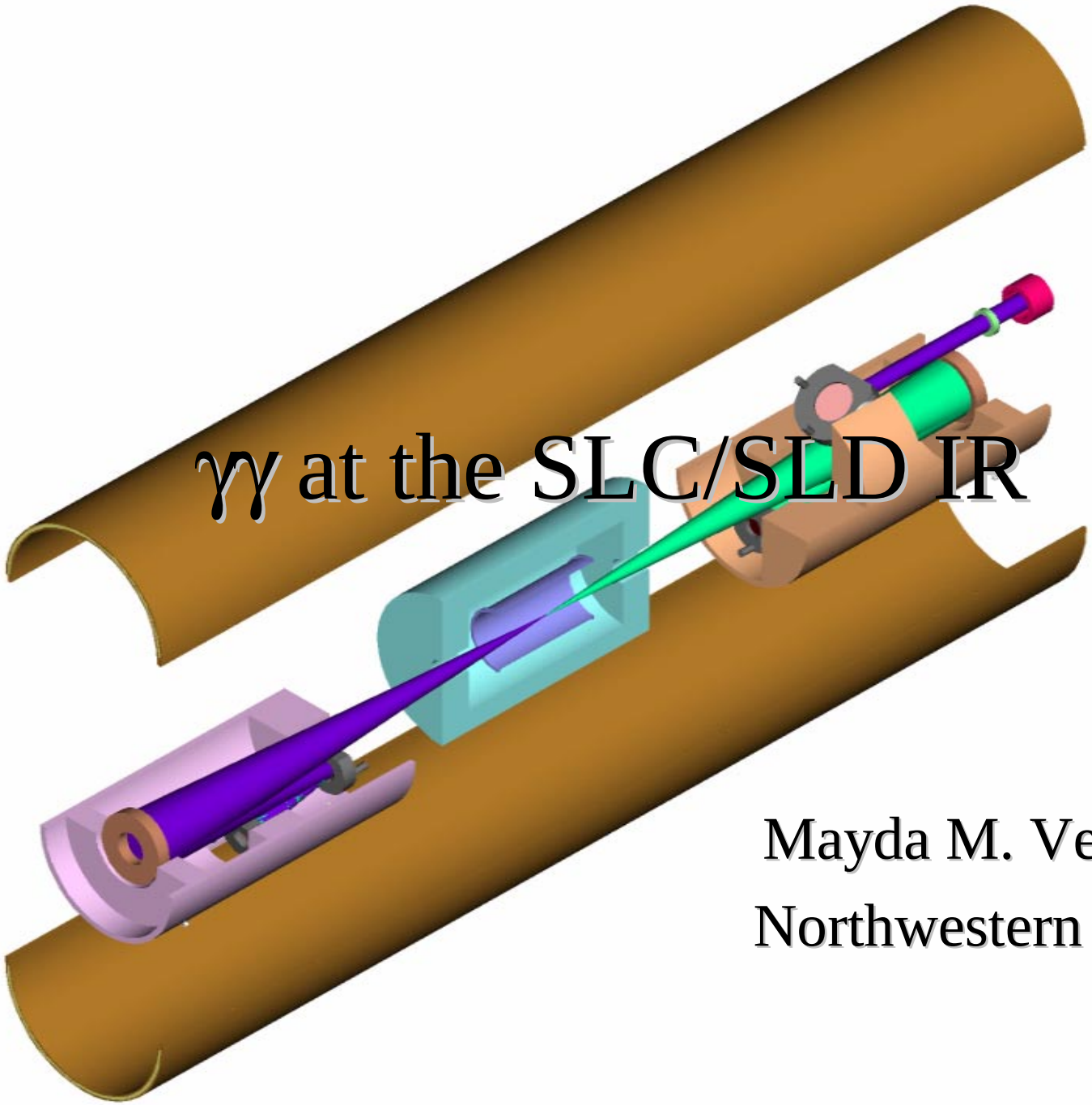
$\gamma\gamma$ at the SLC/SLD IR



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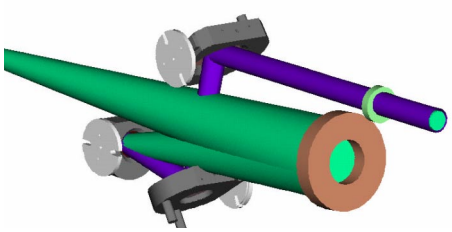
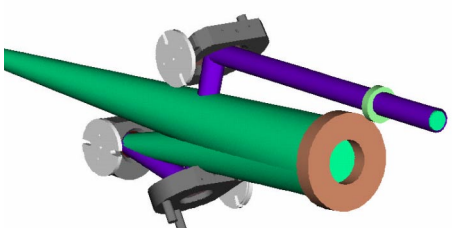


The Basic Proposal

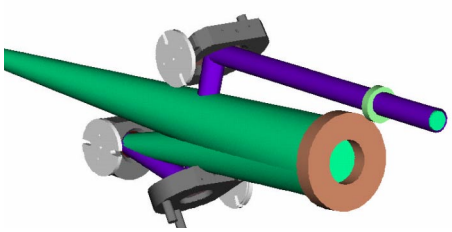
- Goal:
  - Proof-of-principle of $\gamma\gamma$ collision at SLD/SLC IR
    ➔ Measure luminosity, validate our developing tools
  - Test required optics for a JLC/NLC $\gamma\gamma$

- Requirements:
  - Revive the SLC, <$2M
  - Install laser and new beampipe
  - Run and observe $\gamma\gamma \rightarrow$ e+e- in the SLD calorimeter (LAC), and luminosity monitors (LUM)



Hardware to be tested

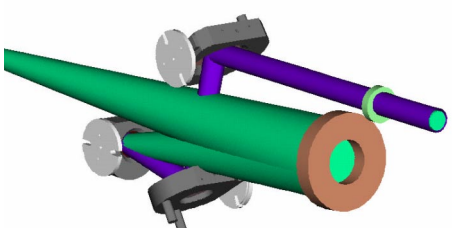
- Optical assembly design
- Wavefront and optics quality requirements
  - Key elements for laser power and and on-axis beam intensity
- Beam pipe design
- Alignment system for mirrors
- Beamsplitter for laser pulses



Measurement & Software Test

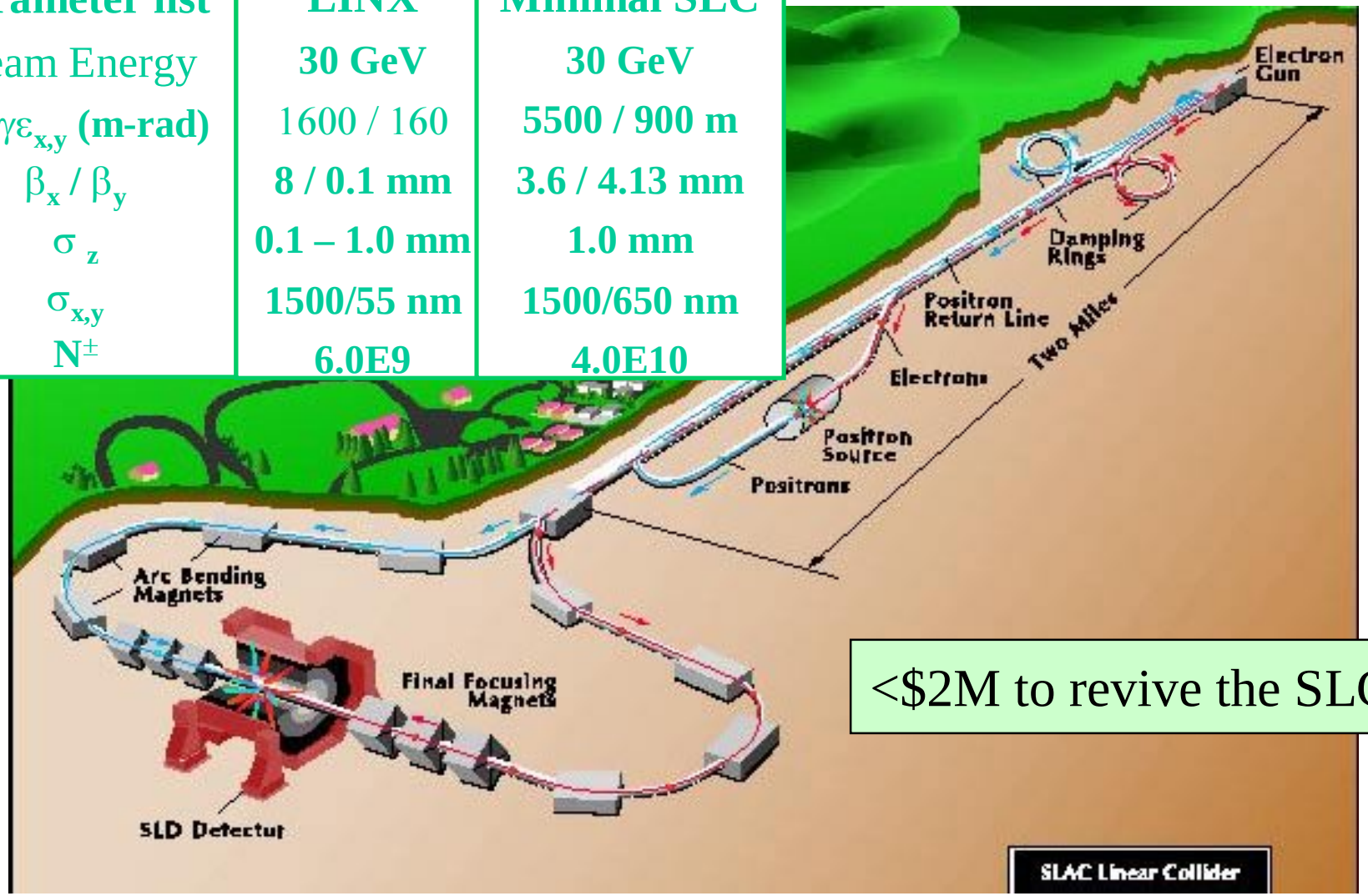
- Luminosity Measurement versus predictions from available beam simulation packages

- e to γ conversion efficiency

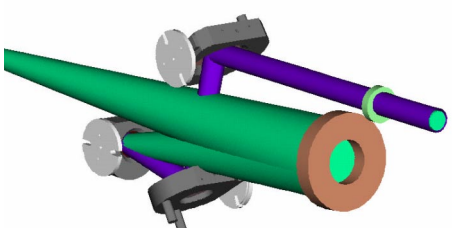


Engineering Test Facility at SLC

Parameter list	LINX	Minimal SLC
Beam Energy	30 GeV	30 GeV
FF $\gamma\varepsilon_{x,y}$ (m-rad)	1600 / 160	5500 / 900 m
β_x / β_y	8 / 0.1 mm	3.6 / 4.13 mm
σ_z	0.1 – 1.0 mm	1.0 mm
$\sigma_{x,y}$	1500/55 nm	1500/650 nm
$N^{\pm}$	6.0E9	4.0E10



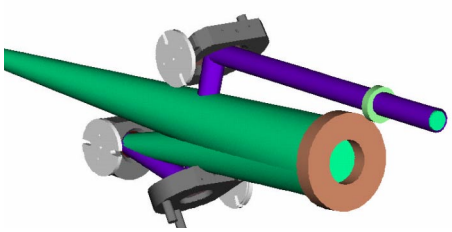
<$2M to revive the SLC



Laser assumptions and rates

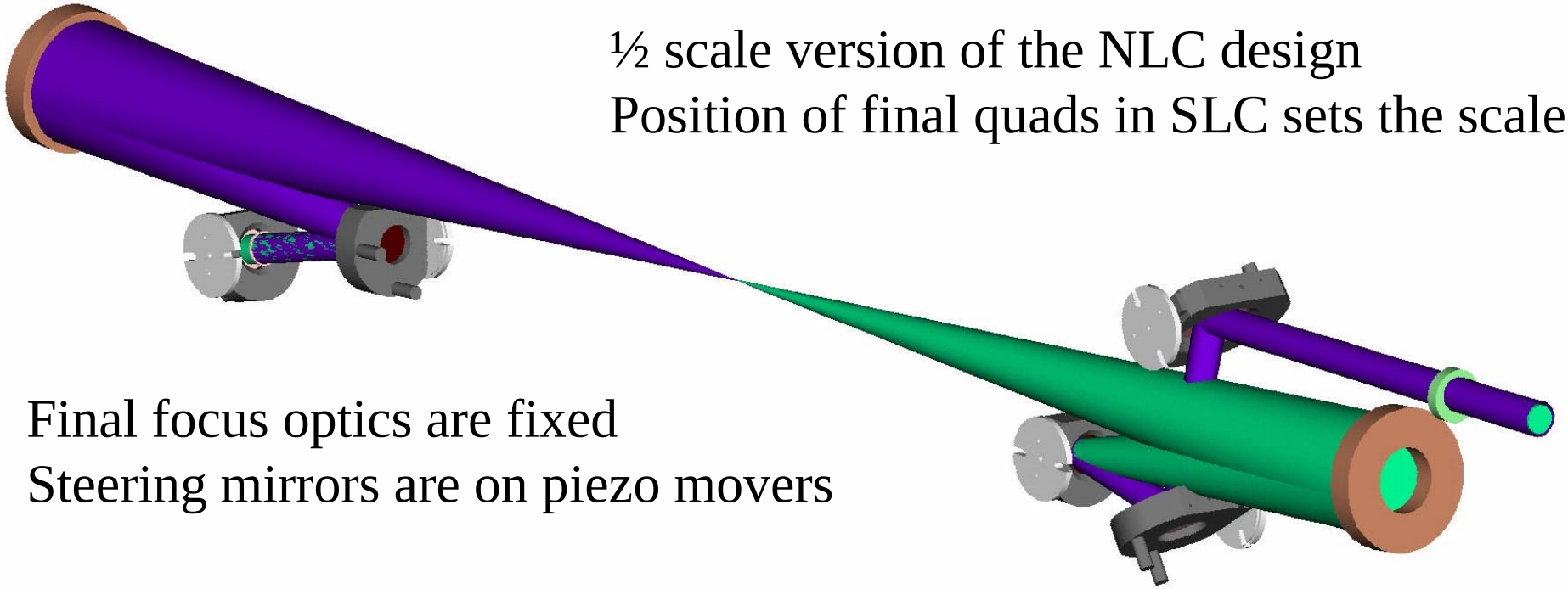
- Laser : 1μm, 0.1 Joule laser pulse
  (25% e→γ conversion efficiency)
- Event rates at Min-SLC is around 10xLINX

Process	**Cross Section**		**Event Rate**
$\gamma\gamma \rightarrow e^+e^-$	**(nb)**		**LINX (sec^{-1})**
LUM	2		10^{-5}
LAC	210		10^{-3}
$\gamma e^- \rightarrow \gamma e^-$			
LUM	0.5		10^{-5}
LAC	78		10^{-3}
$e^-e^- \rightarrow e^-e^-$			
LUM	228		0.02
LAC	94		10^{-3}



Photon Collider at SLC/SLD

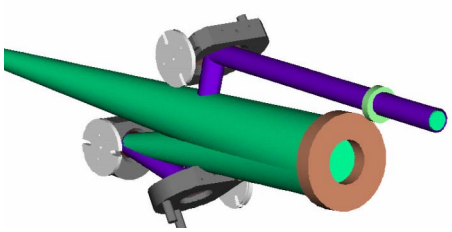
Optical Assembly



½ scale version of the NLC design
Position of final quads in SLC sets the scale

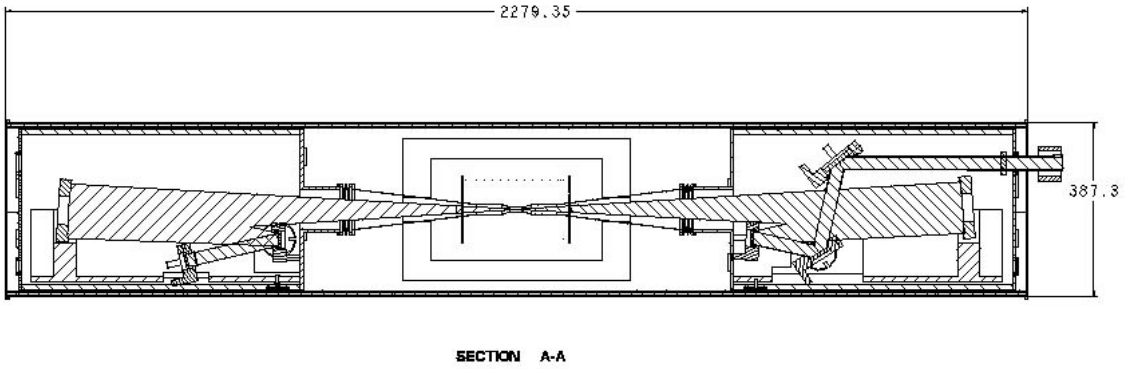
Final focus optics are fixed
Steering mirrors are on piezo movers

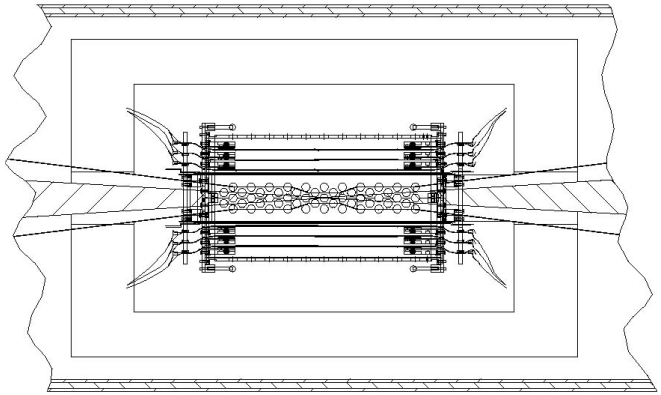
- Unknown factor: Optics damage
  - IP cannot often be opened up to fix the optics
    - Radiation damage to the coating
    - Laser power damage to the mirrors



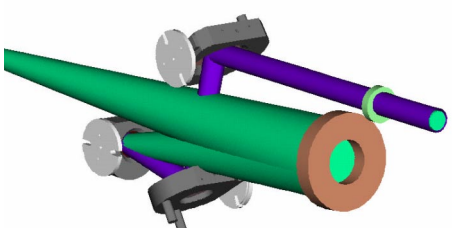
Photon Collider at SLD/SLC Hardware

Beampipe



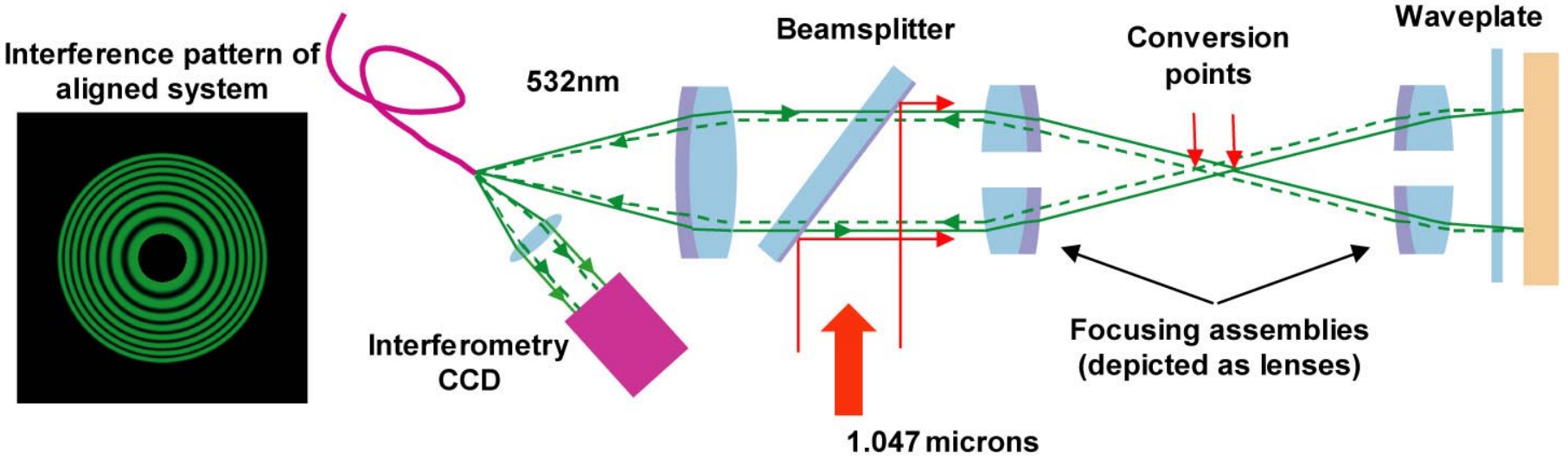


- Initial design of a beampipe has been done
  - New beampipe must be plug replaceable with the old
  - Can this be done before demounting the old beampipe?
  - Other IP hardware in this region that must be integrated?
- New quads or old?
  - Can the old quads accommodate light pipe?
  - The old setup may not have any wiggle room.

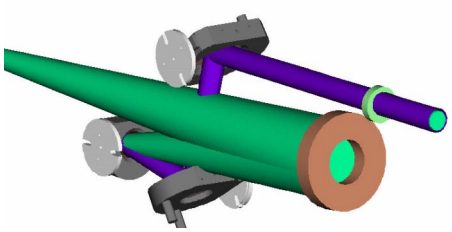


Photon Collider at SLD/SLC
Alignment System

➔ Optical system aligned before installed in IR



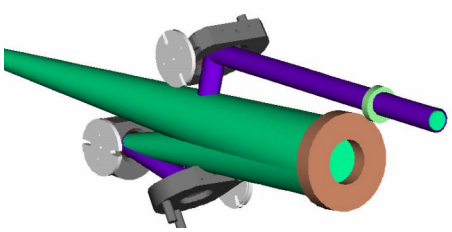
- Similar systems in use
  - ½ Scale prototype of optics / alignment system is currently under construction
  - Operation in end of FY02
  - Demonstration of alignment tolerance



Experimental program

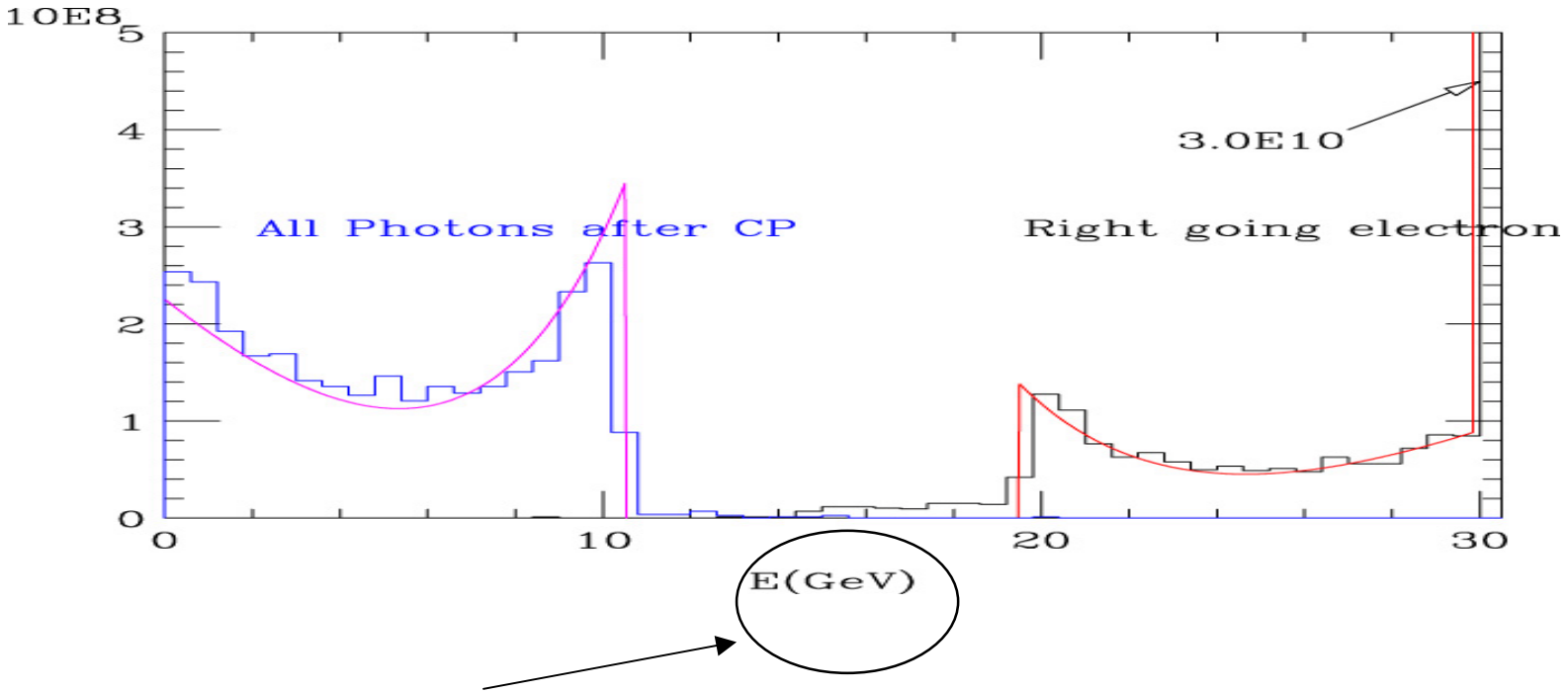
- Pulse-to-pulse conversion measurement
  - Electrons that have interacted are off-energy
    - They will be lost in the extraction line
  - Measure the bunch charge before the IP and just before reaching the beam dump
  - Collect data on the stability and consistency of the laser light delivered to the conversion point

- Direct luminosity measurement
  - $\gamma\gamma \rightarrow e^+e^-$
  - The SLD calorimeter will be revived in order to observe this process

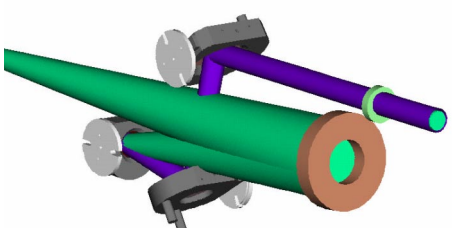


e^- and γ beams at SLC $\gamma\gamma$

➔Comparison of CAIN with a simple PANDORA parameterization

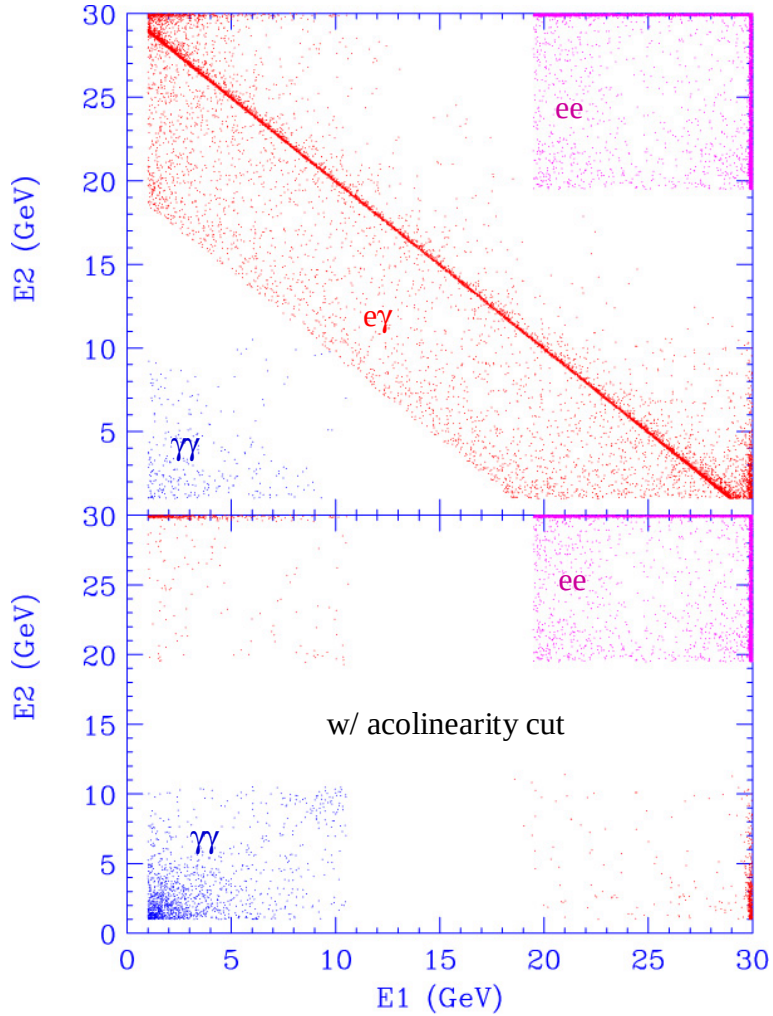


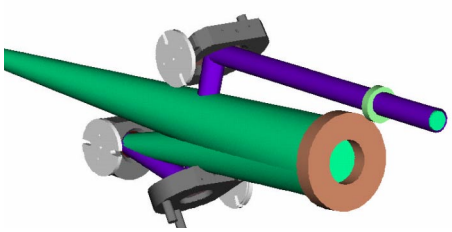
Allowable conversion rate at SLC-$\gamma\gamma$ is limited by the need to minimize multiple Compton backscatters… radiation of tunnel & heating of beam components



Kinematic separation of ee→γγ, eγ→eγ, ee→ee

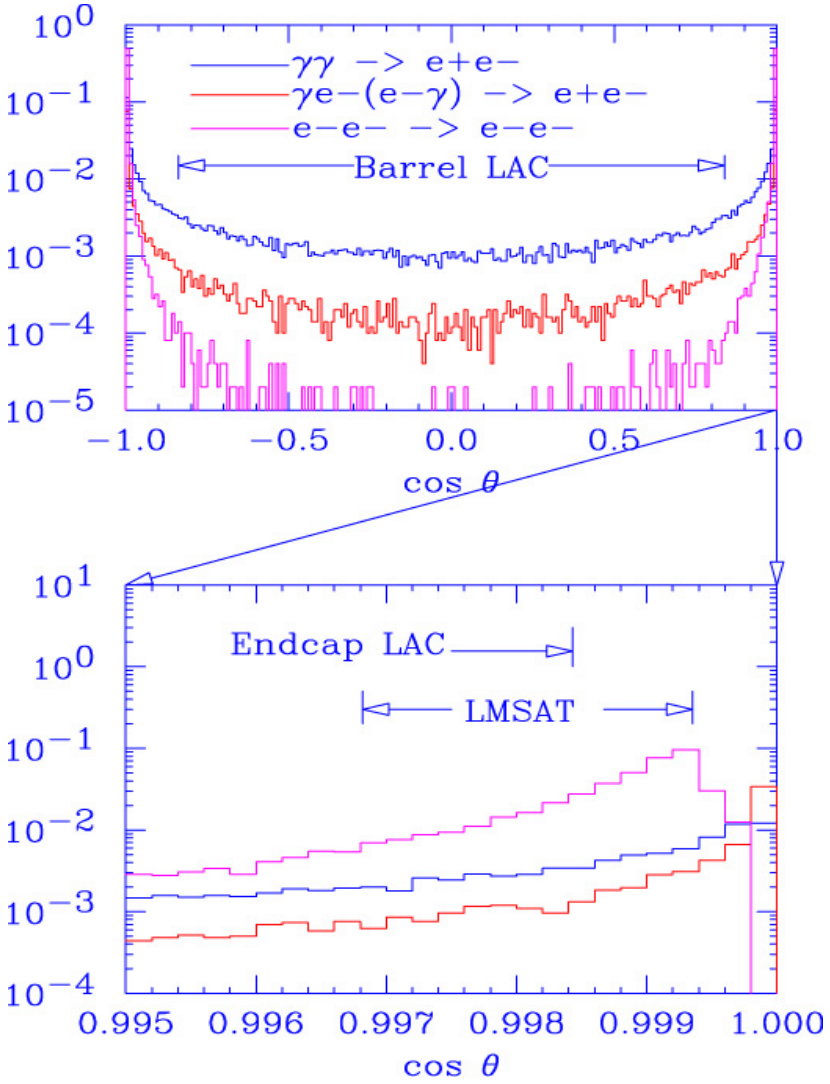
- The 3 possible scatters can be separated solely with their kinematic information:
  - Identify two hit events in the calorimeter
  - No tracking required

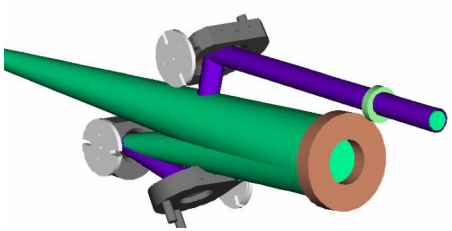




Angular Distributions

- $\gamma\gamma$ is peaked forward much less strongly than ee
- Full calorimetric coverage in angle will greatly improve the counting rate
- 1000 $\gamma\gamma \rightarrow$ ee takes 4 month with Min-SLC design & only using LUM, 100x faster with LAC





Outstanding issues

- Tunnel radiation simulation
  - Particle losses are known, contact radiation group at SLAC for limits and remediation
- Installation plan
  - The old beam pipe surely needs to come out and be measured before we will be ready to begin construction on the new
  - Otherwise, laser installation should be orthogonal
- Run plan
  - Mainly a question of the luminosity delivered and how long it will take to make a measurement in the Calorimeter
- Costing
  - Should be driven by achieving the best luminosity/cost ratio
    - Maximize bunch charge
    - FF improvements useful?