

XFEL-based $\gamma\gamma$ Collider Higgs Factory

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XFEL $\gamma\gamma$ Collider Meeting
Jan 13, 2021

Higgs coupling study with XFEL $\gamma\gamma$ Collider - direct scan

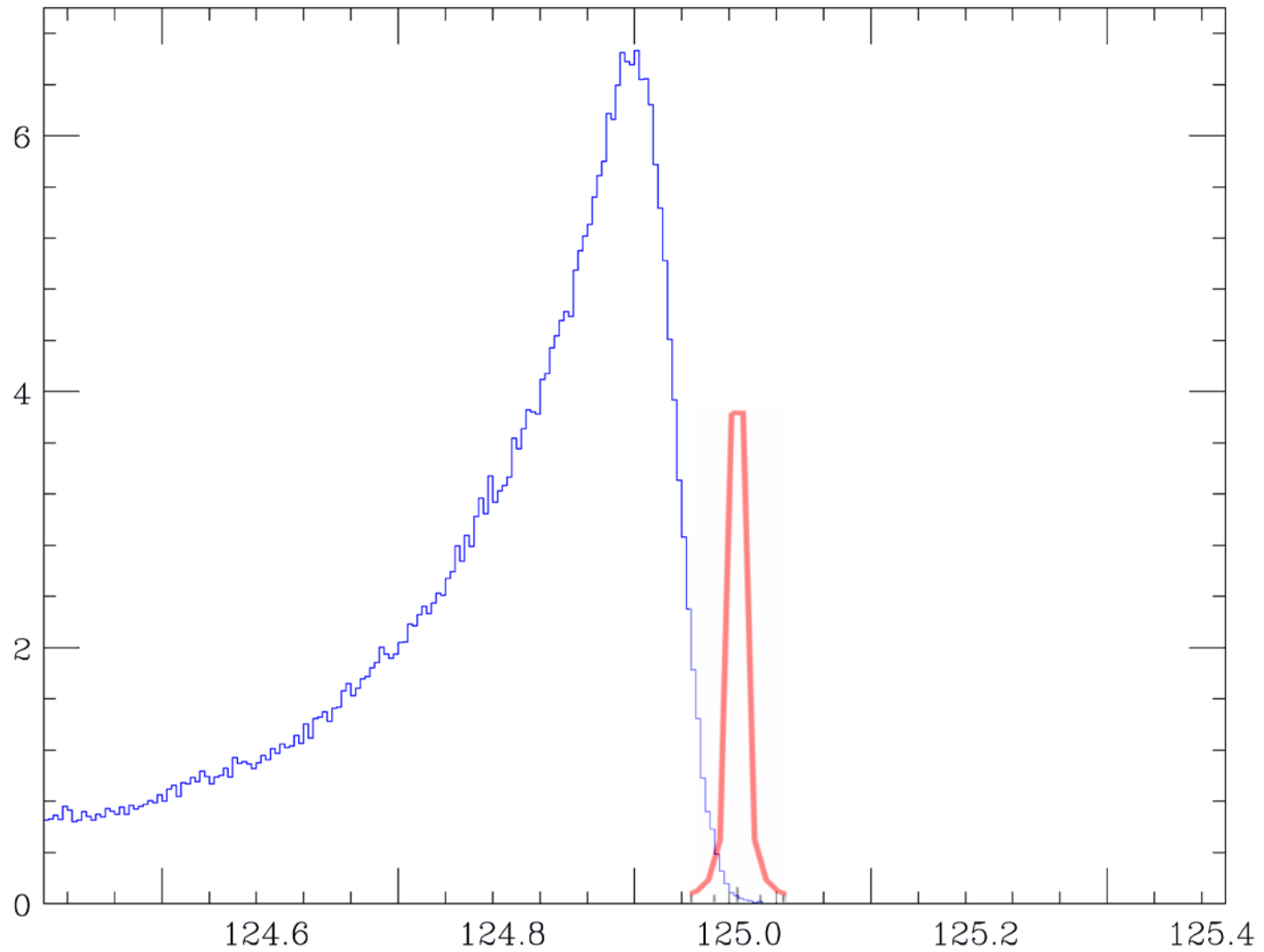
- To compare ILC with the XFEL $\gamma\gamma$ collider, I need a short acronym, which I have chosen as XCC for XFEL Compton Collider
- If we run near $E_{cm}=125$ GeV we measure the Higgs total width directly by scanning. To achieve ILC Higgs precision we need to

(1) Increase x from 1000 to 1800, so that the x-ray photon energy increases from 1.04 keV to 1.88 keV. The pulse energy is kept at 0.7 Joules. The XFEL laser waist radius is reduced from 37.7 nm to 21.8 nm.

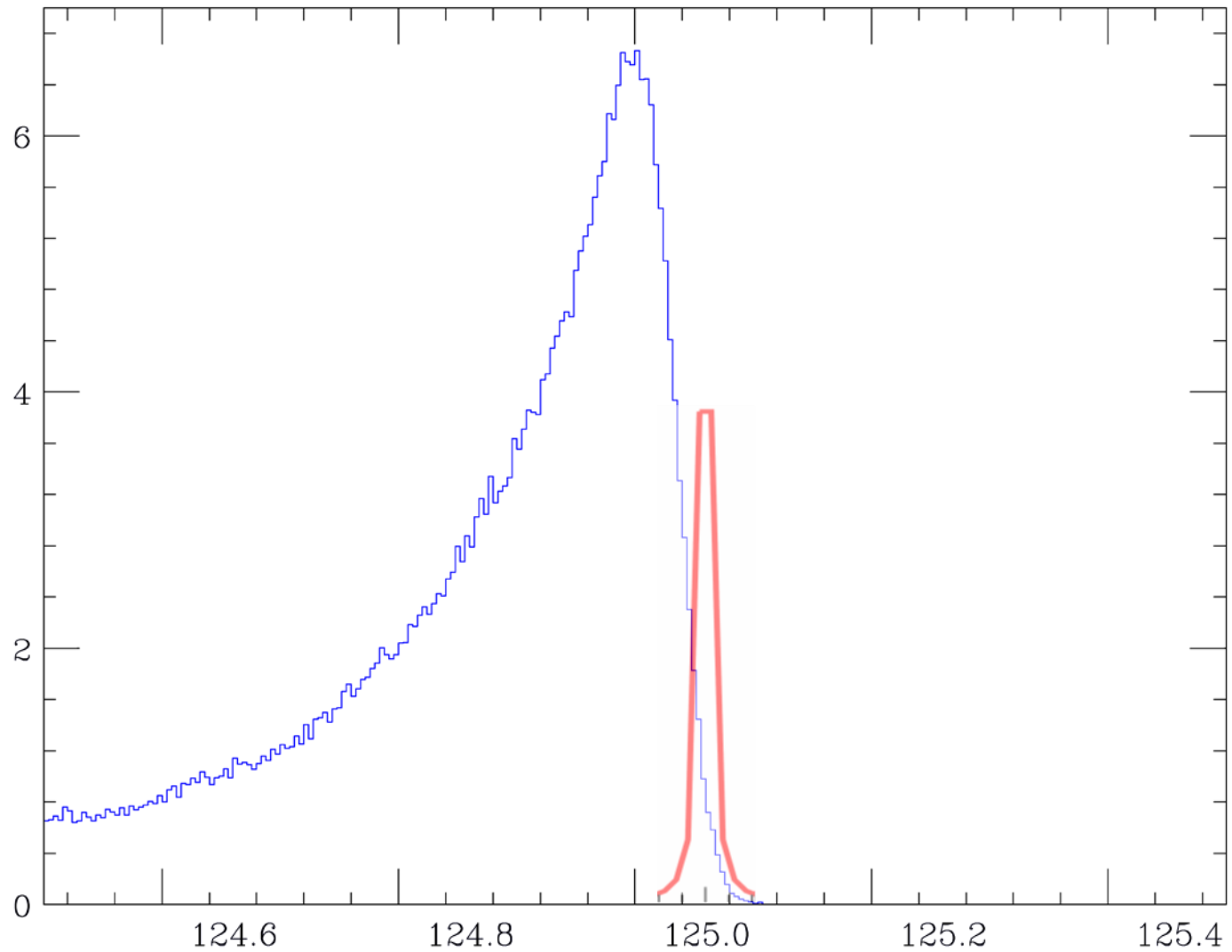
(2) The electron energy spread must be between 0.010% and 0.015%. I assume that this spec will be the hardest to achieve; however, it could make other aspects of the design easier to achieve, such as the small round beam IP spot size.

(3) The number of bunches per train times the train repetition rate needs to be increased by a factor of 6.3. This could be done, for example by increasing the number of bunches per train from 76 to 238 and doubling the Linac rep rate from 240 to 480 Hz.

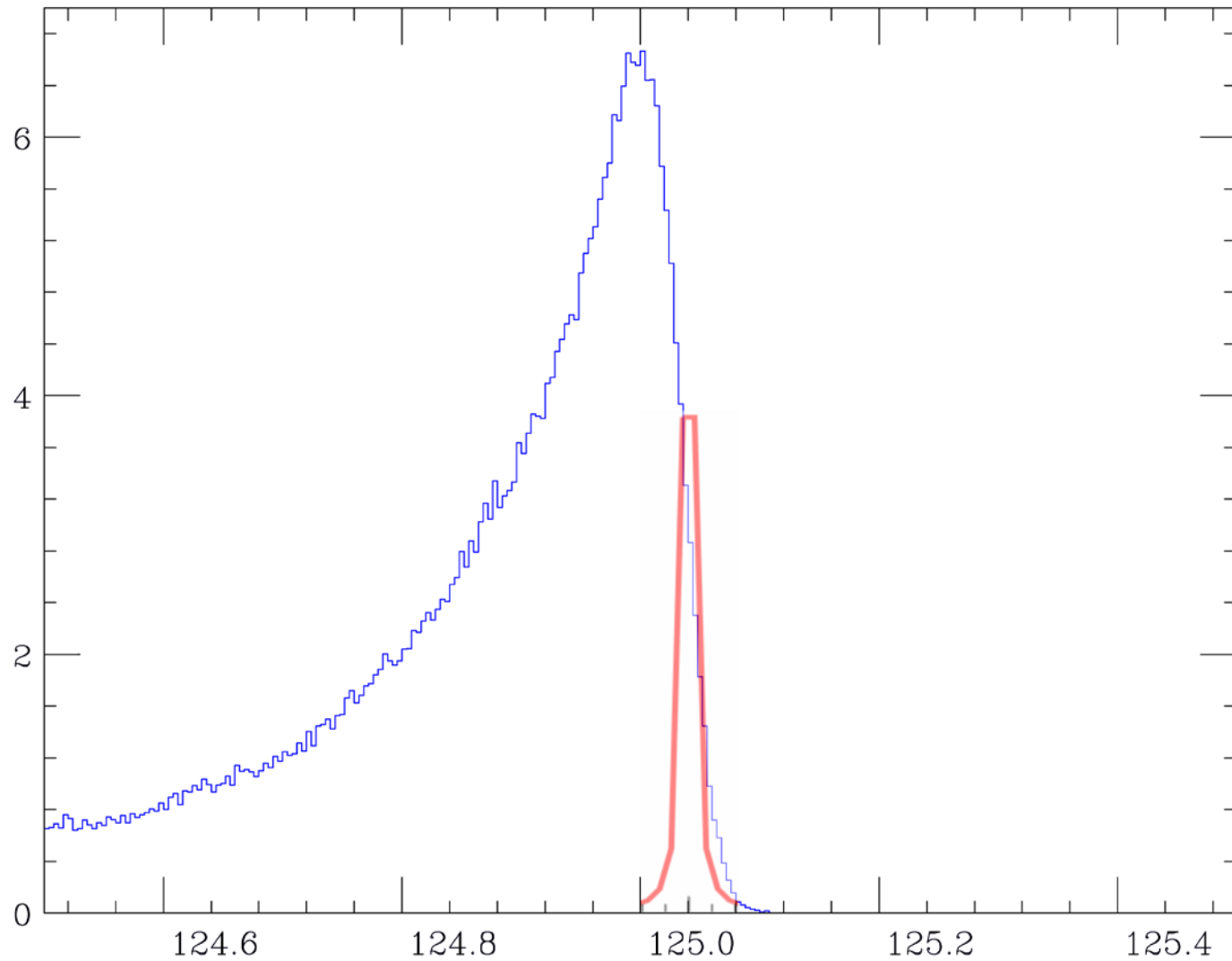
$\gamma\gamma$ Luminosity Spectra $x=1400$ $2P_c\lambda_e = -0.9$



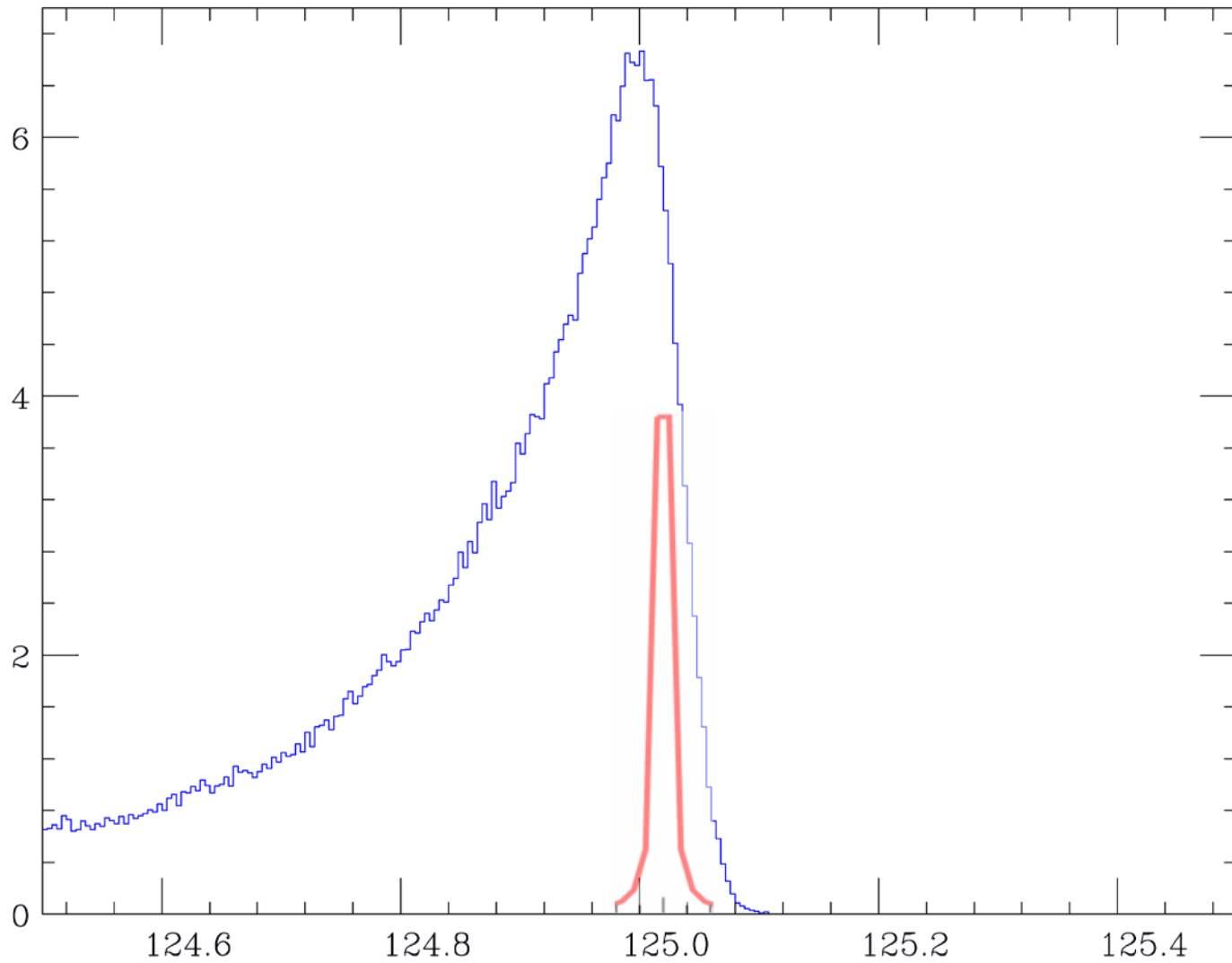
$\gamma\gamma$ Luminosity Spectra $x=1400$ $2P_c\lambda_e = -0.9$



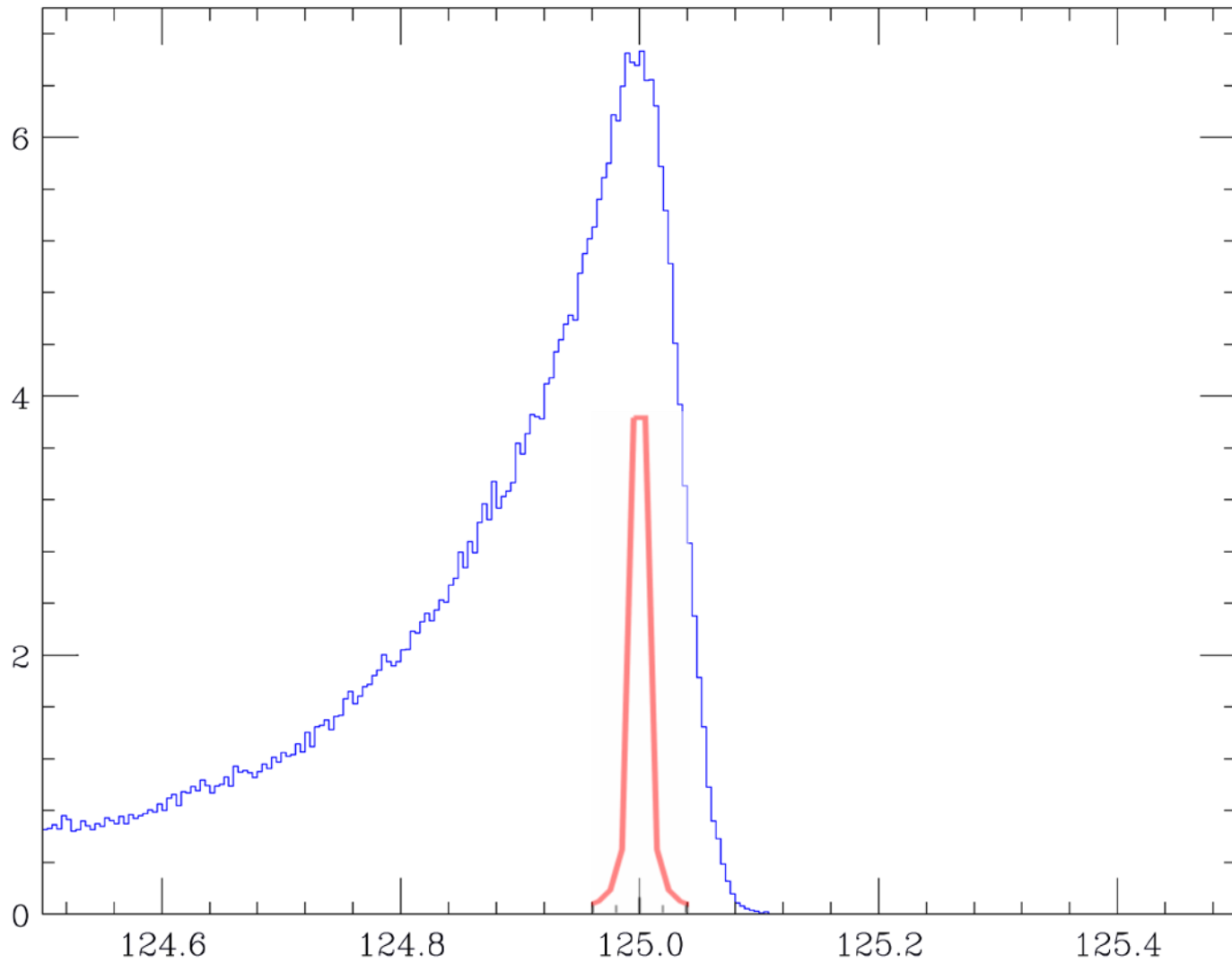
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Higgs coupling study with XFEL $\gamma\gamma$ Collider - direct scan

ILC

Higgs total width: 0.0235778

Higgs coupling errors :

bb : 0.0102134
cc : 0.018383
gg : 0.0163973
WW : 0.00549084
tautau : 0.0115883
ZZ : 0.0056596
gamgam : 0.0112247
mumu : 0.0397616
Z gam : 0.0911103

95% conf upper limits

inv : 0.00358854
other : 0.0159841

XCC

Higgs total width: 0.0235718

Higgs coupling errors :

bb : 0.011984
cc : 0.0181905
gg : 0.0165971
WW : 0.0138991
tautau : 0.01294
ZZ : 0.0139143
gamgam : 0.016929
mumu : 0.0412199
Z gam : 0.101603

95% conf upper limits

other : 0.00832184

Higgs coupling study with XCC - $e^- \gamma \rightarrow e^- H$ @ 140 GeV

- It may be possible to avoid a direct scan and instead extract the coupling of the Higgs to 2 photons by measuring the cross section for $e^- \gamma \rightarrow e^- H$ @ 140 GeV
- This method assumes we run half the time in $\gamma\gamma$ mode at $E_{cm}=125$ GeV and half the time in $e^- \gamma$ mode at $E_{cm}=140$ GeV

The number of bunches per train times the train repetition rate needs to be increased by a factor of 3.7. This could be done, for example by increasing the number of bunches per train from 76 to 280.

Higgs coupling study with XCC - $e^- \gamma \rightarrow e^- H$ @ 140 GeV

ILC

Higgs total width: 0.0235778

Higgs coupling errors :

bb : 0.0102134
cc : 0.018383
gg : 0.0163973
WW : 0.00549084
tautau : 0.0115883
ZZ : 0.0056596
gamgam : 0.0112247
mumu : 0.0397616
Z gam : 0.0911103

95% conf upper limits

inv : 0.00358854
other : 0.0159841

XCC

Higgs total width: 0.0229239

Higgs coupling errors :

bb : 0.00961959
cc : 0.0122023
gg : 0.0114985
WW : 0.00923716
tautau : 0.00998536
ZZ : 0.00917532
gamgam : 0.00366321
mumu : 0.0344765
Z gam : 0.100054

95% conf upper limits

other : 0.0131059