

XCC Cost, Physics with 0% e^- Polarization, & $\gamma\gamma \rightarrow HH$ at $E_{\text{cm}} = 280 \text{ GeV}$

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XCC Meeting
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XCC Cost Estimate

tunnel: \$40k/m

Collider hall: \$200M (Sami's estimate)

accelerator: \$350k/m (\$100k/m) for peak RF cost \$20/kW (\$2/kW)

transport/XFEL/FF line: \$100k/m

two linacs

1.6 km tunnel \$64M

Collider hall \$200M

1.4 km accelerator \$490M (\$140M)

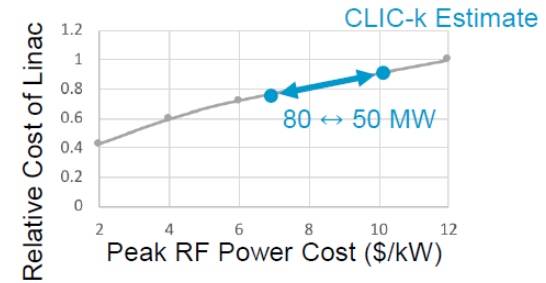
0.7 km 30 GeV transport line \$70M

0.8 km XFEL \$80M

0.4 km FF \$40M

\$944M (\$594M) total for peak RF cost \$20/kW (\$2/kW)

If these numbers don't include labor, contingency and other DOE project costs then we need to scale these number by a certain factor. e.g., $\pi \times \$944\text{M} = \3B



Getting peak RF cost → \$2/kW is the key to keeping XCC project cost in the \$1B - \$2B range

My detector cost is estimate is \$700M. Marty says \$1000M for ILC detector, but I think the XCC detector volume can be made smaller

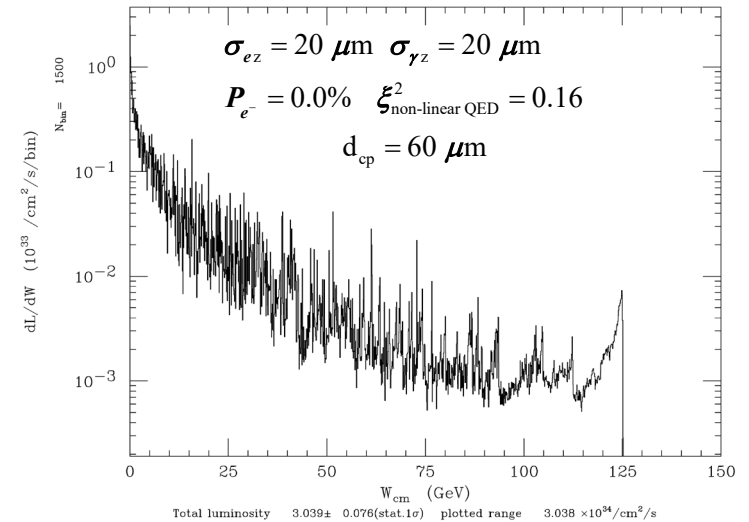
Config with $\sigma_z=20 \mu\text{m}$ $d_{cp}=60 \mu\text{m}$ $P_{e^-}=0$

Machine	Polarization	$N_{\text{Higgs}} / (10^7 \text{ s})$	$N_{\text{Hadronic Events}} (\sqrt{s} > 60 \text{ GeV}) / N_{\text{Higgs}}$	$N_{\text{minbias/BX}}$
XCC	0% e^-	5,000	220	9.5
XCC	90% e^-	25,000	70	9.5
ILC	-80% e^- +30% e^+	42,000	230	1.3
ILC	+80% e^- -30% e^+	28,000	55	1.3

XCC $\gamma\text{-}\gamma$ Higgs Factory v01914

Luminosity Spectrum (γ,γ)

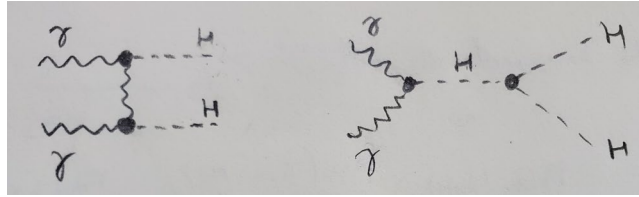
20210507(193513) CAIN



Even without e^- polarization the XCC would provide model independent measurements of the Higgs couplings (the $\sigma \times \text{BR}$ measurements at $\sqrt{s} = 125 \text{ GeV}$ are calibrated with $\sigma(e^- \gamma \rightarrow e^- H)$ measurement at $\sqrt{s} = 140 \text{ GeV}$). These model independent measurements would be unique with respect to the LHC.

We need to do a study to determine if we can learn anything from the low statistics XCC model independent results that won't already be known from HL-LHC. Could the 0% e^- XCC measurements expose something covered up the the model dependent assumptions in the HL-LHC analyses?

Energy upgrade to $E_{\text{cm}}=280$ GeV for Higgs Self Coupling Study



2012 Study

A feasibility study of the measurement of Higgs pair creation
at a Photon Linear Collider

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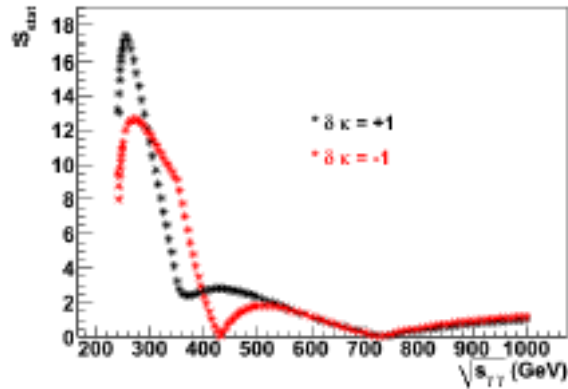


FIG. 3. Statistical sensitivity (S_{stat}) as a function of $\gamma\gamma$ collision energy. Black and red dots show the $\delta\kappa = +1$ and $\delta\kappa = -1$ cases.

Optimum sensitivity at $\sqrt{s_{\gamma\gamma}} = 280$ GeV

TABLE I. The parameters of electron and laser beams based on TESLA optimistic parameters. The polarization of electron beam was assumed to be 100 %.

parameter	unit	
electron beam energy	E_e [GeV]	190
# of electrons / bunch	$N \times 10^{10}$	2
longitudinal beam size	σ_z [mm]	0.35
transverse emittance	$\gamma\epsilon_{x/y}$ [10^{-6} m-rad]	2.5/0.03
β function @ IP	$\beta_{x/y}$ [mm]	1.5/0.3
transverse beam size	$\sigma_{x/y}$ [nm]	100/5.7
laser wavelength	λ_L [nm]	1054
laser pulse energy	[J]	10
$x = 4\omega E_e/m_e^2$		3.42

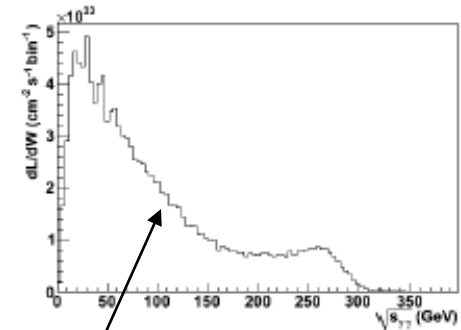


FIG. 4. Luminosity distribution generated by CAIN. Input parameters are shown in TABLE I.

Does this optical laser $\gamma\gamma$ spectrum include the beamstrahlung luminosity? To be checked. There are two possibilities:

Yes, but e^- Compton conversion efficiency is very high, so
beamstrahlung lumi low.

No, the beamstrahlung luminosity has not been included

We need to redo this study with the XCC $\gamma\gamma$ spectrum.