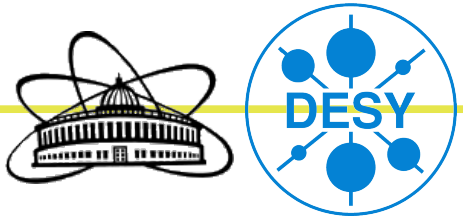

ILC BeamDiagnostics using BeamCal and GamCal

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content

- Beam parameters reconstruction
- Geant4 simulation for BeamCal
- Comparison of different readout set-ups
- Status and summary

BP reconstruction

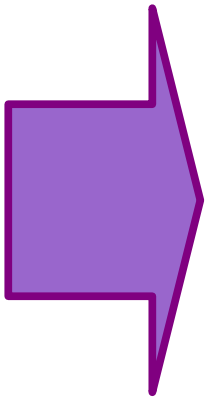
Simulation chain:
- Produce beamstrahlung pairs with GUINEA-PIG
- Run those through detector simulation
- From obtained energy distribution restore the observables
- Reconstruct initial beam parameters using Moore-Penrose inverse (algorithm - A.Stahl)

$$\left(\text{Observables}\right) = \left(\text{Observables}\right)_{\text{nom}} + \left(\text{Taylor Matrix}\right) * \left(\Delta\,\text{BeamPar}\right)$$

Observables:

1. Total energy
2. Radial moment
3. Inv. radial moment
4. Eγ
5. Up-Down imbalance
6. Right-Left imb.
7. Diagonal imb.
8. Energy in r>R_out
9. N/E
10. Phi moment
11. Inv. phi moment
12., 13. Forw-Back asymmetries

NEW →



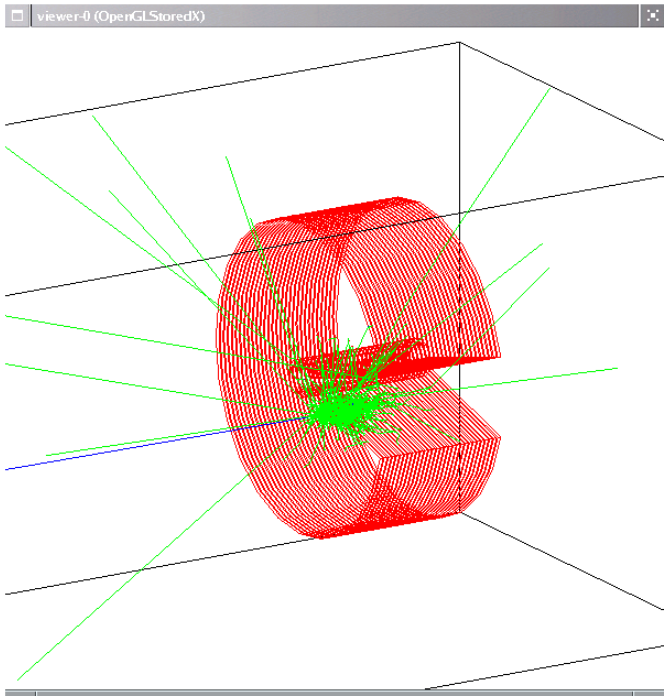
Beam parameters:

1. Bunch sizes
2. Emittances
3. Beam offsets
4. Waist shifts
5. Bunch rotations
6. Profile rotations
7. Number of particles

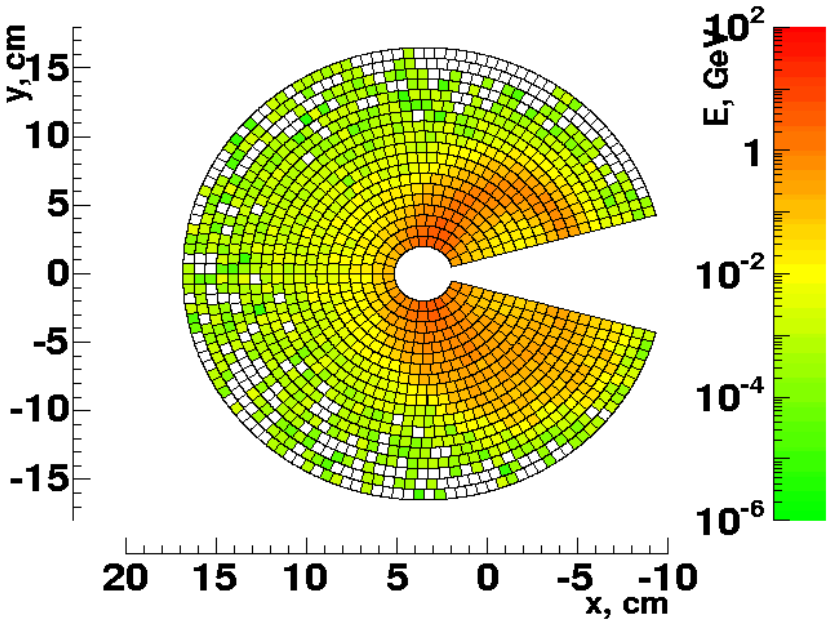
BeCaS (BeamCal Simulation)

Specification:

- Geant4.8.0 physics
- bcalrc configure file
- 0, 2, 14, 20 mrad beam crossing angle options
- Various magnetic field types (solenoid, DiD, antiDiD from fieldmap.txt)
- Root tree output



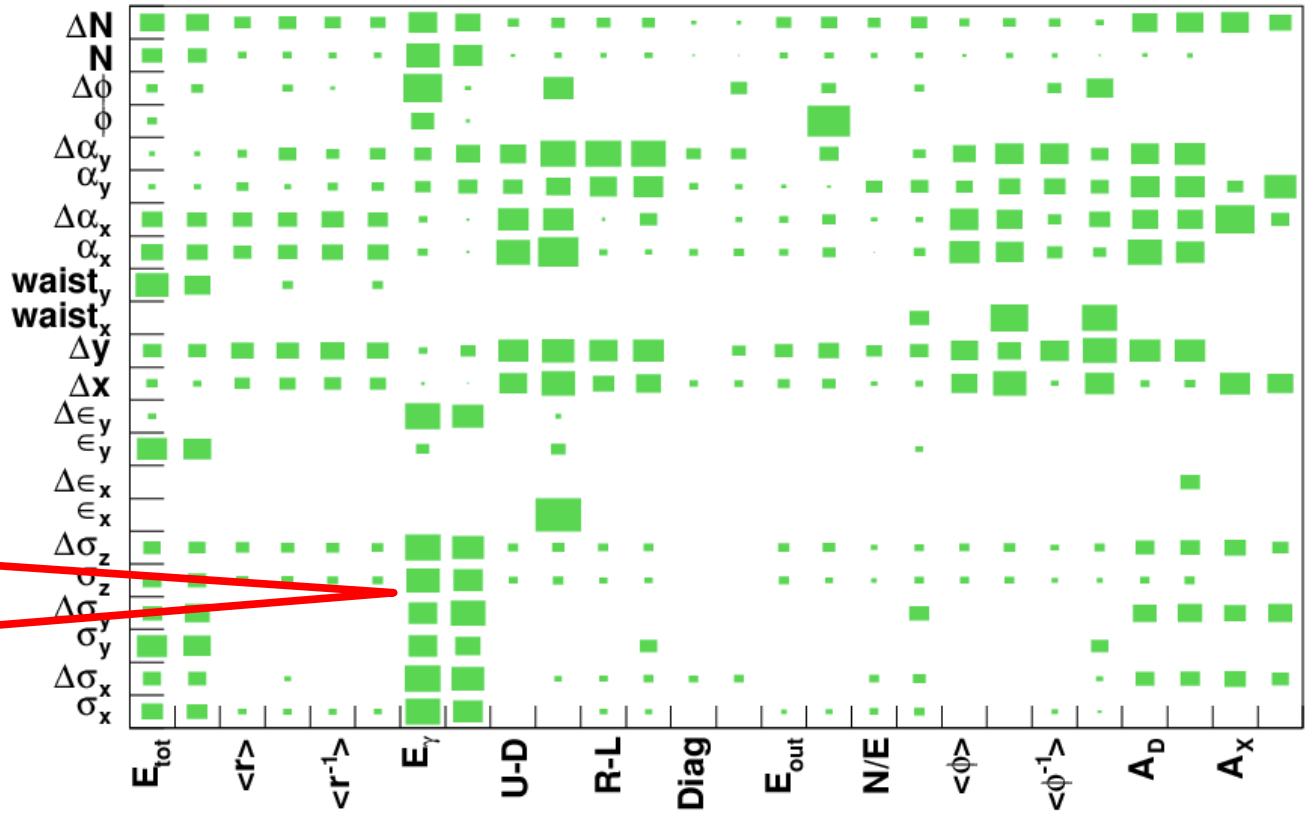
20 mrad, DiD Face energy distr-n:



single parameter reconstruction, whole calorimeter data

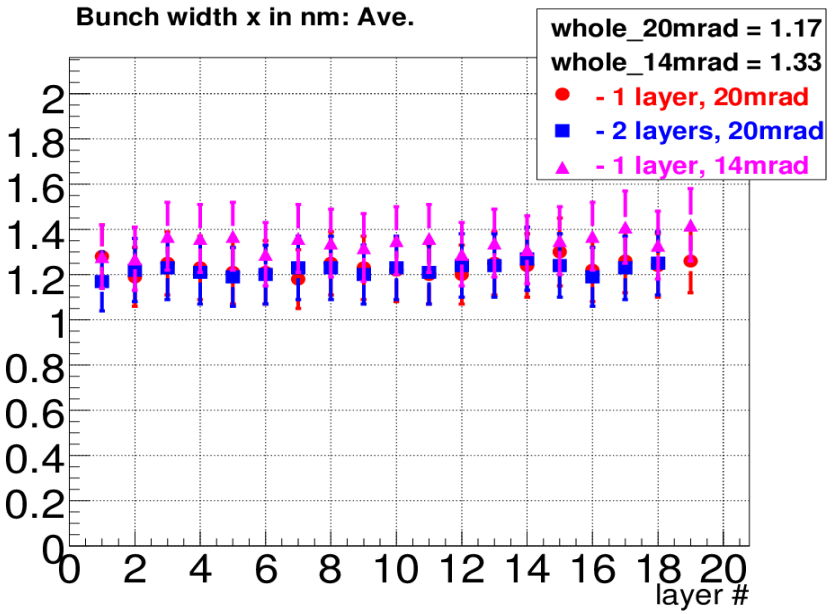
bp	unit	nom.	reconstructed 2mrad*	20mrad DiD	20mrad DiD + E_γ	14mrad antiDiD + E_γ
σ_z	μm	300	300.75 ± **4.56**	307.98 ± **4.72**	299.80 ± **1.69**	301.09 ± **1.65**
ε_x	10^{-6}m rad	10	11.99 ± **7.61**	— ± —	— ± —	9.94 ± **2.16**
Δx	nm	0	4.77 ± **14.24**	4.55 ± **8.14**	4.57 ± **8.13**	-3.84 ± **11.08**
α_y	rad	0	0.002 ± **0.016**	0.010 ± **0.025**	-0.001 ± **0.025**	-0.071 ± **0.017**

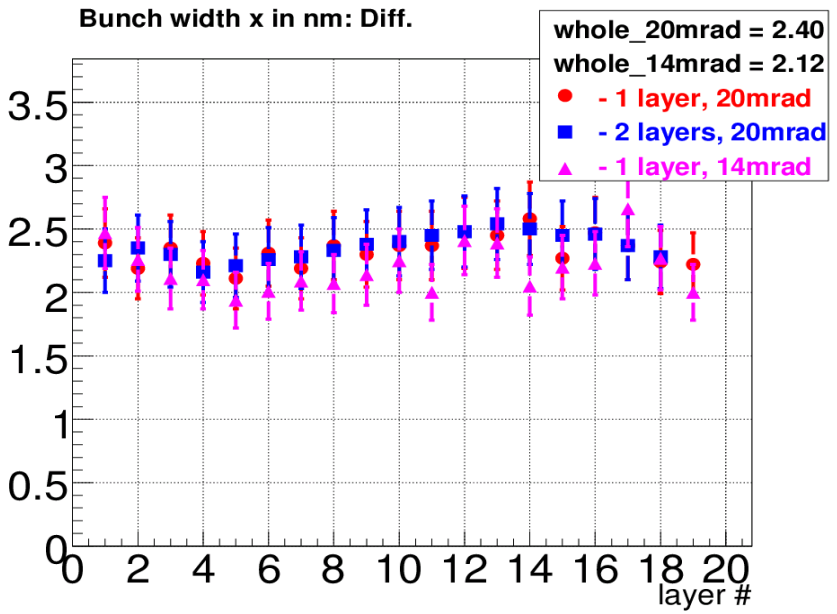
(*) - simplified simulation by Ch. Grah

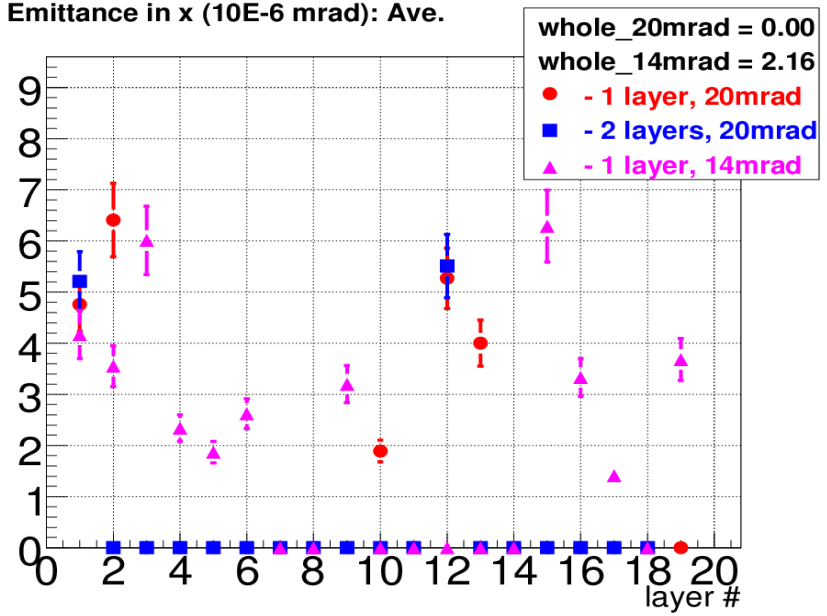


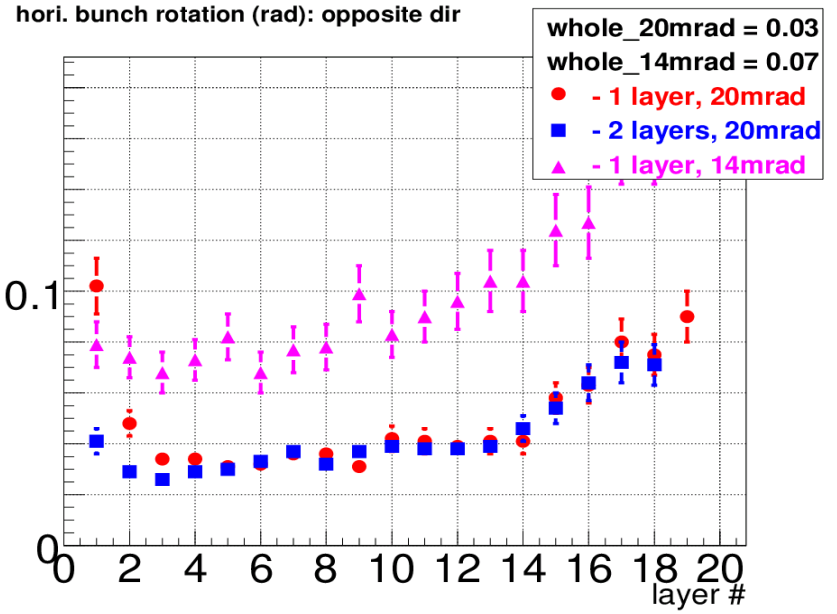
High significance of information from gammas for bunch sizes reconstruction.

readout schemes: single layer.





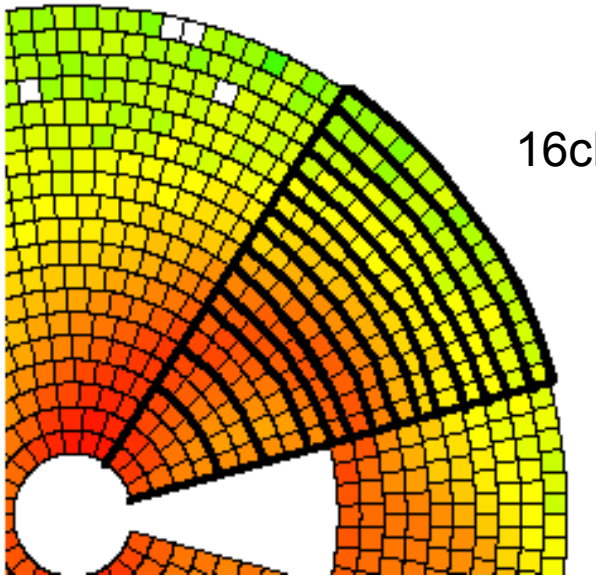




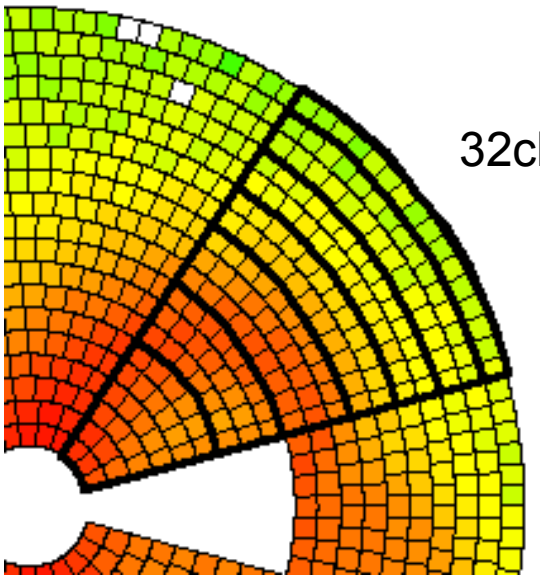
readout schemes: clusterization and digitization.

bp	unit	nom.	RO scheme (6th layer) detailed	digitized	16 channel	32 channel
σ_x	nm	655.0	653.72 ± **1.29**	653.84 ± **1.35**	653.97 ± **1.30**	654.04 ± **1.27**
$\Delta\sigma_x$	nm	0.	-1.72 ± **2.01**	-1.87 ± **2.08**	-1.65 ± **2.01**	-1.65 ± **2.02**
σ_z	μm	300.	300.90 ± **1.69**	300.35 ± **1.63**	300.48 ± **1.56**	300.39 ± **1.47**
$\Delta\sigma_z$	μm	0.	-0.59 ± **1.82**	-1.26 ± **1.97**	-0.41 ± **1.77**	-0.33 ± **1.82**
ε_x	10^{-6}m rad	10	10.18 ± **2.62**	9.71 ± **2.62**	10.18 ± **2.62**	10.18 ± **2.62**
Δx	nm	0	-5.35 ± **11.52**	-9.82 ± **12.63**	-7.26 ± **9.80**	-7.78 ± **9.76**
α_v	rad	0	-0.056 ± **0.019**	-0.119 ± **0.017**	-0.076 ± **0.025**	-0.077 ± **0.025**

Digitization: 256 steps, 0.04 GeV each
Bhabhas: 0.13 events/BX (COMPHEP)
Clusterization patterns:



16ch



32ch

- Geant4-based simulation for BeamCal written
- Beam diagnostics data generated for 20mrad DiD and 14mrad antiDiD (using GRID - very fast!)
- New observables added
- Photon data included into observables and found to be **very efficient**.
- Different readout patterns are being compared to find out most effective for beam diagnostics purposes.

SUMMARY

- Beamstrahlung photons data from GamCal appear to have a significant influence on beam parameters resolution.
- Using single layer for BP reconstruction is almost as precise as complete BeamCal
- Also clusterization and digitization does almost no impact on the precision