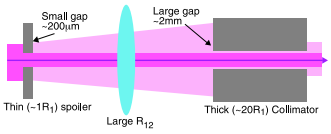
Collimation System

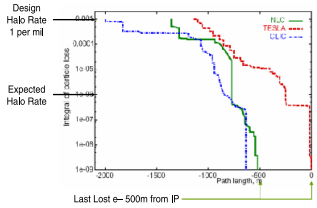
Innovative Optics
Wakefield Experiments
Simulations
Hardware Development
Material Damage Studies
Theory

Detector free of machine backgrounds
Headroom against collimator wakefields
Hardware robust against lost beam

Spoiler Absorber Scheme

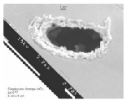


TRC Collimator Study Finding Excellent Efficiency



Single Pulse Material Damage Studies

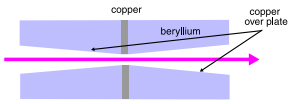
Fundamental R&D for Optics Design

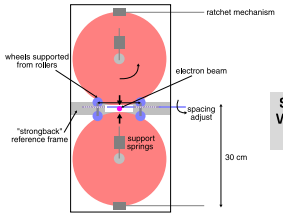


30 GeV Beam with 3–20x109 e–
$>\sigma_{xy}^2$ ~ 45 – 200um^2
$>\sigma_z$ ~ 1 mm
Damage: beam densities>7x10^{14} e–/cm^2
Picture is for 6x10^{15} e–/cm^2
NLC is 7.5 x 10^{16} e–/cm^2

Rotating Collimator Spoilers

Thin hi-Z SPOILERS with tapered low resistivity surface and 1000 x 1mm damage-able circumference



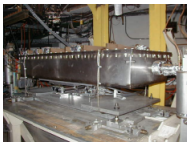


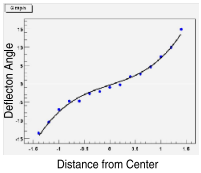
Stability under Wheel Rotation ~±15 μm

Measure Collimator Wakefields

Fundamental R&D

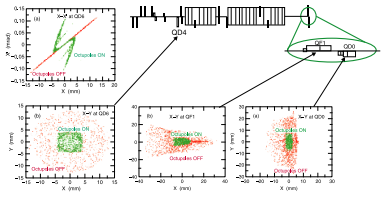
ASSET: 1.19GeV, 2x10^{10} e– 650 μm bunch length, damped beam (300 x 60 μm)





Tail-folding Octupoles

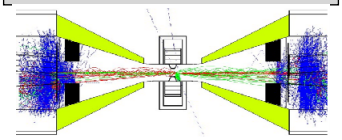
Same Efficiency with 3x larger collimator gaps and x10 reduced wakefields



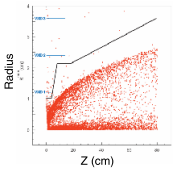
Backgrounds

IP Backgrounds Controlled with Masks, Shielding, Solenoid Field, Detector Granularity and Detector Timing

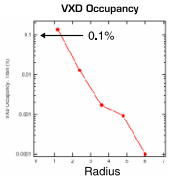
Beamstrahlung γ make e+e– pairs and hadrons
pairs proportional to LUMINOSITY
VXD, Tracker and Main (>40 mrad) calorimeter occupancy <~1% even integrating 192 bunches



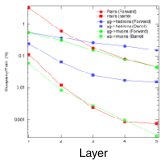
Max Radius of Pairs vs Z
SD @ 5 Tesla



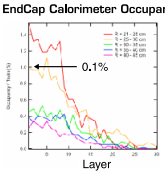
VXD Occupancy



SiD Tracker Occupancies



EndCap Calorimeter Occupancy

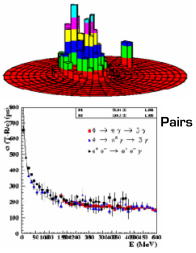


Detector Readout

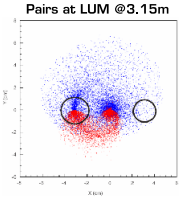
CCD VXD: Read out in 8 ms inter train gap:
No pile up, No RF pickup

Silicon Tracker and Si-EM Calorimeter (θ>40 mrad):
- 1 measurement with time tag per train
- 50 ns rise time and x10 S/N ⟶ 5ns/pixel ⟶ ~1ns per Em cluster or track
- eg.:Kloe calorimeter 200 ps resolution

Pair Detector (θ>40 mrad) will have per-bunch measurement for good electron ID
- R&D required and in progress (ALCPG Beam Instr. Group)
- eg. Fast detector technology (thin hi-field Si or Cerenkov) ⟶ switched capacitor array ⟶ smart readout



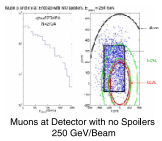
Pairs at LUM @3.15m



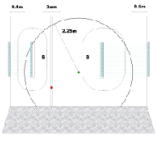
Muon Backgrounds

Collimators make muons when scraping halo
Design for 1 per mil halo (x1000 expected)
Tunnel-filling spoilers reduce μ rate by greater than x1000 and protect detector and personnel in both IRs independent of muon source

12,180 μ/train for 0.1% halo reduced to 7 μ/train



Muons at Detector with no Spoilers
250 GeV/Beam



9 & 18m Toroid Spoiler Walls