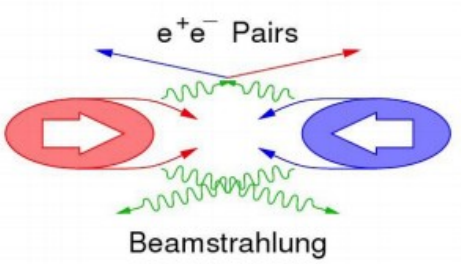
Study of Pair Background in ILD



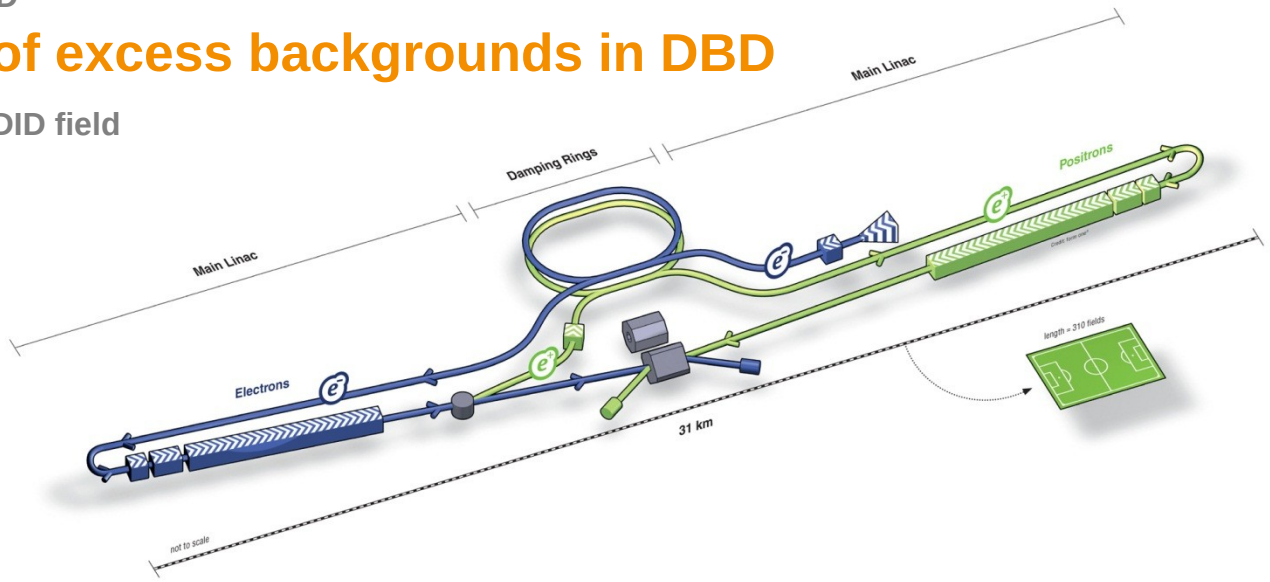
Earlier Studies of Pair Backgrounds

theory, LOI, DBD

Study of the source of excess backgrounds in DBD

BeamCal, Anti-DID field

Outlook



ILC Scheme | © www.form-one.de

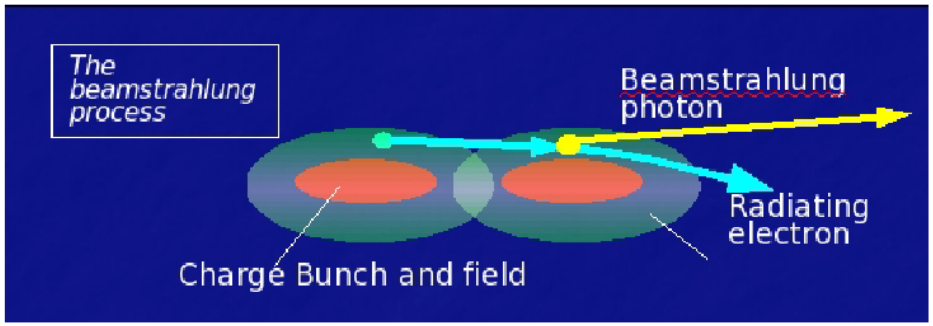
Eduard Avetisyan

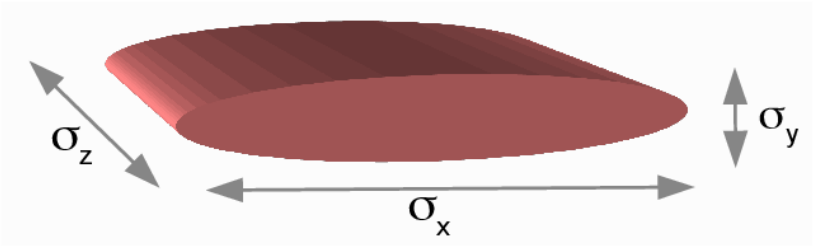
European Linear Collider Workshop
ECFA LC2013
28.5.2013

HELMHOLTZ ASSOCIATION

DESY

Strong fields at the collider interaction point

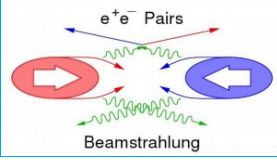




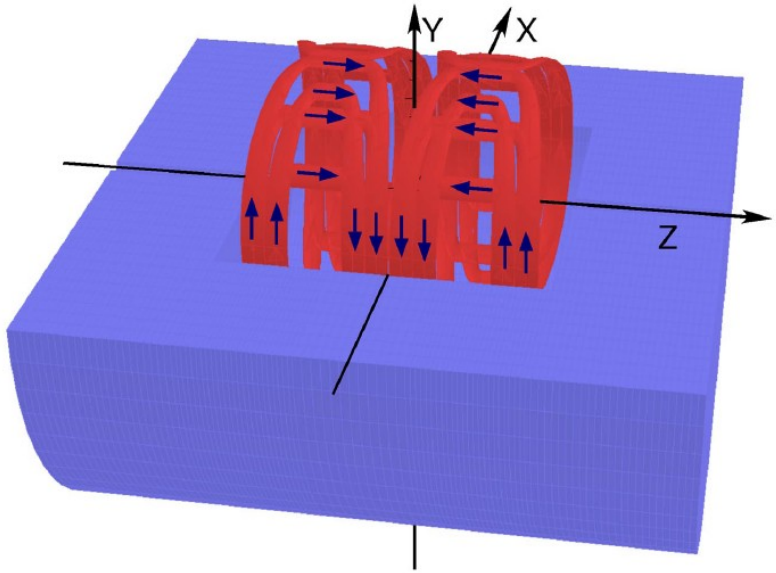
$$\Upsilon(\text{or } \chi) = \frac{e}{m^3}|F_{\mu\nu}p^{\nu}| \equiv \frac{\text{field strength in rest frame}}{1.3 \times 10^{18}\text{V/m}} \approx \frac{5}{6}\frac{N\ \gamma\ r_e^2}{\alpha(\sigma_x + \sigma_y)\sigma_z}$$

Machine	LEP2	SLC	ILC	CLIC
E (GeV)	94.5	46.6	500	1500
$N(\times 10^{10})$	334	4	2	0.37
σ_x, σ_y (μm)	190, 3	2.1, 0.9	0.49, 0.002	0.045, 0.001
σ_z (mm)	20	1.1	0.15	0.044
Υ_{av}	0.00015	0.001	0.24	4.9

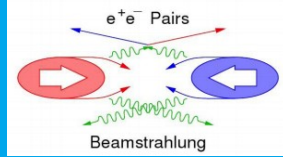
Magnetic Fields



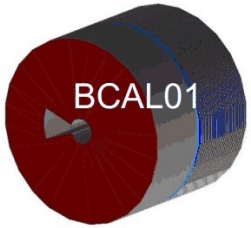
- Initial proposal: Detector-Integrated Dipole (**DID**) magnet
  - Purpose: compensate the interaction angle and polarization loss due to precession
  - Outcome: Enormous backgrounds
- Current proposal: Reverted polarity (Anti-DID) field
  - Purpose: guide the low-energy pair background towards beam exits
  - Several models tested



Old (LOI) and new (DBD) studies

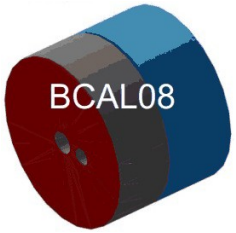


> LOI Setup (2007)



	RDR-500	Low-P 500	RDR-1000
NBunches	2625	1320	2450
Interval (ns)	370	480	366
Lumi	1.47	2.94	2.71

- Geometry: **ILD_00fwp01** (with **BCal01**)
- Anti-DID: **fieldX02**



> DBD setup (2012)

- Geometry: **ILD_o1_v05**

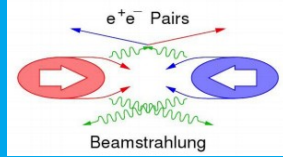
  (with **BCal08**)
- Anti-DID: **fieldX03**

LOI

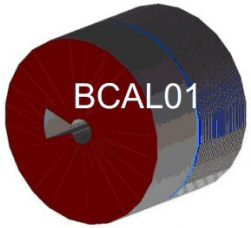
Subdetector	Units	Layer	Nom-500	Low-P-500	Nom-1000
VTX-DL	hits/cm^2/BX	1	3.214±0.601	7.065±0.818	7.124±1.162
		2	1.988±0.464	4.314±0.604	4.516±0.780
		3	0.144±0.080	0.332±0.107	0.340±0.152
		4	0.118±0.074	0.255±0.095	0.248±0.101
		5	0.027±0.026	0.055±0.037	0.046±0.036
		6	0.024±0.022	0.046±0.030	0.049±0.044
SIT	hits/cm^2/BX	1	0.017±0.001	0.031±0.007	0.032±0.012
		2	0.004±0.003	0.016±0.005	0.008±0.002
FTD	hits/cm^2/BX	1	0.013±0.005	0.031±0.007	0.019±0.006
		2	0.008±0.003	0.023±0.007	0.013±0.005
		3	0.002±0.001	0.005±0.002	0.003±0.001
		4	0.002±0.001	0.007±0.002	0.004±0.001
		5	0.001±0.001	0.006±0.002	0.002±0.001
		6	0.001±0.001	0.005±0.002	0.002±0.001
		7	0.001±0.001	0.007±0.002	0.001±0.001
SET	hits/BX	1	5.642±2.480	57.507±10.686	13.022±7.338
		2	5.978±2.360	59.775±8.479	13.711±7.606
TPC	hits/BX	-	408±292	3621±709	803±356
ECAL	hits/BX	-	155±50	1176±105	274±76
HCAL	hits/BX	-	8419±649	24222±744	19905±650

DESY

Old (LOI) and new (DBD) studies



> LOI Setup



	RDR-500	Low-P 500	RDR-1000
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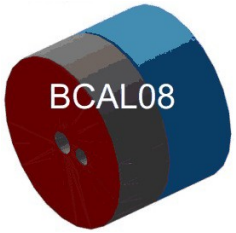
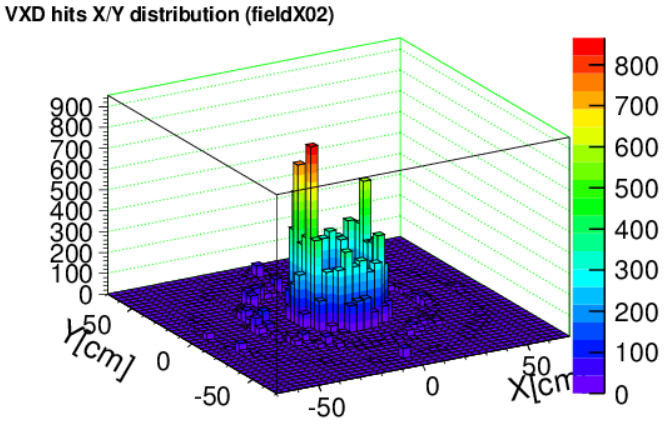
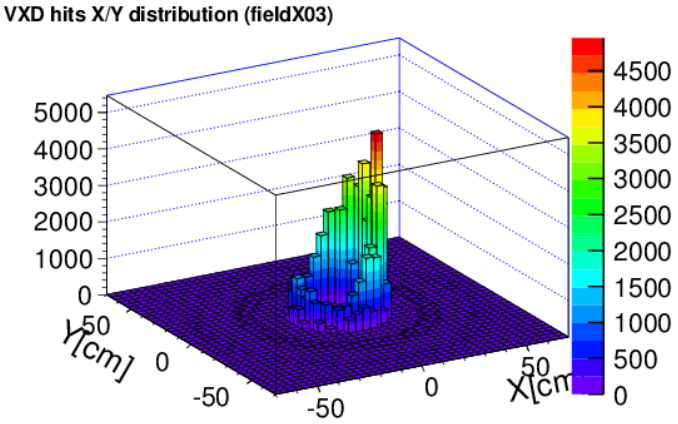
- Geometry: **ILD_00fwp01** (with **BCal01**)
- Anti-DID: **fieldX02**



> DBD setup

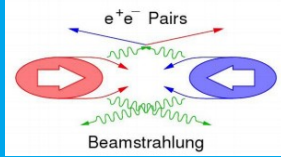
- Geometry: **ILD_o1_v05** (with **BCal08**)
- Anti-DID: **fieldX03**





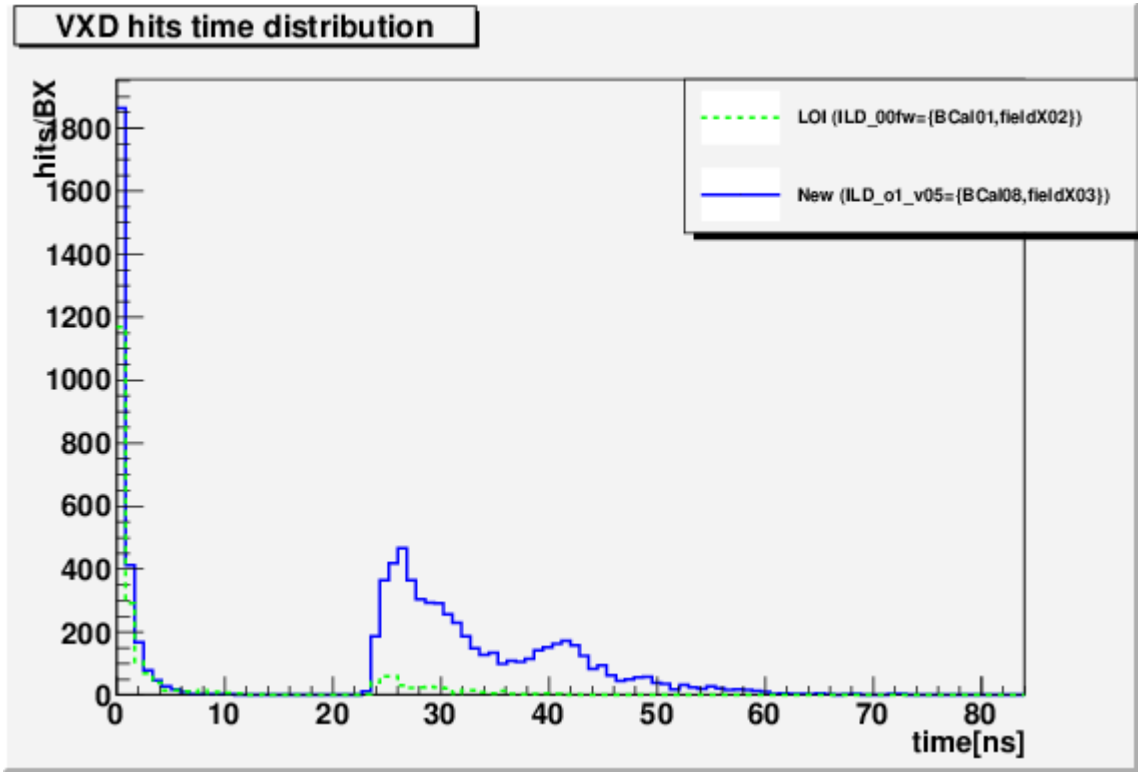
DESY

Timing and position study



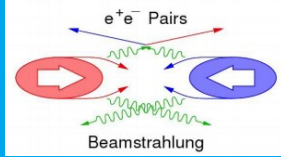
> Time distribution of **MCParticles** hitting the VXD

- Large excess of hits with **t>24ns** (corresponds to ~3.6m)
- Majority backscatter hits – BCal region!



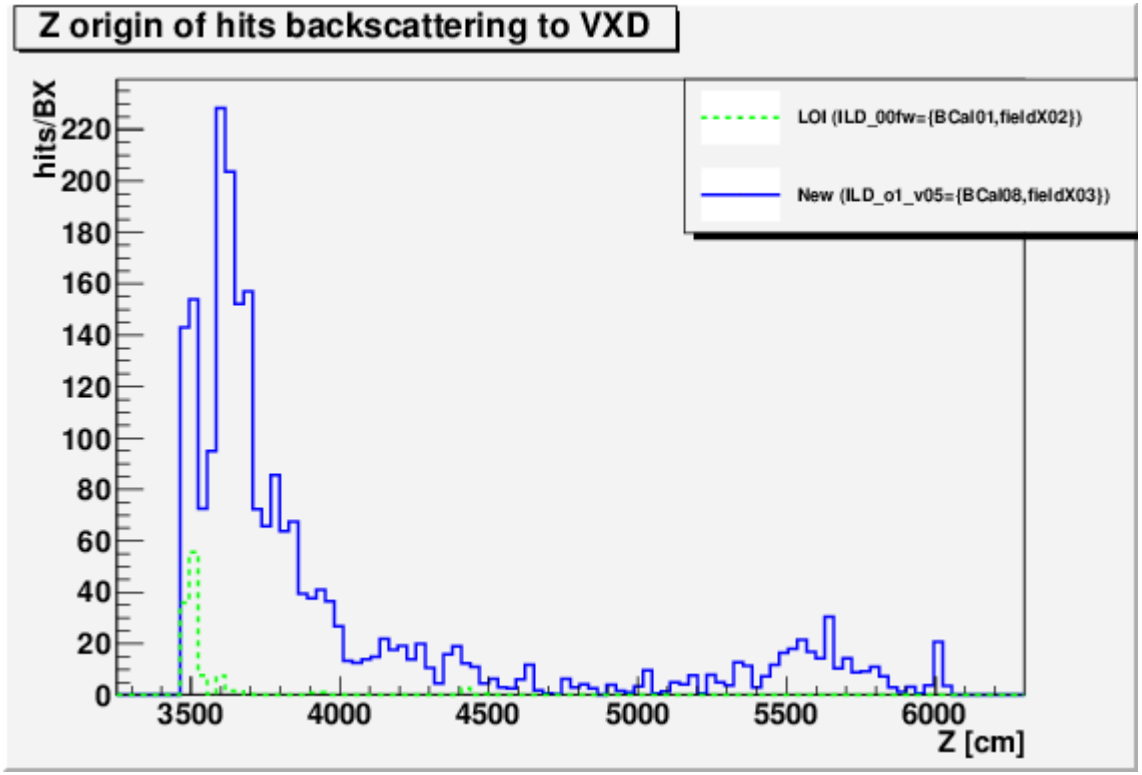
DESY

Timing and position study

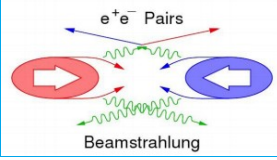


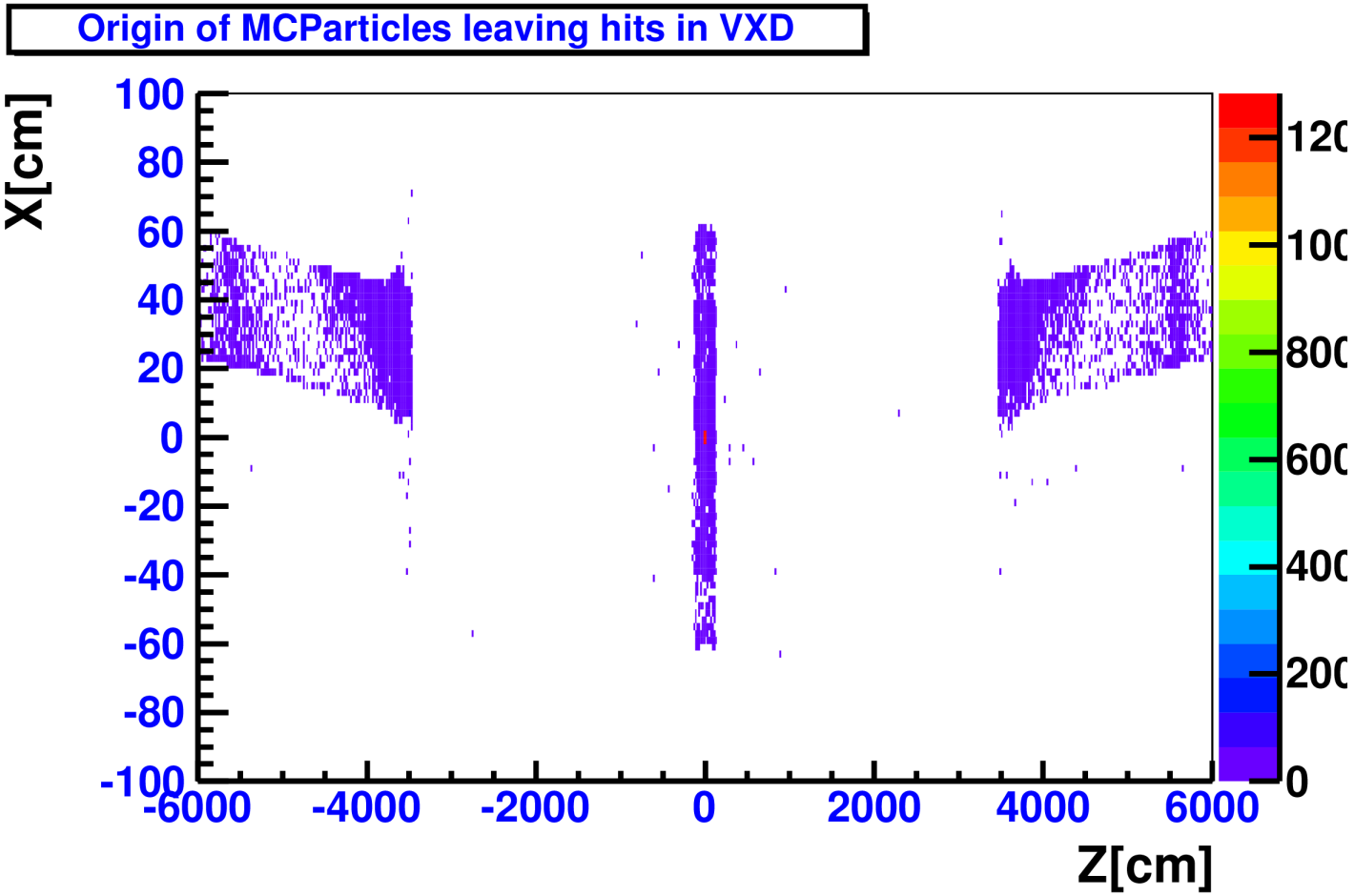
> Origin of **MCParticles** hitting the VXD

- Large excess of hits with **t>24ns** (corresponds to ~3.6m)
- Majority backscatter hits – BCal region!

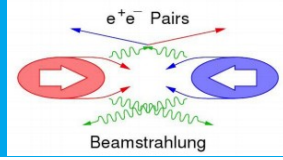


Position study

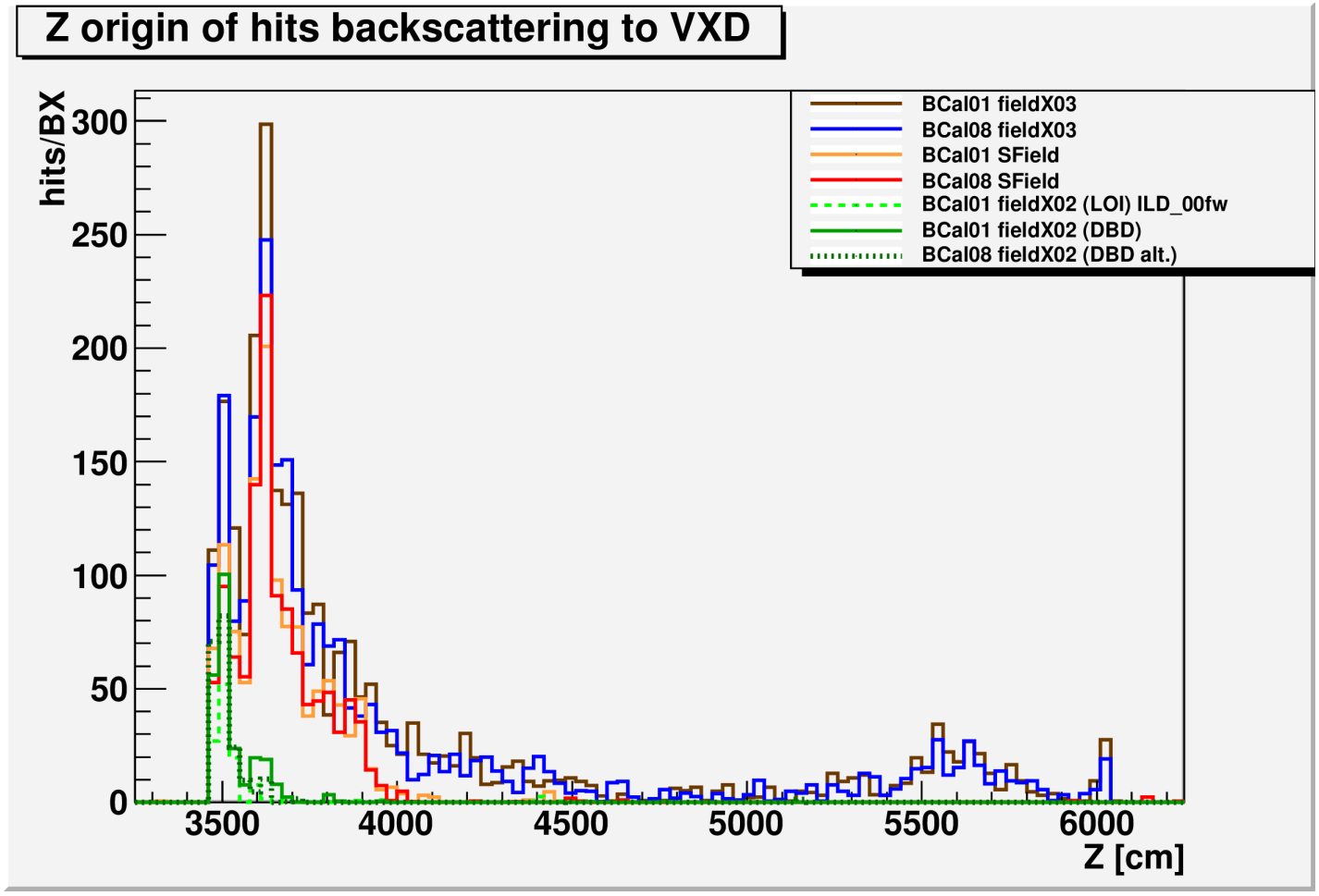




Geometry and magnetic field study

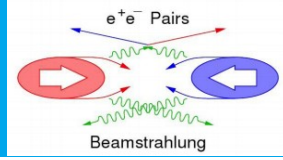


- BCal or Anti-DID?
- Generated all options – also without any anti-DID

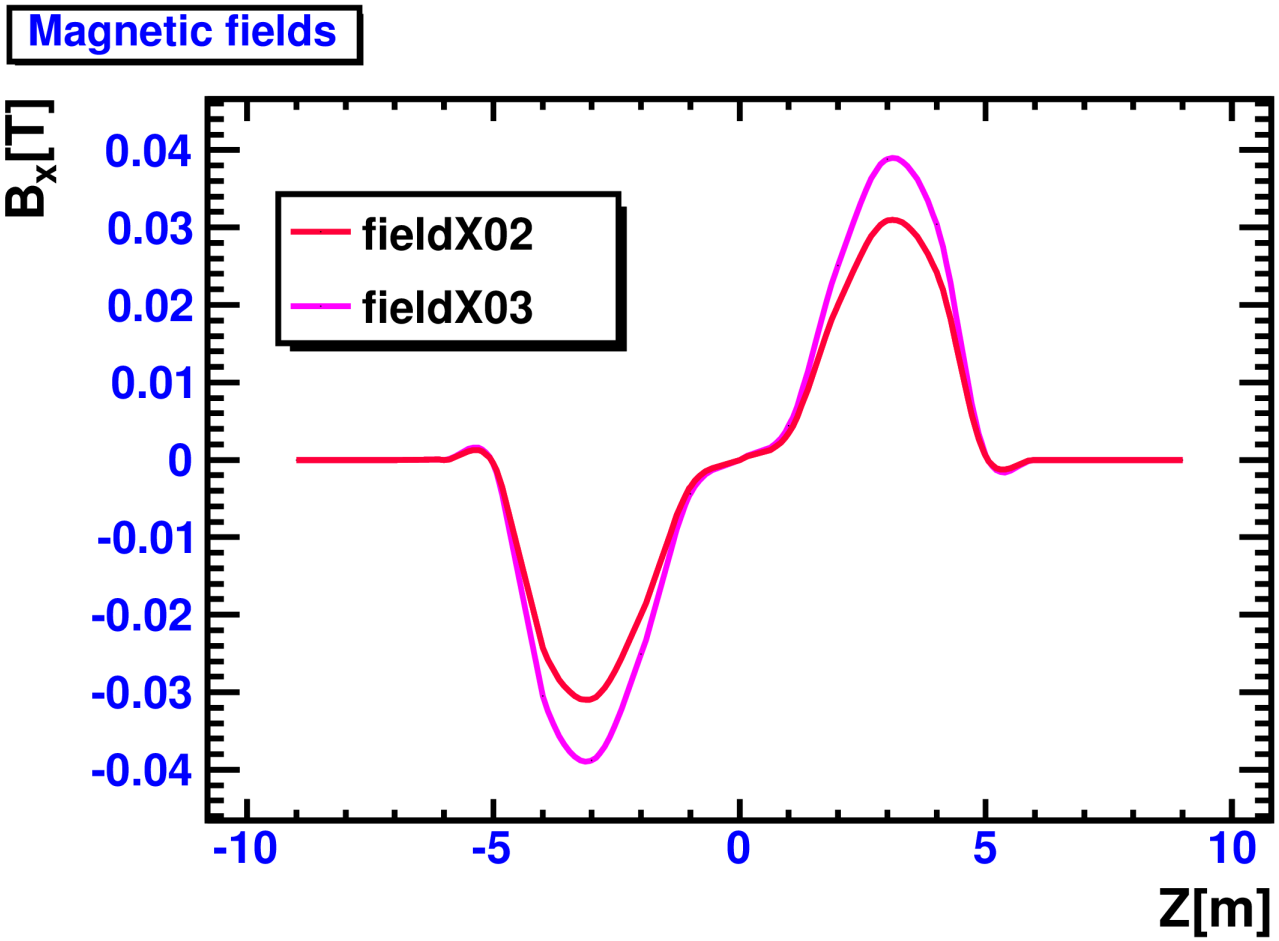


DESY

Comparison of magnetic fields

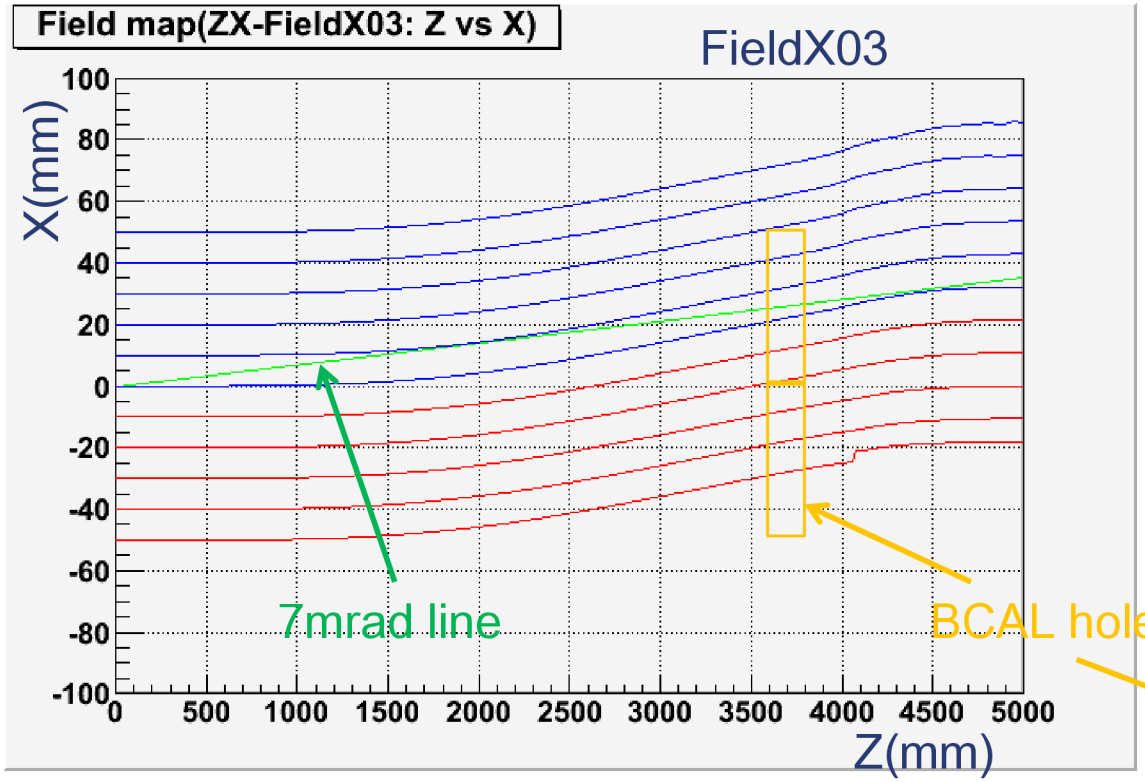


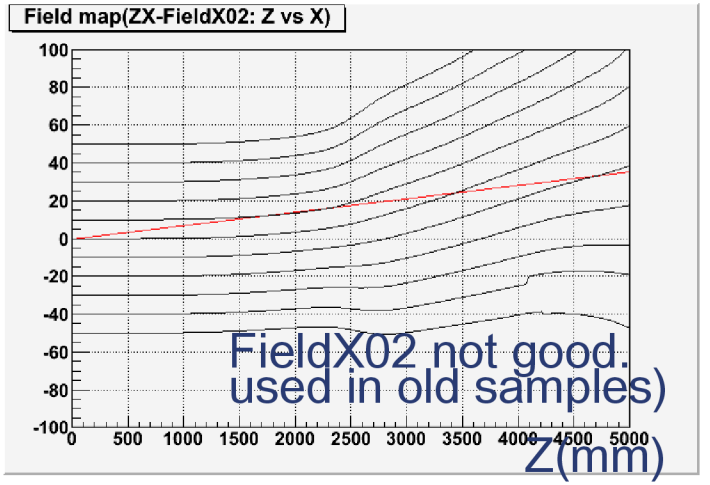
> The new anti-DID fieldX03 has a slightly larger magnitude

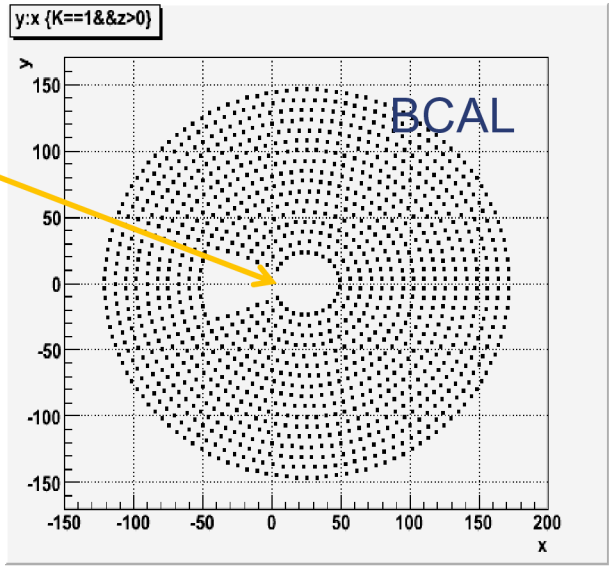


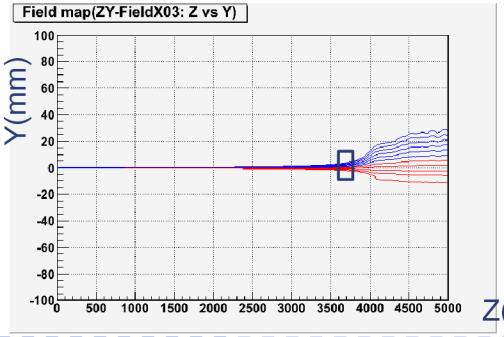
DESY

Anti-DID field









Direct hits vs Backscatter

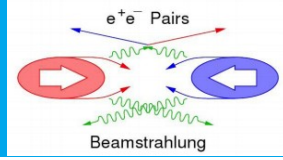
					Layer0 Hits/BX		
	Detector	ilcsoft	FieldMap	Mokka	t<20ns	t>20ns	(t>20)/(t<20)
500-TDR	O1_v02	v01-13-04	fieldX03	07-07-p06	557	1576	2.83
	O1_v03	v01-13-05	fieldX03	07-07-p07	568	1490	2.62
	O1_v03	v01-13-06	fieldX03	07-07-p08	563	1800	3.20
	O1_v03-X02	v01-13-05	fieldX02	07-07-p07	541	305	0.56
500-RDR	O1_v02	v01-13-04	fieldX03	07-07-p06	382	322	0.84
	ILD_00fw		fieldX02	06-07-p02	650	150	0.23

- No difference between ILD_O1_V02 and ILD_O1_V03
- TDR/RDR (ILD_O1_V02)
  - direct hits (t<20ns) x 1.5, back scattering (t > 20ns) x 4.8

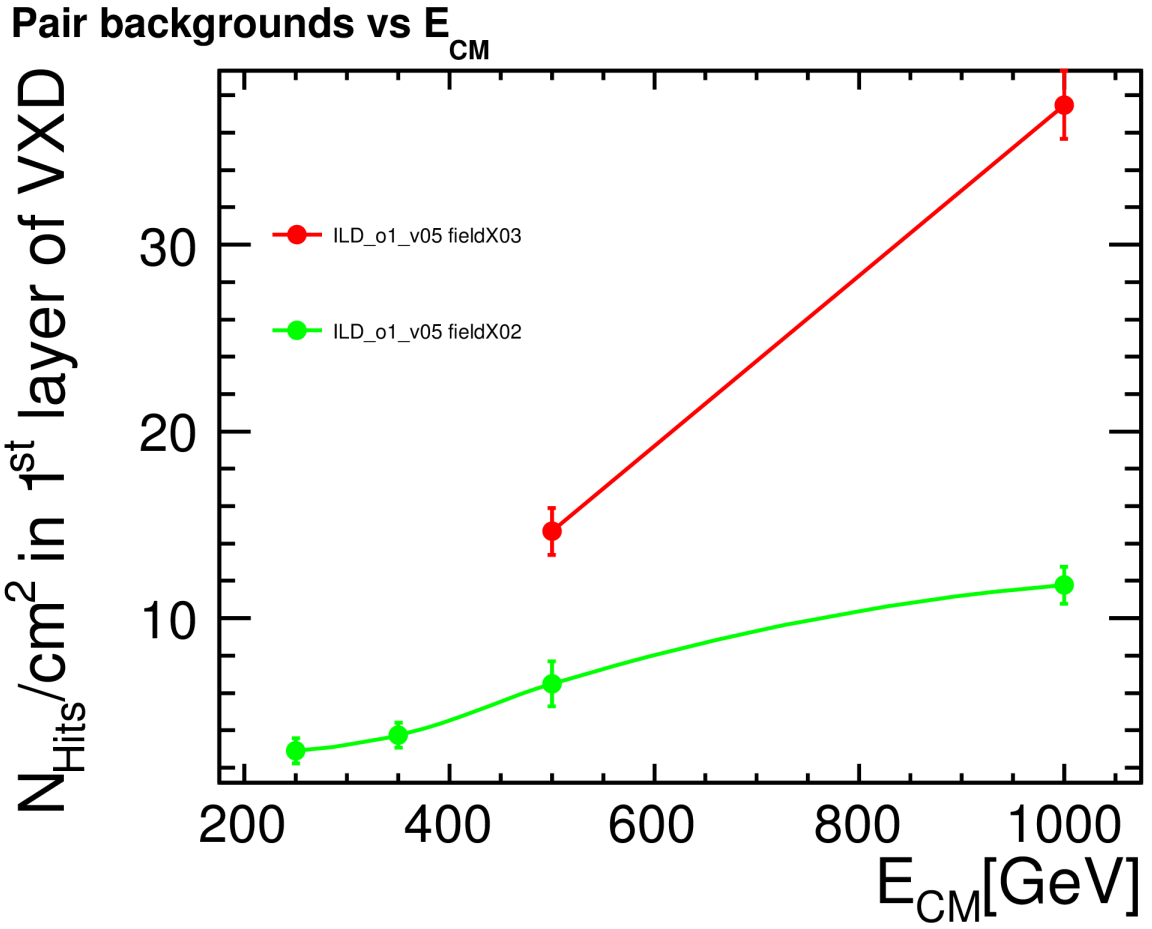
- 500-RDR (ILD_00fw)
  - /grid/ilc/mc2008_2/simulated/ILD_00/pair_bkgs_nominalparams_cms500/pairs_nominal_500GeV_runXX
  - Total rate of ILD_O1_V02 is similar to ILD_00fw, but direct/backscattering ratio is different.

	ILD_00fw	ILD_O1_V02
FieldMap	fieldX02	fieldX03
TPCCut	10kev	0kev
range cut	0.2mm	0.1mm
userDeltaIntersection	default	1e-5mm
userDeltaOneStep	default	1e-4mm
PhysicsList	LCPHYS	QGSP_BERT

Background dependence on Energy

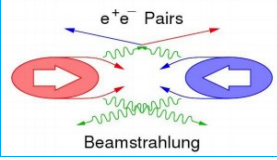


fieldX03 causes 2-4X increase in backgrounds



DESY

Outlook



- Study the response of the other detectors vs. field/geometry/energy
- Fine-tune **fieldX03** (**fieldX04**?) to provide good background suppression
  - and appropriate field lines in large and small radii simultaneously

Thank you!