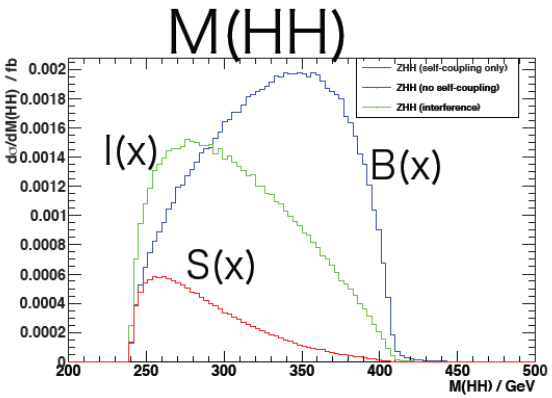
Example of recent improvement in ILC Higgs self coupling analysis

Weighting Method to Enhance the Sensitivity to λ

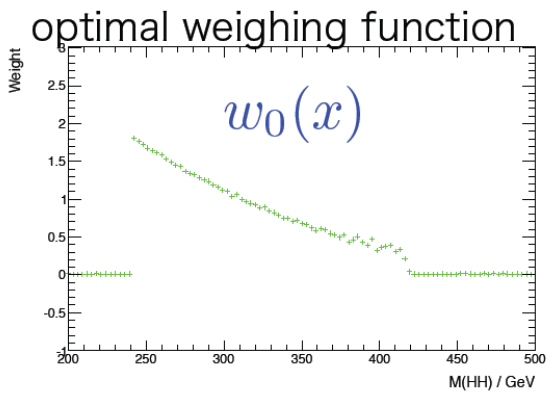


$$\frac{\mathrm{d}\sigma}{\mathrm{d}x} = B(x) + \lambda I(x) + \lambda^2 S(x)$$

irreducible interference self-coupling

Observable: weighted cross-section

$$\sigma_w = \int \frac{\mathrm{d}\sigma}{\mathrm{d}x} w(x)\mathrm{d}x$$



Equation for the optimal w(x) (variational principle):

$$\sigma(x)w_0(x)\int (I(x)+2S(x))w_0(x)\mathrm{d}x = (I(x)+2S(x))\int \sigma(x)w_0^2(x)\mathrm{d}x$$

General solution:

$$w_0(x) = c\cdot\frac{I(x)+2S(x)}{\sigma(x)}$$

c: arbitrary normalization factor

$e^+e^- \to ZHH \quad @\ \sqrt{s} = 500\ \mathrm{GeV}$ $\quad \frac{\delta\lambda}{\lambda} = 1.8\frac{\delta\sigma}{\sigma} \quad \Rightarrow \quad 1.66\frac{\delta\sigma}{\sigma}$

$e^+e^- \to \nu\bar{\nu}HH \quad @\ \sqrt{s} = 1000\ \mathrm{GeV}$ $\quad \frac{\delta\lambda}{\lambda} = 0.85\frac{\delta\sigma}{\sigma} \quad \Rightarrow \quad 0.76\frac{\delta\sigma}{\sigma}$

ILC Higgs Self Coupling Summary

Scenario A: $HH \rightarrow bbbb$, full simulation done

Scenario B: add $HH \rightarrow bbWW^*$, full simulation ongoing

Scenario C: additional Higgs decay modes; color-singlet clustering

$$\frac{\delta\lambda}{\lambda}$$

HHH	500 GeV			500 GeV + 1 TeV		
Scenario	A	B	C	A	B	C
Canonical	104%	83%	66%	26%	21%	17%
LumiUP	58%	46%	37%	16%	13%	10%