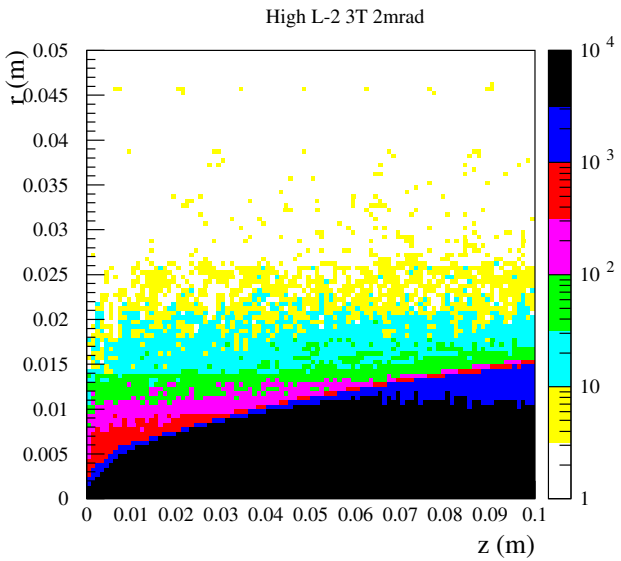
Tor, 1TeV 3T



Andrei – I, 1TeV 3T

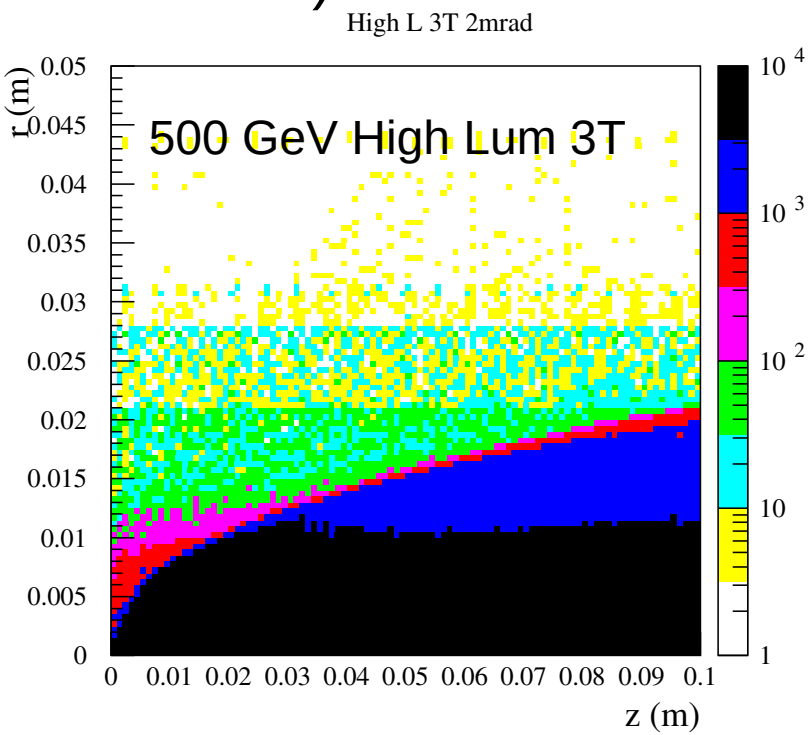


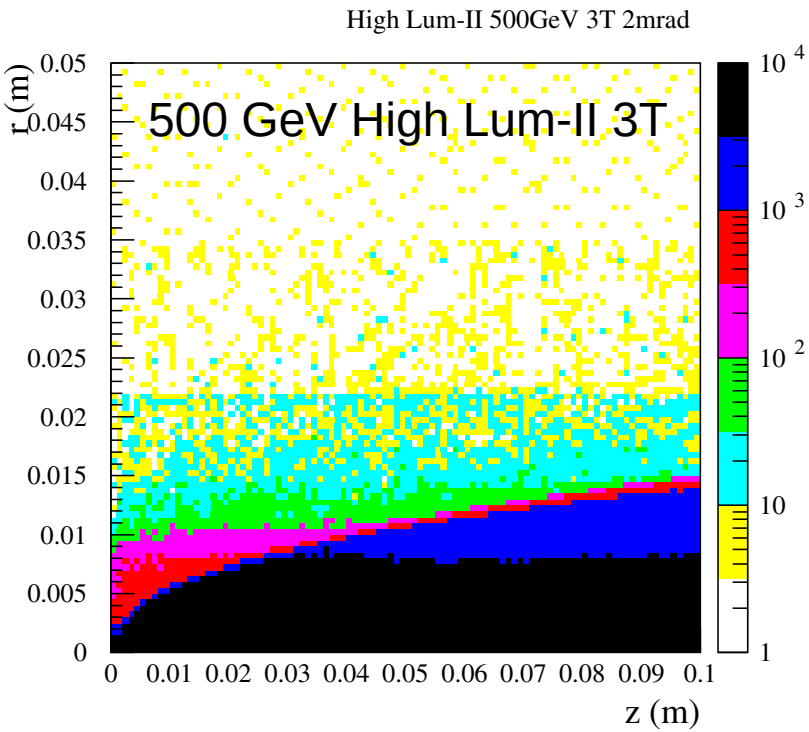
Andrei – II, 1TeV 3T



Pair background

- Machine-option dependence (3)
  - Andrei's parameter at 1 TeV applied to 500 GeV (I don't know this is appropriate or not. Luminosity gain is only x1.5)





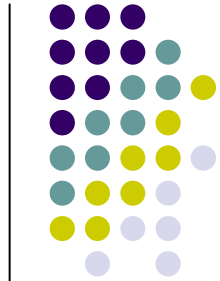
Results

ECM (GeV)	Option	B (T)	R_{core} (mm)	R_{Be} (mm)	R_s (mm)	R_{VTX} (mm)	Z_{VTX} (mm)
500	Nominal	3	10.5	12.5	30	16.6	52.4
		4	9	11	28	14.9	47.4
		5	7.5	9.5	25	13.2	42.0
500	High L	3	16.5	18.5	42	24.1	75.4
		4	13.5	15.5	36	20.2	63.6
		5	12	14	33	18.4	57.9
1000	Nomonal	3	11	13	32	17.3	54.7
	High L	3	18.5	20.5	42	25.8	80.5
	High L'	**3**	**13**	**15**	**34**	**19.4**	**61.1**
	High L''	**3**	**11.5**	**13.5**	**32**	**17.8**	**56.1**
500	**High L''**	**3**	**11**	**13**	**30**	**17**	**53.7**

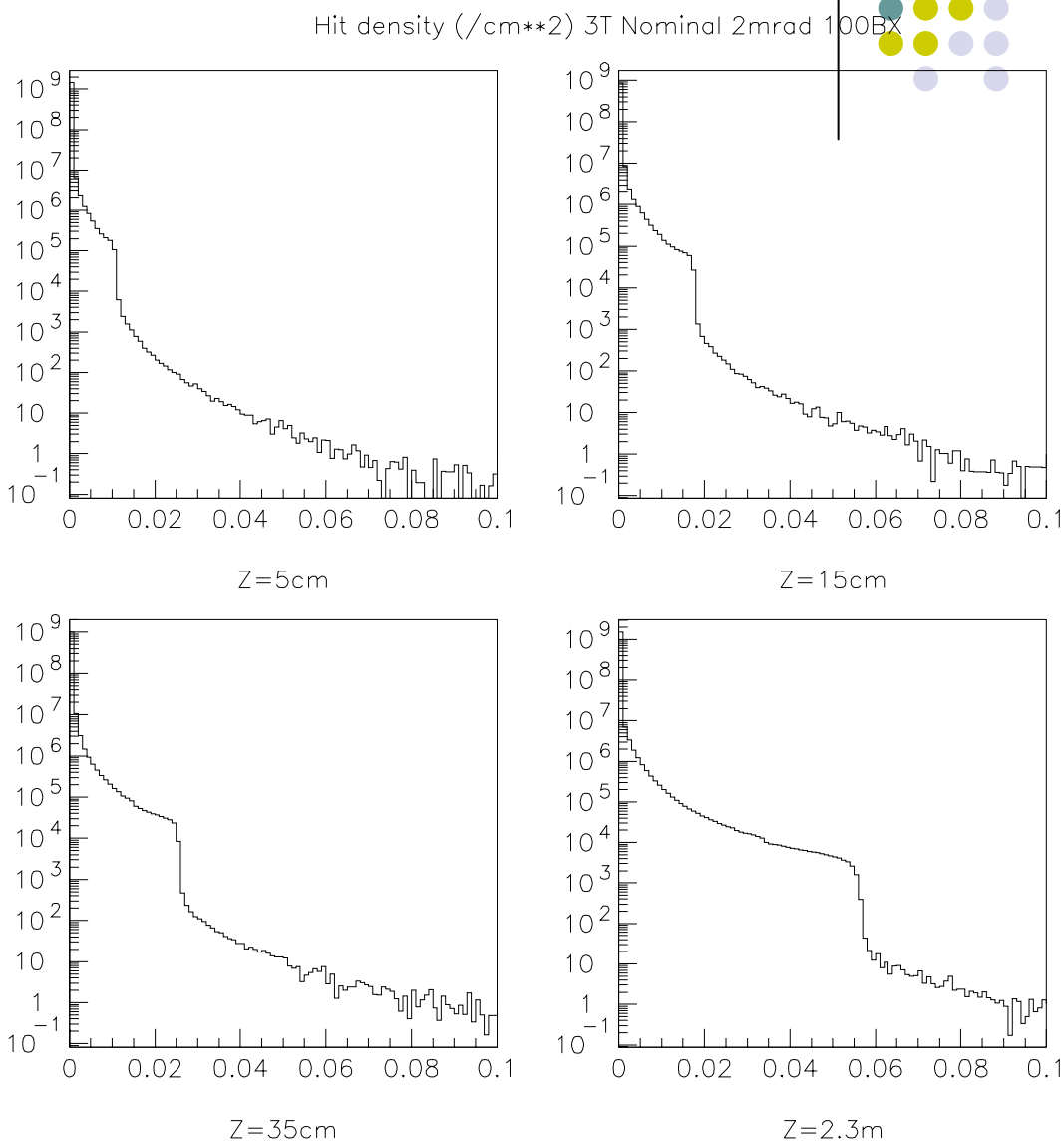
Conclusion

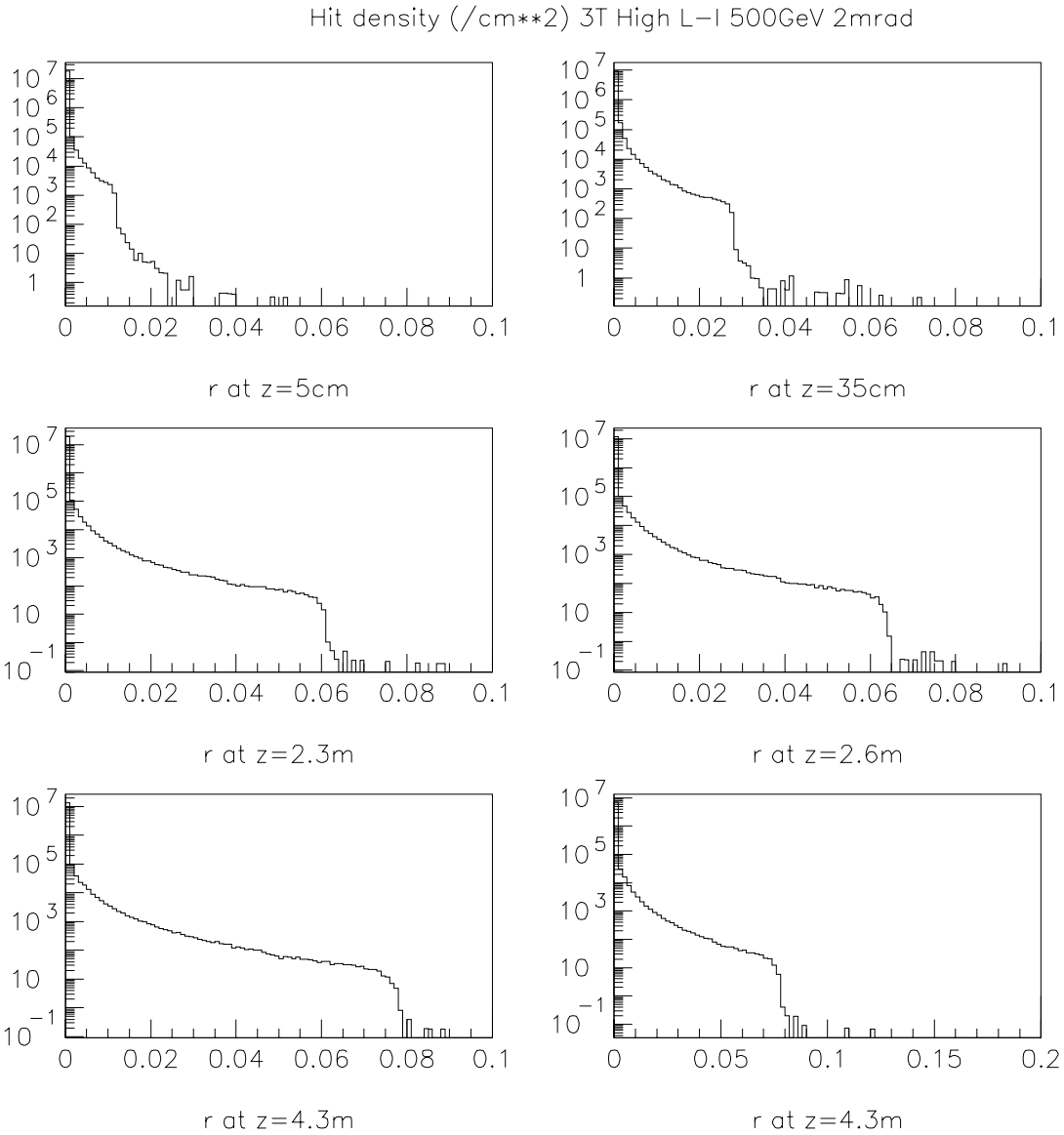
- Minimum radius of the vertex detector has been calculated based on a consideration of direct pair-background hits on beam pipe (Other factors such as synchrotron radiation and backscattering from BCAL should also be taken into account for the actual design)
- R_{VTX} has a weak B dependence $\sim 1/B^{1/2}$
- R_{VTX} has a strong dependence on machine parameter set: High Luminosity option requires larger R_{VTX} than Nominal option by 5 mm or more for all detector concepts
- Andrei's new parameters for High Luminosity option are very preferable from the viewpoint of background. His approach should also be applied to 500 GeV case if possible
- Disadvantage of the GLD VTX due to low B-field might be recovered by other features of GLD (K/π separation by dE/dx and TOF will help quark/anti-quark tag)

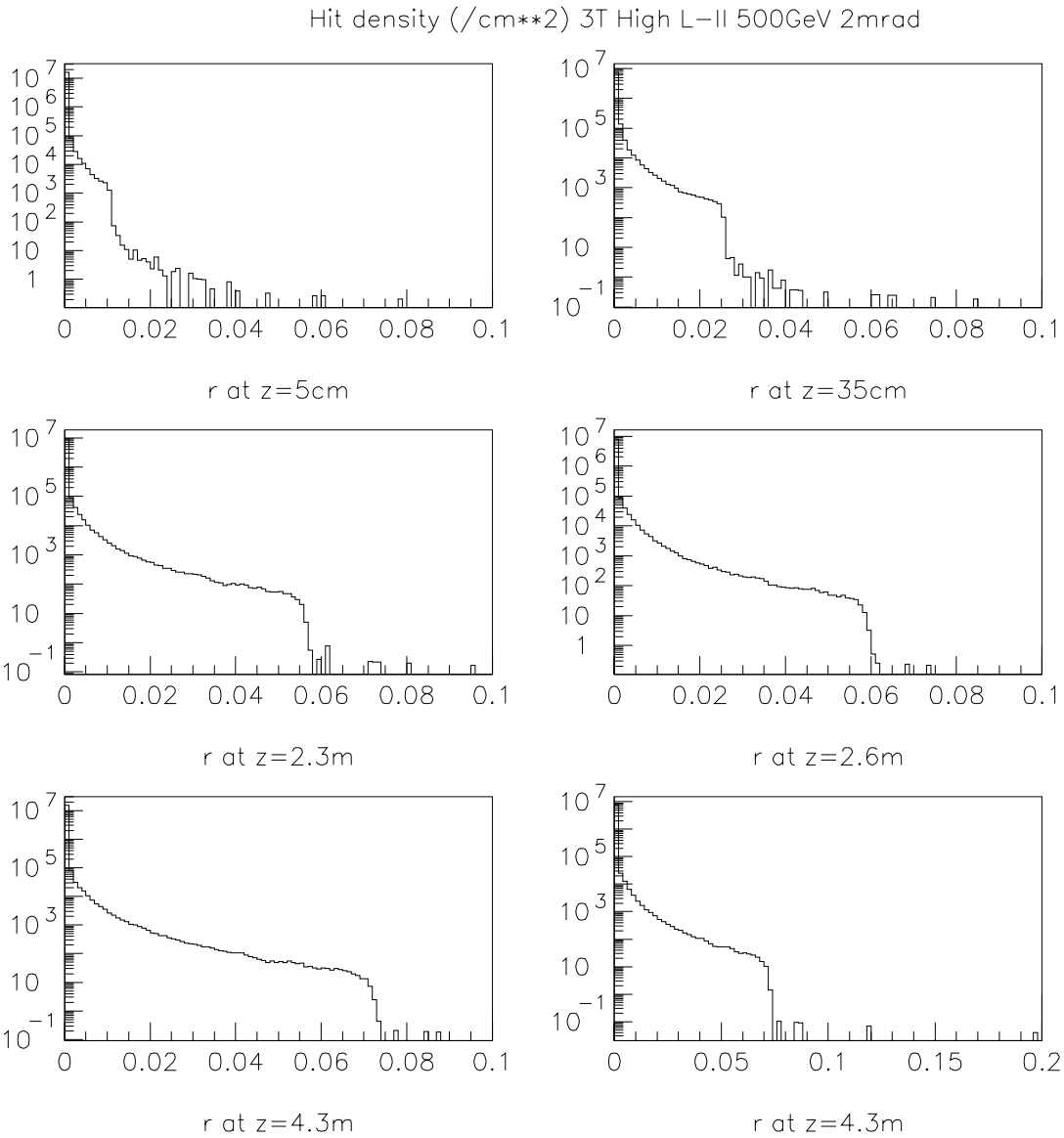
Backup slides



- Track density ($1/cm^2$) as a function of R at several z-position
- Nominal 500 GeV
- 3 T
- 2 mrad
- 100 BX




Hit density (/cm**2) 3T High L−I 500GeV 2mrad
r at z=5cm
r at z=35cm
r at z=2.3m
r at z=2.6m
r at z=4.3m
r at z=4.3m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