Multi-TeV Post-collision Line

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Background
Infrastructure
Extrapolation strategy
New tools

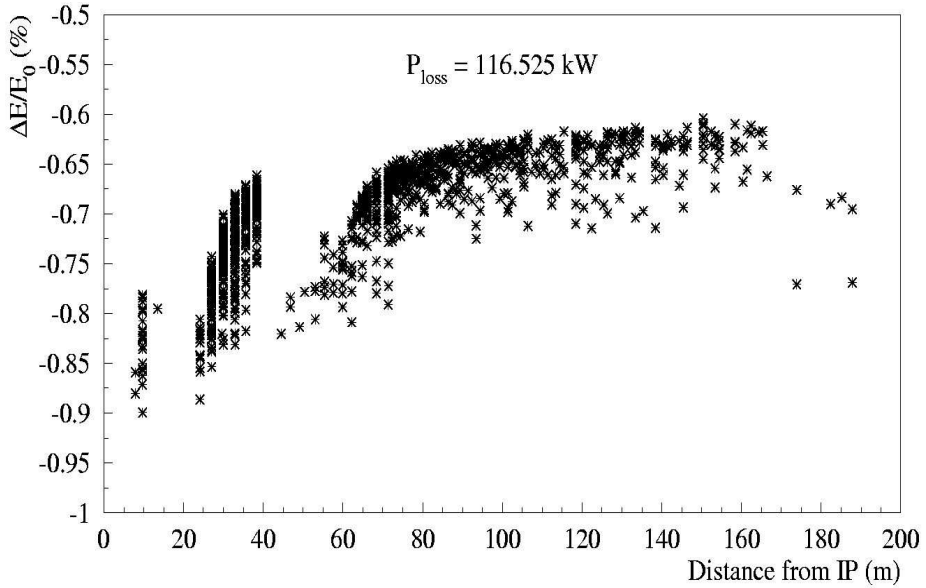
Background

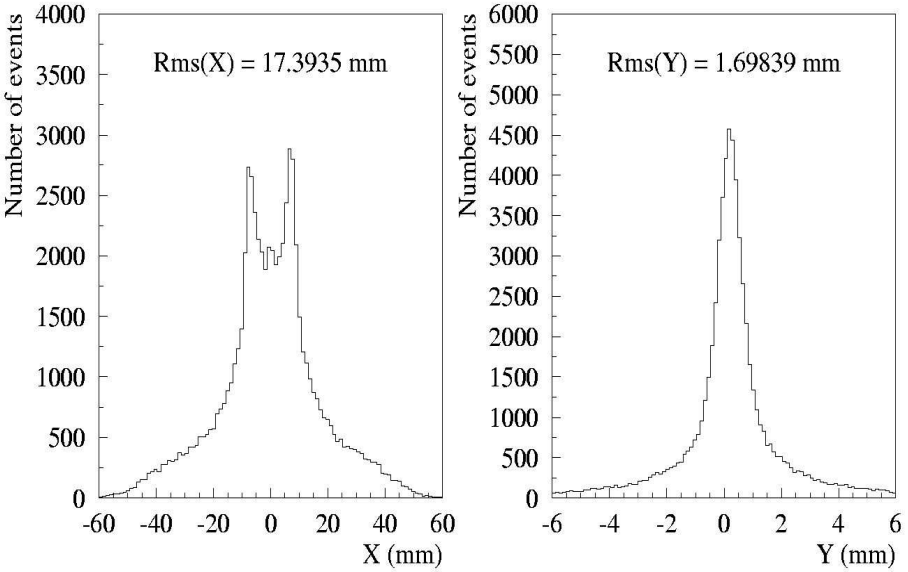
- Design of the beam line between the IP and the beam dump for the multi-TeV CLIC.
- Integrating diagnostics.
- The multi-TeV IP will have a 20 mrad crossing angle in order to (DS+FZ)
  - > minimize heat load on the FF quadrupoles
  - > minimize effect of parasitic collisions
  - < minimize effect of detector solenoid
- Start from [JING]LC 20 mrad and extrapolate and see where things break (losses and background).

Creating the Infrastructure

- Install and get the following programs to run
  - Guinea-pig
  - Dimad
  - BDSIM
- and verify published results in order to get comfortable with the codes.
- Develop experience...

The ILC extraction line





Results obtained with 1 TeV high luminosity ILC using low-statistics files, in good agreement with Yuri Nosochvov's PAC05 paper. A more complete study of this case is needed: vertical offsets, improved design, collimation, comparisons with BDSIM, etc...

Future: Extrapolating towards multi-TeV

- Interpolate machines in the parameters: E, N_{bunch}, σ_x, σ_y, ε_x, ε_y, σ_z
  - (ILC 250+250 GeV nominal)
  - ILC 500+500 GeV nominal
  - ILC 500+500 GeV high luminosity
  - CLIC 1500+1500 GeV
- Generate corresponding GUINEA-PIG output
- and scale the magnetic fields with *fudgefactor*Energy*
- *fudgefactor* may be necessary to tune down the extraction line to reduce losses of the ever more present low energy tails.
- Observe where new effects become important (coherent pairs) or where losses become unmanagable.

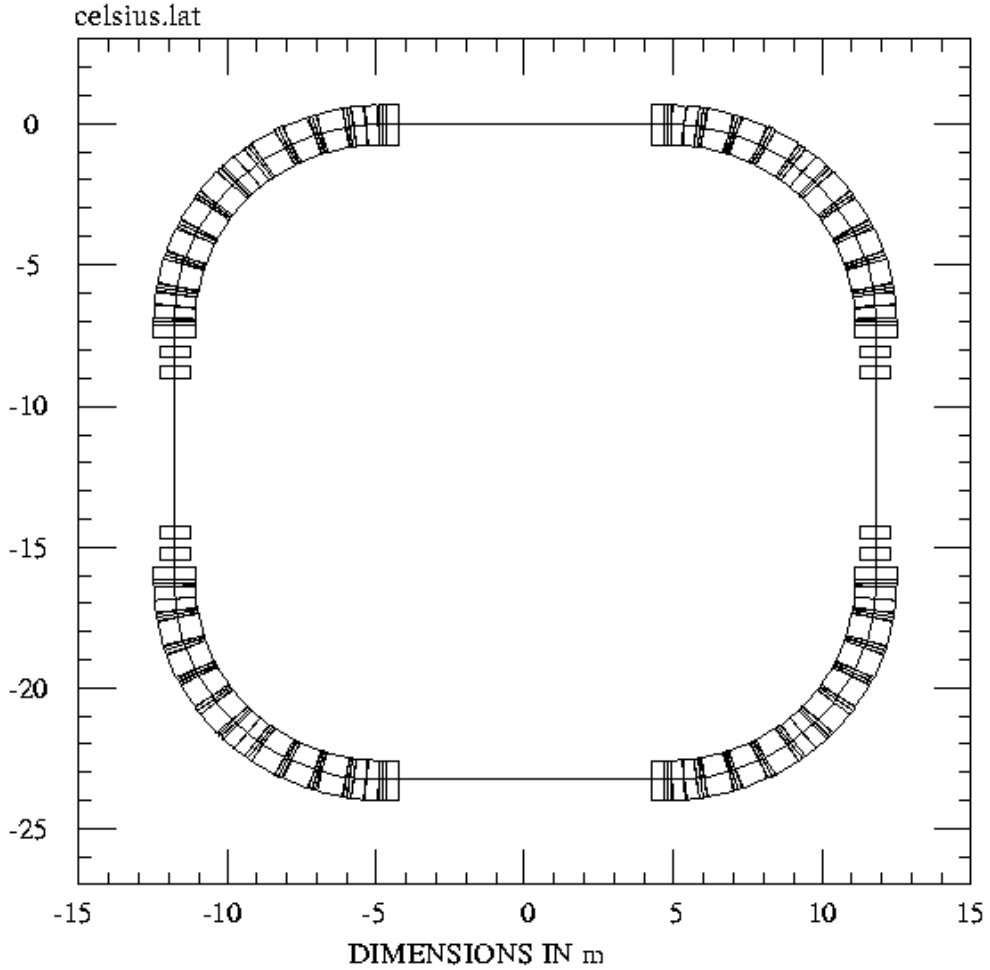
New Visualization and Simulation Tools 1

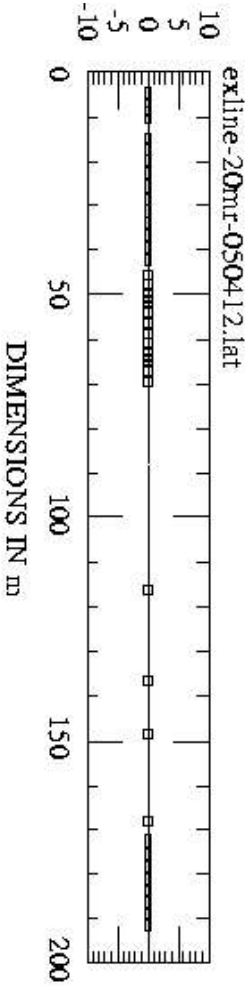
- Converter from MAD8 (survey file) to .LAT (quasi TRANSPORT)

```
! PROTONS: P*C =     8.88890     GeV,  Ekin =     8.00000     GeV
 !6-fold symmetry HESR lattice designed by Yu.Senichev
 !Unix    ...26/05/05...11.15.07
 !  SURVEY
 ! 620 RECORDS EXPECTED
    0   0           0.05               0               0         '#PIPERAD  '
    3  17.0000000   .0000000000E+00    .00000          8.8888961 'OCC       '
   55   1.5000000   .1255974500E+02    .00000          8.8888961 'QC1       '
    3   3.5000000   .0000000000E+00    .00000          8.8888961 'OC12      '
   55   1.5000000  -.1303128641E+02    .00000          8.8888961 'QC2       '
    3  19.0000000   .0000000000E+00    .00000          8.8888961 'OC23      '
```

- Over the past 15 years: Optics, Matching, Orbit Correction, Response matrix analysis, Normal forms, Loss calculations, Layout of the geometry.

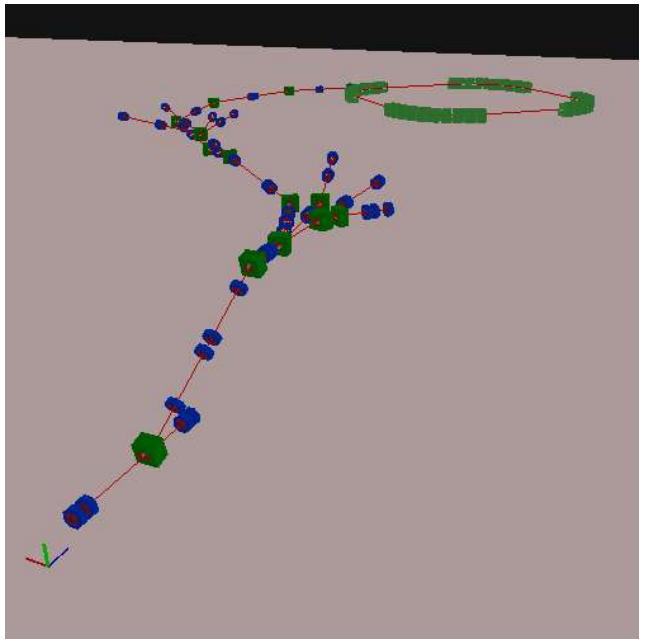
Layout of the Geometry

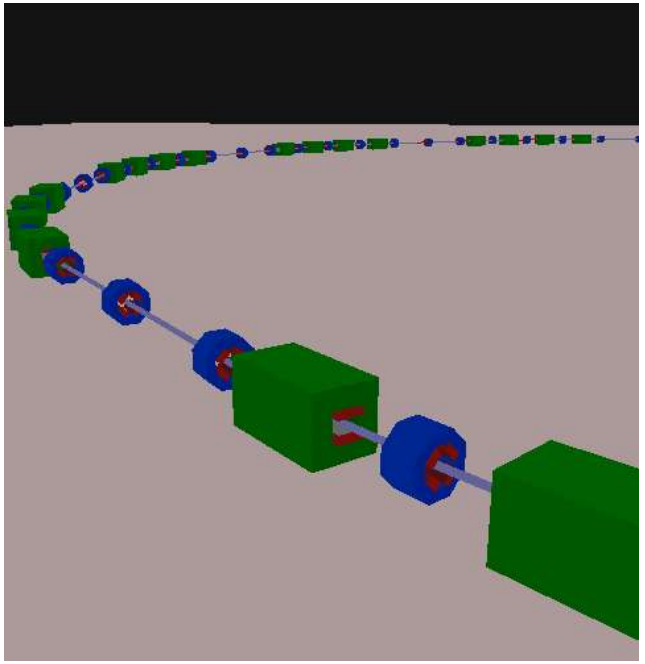


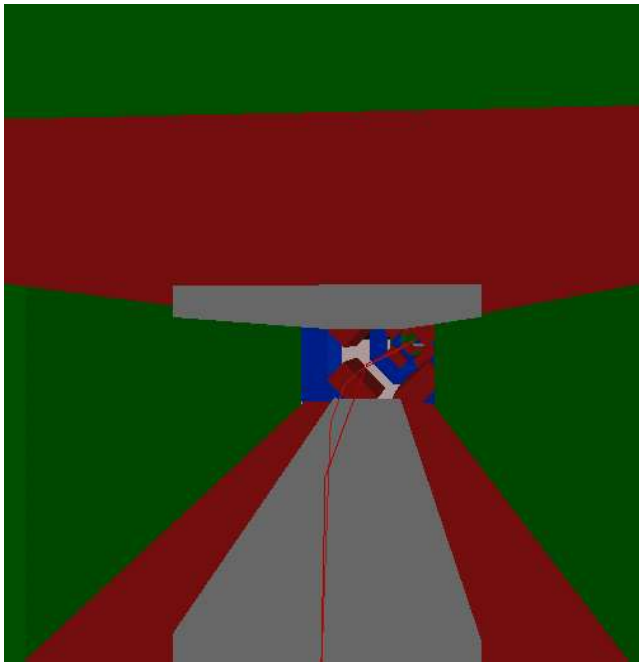


New Visualization and Simulation Tools 2

- 3D model in OpenGL to walk around in and inspect geometry of magnets and beam pipes, orbits, and space between elements.
- Triggered by the large energy spread -- generate 3D field map directly from MAD (done, but fringe fields are missing).
- Checked that numerically integrated closed orbit is actually closed within numerical accuracy. (Easy to implement in any language, e.g. MATLAB, C, or Fortran)







Some Details

- First generate MAD survey file
- svy2lat to .LAT file
- `layout -3 ilc.lat` generates a bunch of files that describe the field map and the OpenGL description of the beam line (magnets, pipe, orbit)

- #LAYOUT.COORDINATES write a stanza for each element
- with the aperture, position and Frenet tripod unit vectors and the magnetic field properties (the line from the TRANSPORT file)

```
    63 QF1
 55    0.250000  0.2000549167E+03   0.00000          8.8888961 'QF1      '
   0.0000     0.0500     0.0000     0.0000           APERTURE
 -4.73621349        0.00000000        86.9274431     POSITION
 0.923879534        0.00000000       0.382683429     E_X
  0.00000000        1.00000000        0.00000000     E_Y
-0.382683429        0.00000000       0.923879534     E_Z
```

- Could also write pointer to a field map file

Conclusions

- Creating the computational infrastructure
- Verifying the 20 mrad ILC results
- Extrapolating towards multi-TeV
- New software tools

Gantt-Chart

ILPS/PCDL

	2005				2006				2007			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Recruitment:												
PostDoc (sub-TeV)	1.1											
Post-Doc (multi-TeV)		1.2										
Software:												
MAD, DIMAD, GUINEA-PIG	2.1											
BDSIM operational		2.2										
Comparison BDSIM and DIMAD		2.3										
3D modeller for beamline		2.4										
3D-Fieldmap and direct integrator			2.5									
Losses calculation program			2.6									
Sub-TeV/ILC studies:												
Beamstrahlung and comparison e+/e- vs. e-/e-	3.1											
2 mrad post collision line		3.2										
Losses in the post collision line		3.3 >>>		>>>								
Comparison e+/e- and e-/e- collisions		3.4 >>>		>>>								
Neutron background simulations		3.5 >>>		>>>								
Optimization and compatibility		3.6 >>>		>>>								
Background studies for 2 and 20 mrad schemes					3.7 >>>		>>>	>>>				
Datagrid application						3.8 >>>		>>>				
Final report								3.9				
Multi-TeV/CLIC studies:												
Extrapolating luminosities of sub-TeV design		4.1 >>>										
Extrapolating energy of sub-TeV design			4.2 >>>									
Report on problem areas				4.3								
Adapted multi-TeV design				4.4 >>>		>>>						
Report on multi-TeV design						4.5						
Coherent pair diagnostics					4.6 >>>		>>>					
Beamstrahlung diagnostics						4.7 >>>		>>>				
Polarization diagnostics						4.8 >>>		>>>				
Report on diagnostic integration								4.9				
Optimization									4.1 >>>		>>>	
Final report												4.11