ISR and data-taking strategy for Higgs cross section measurement

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The measurement of $\sigma(e^+ e^- \rightarrow Z\ H)$

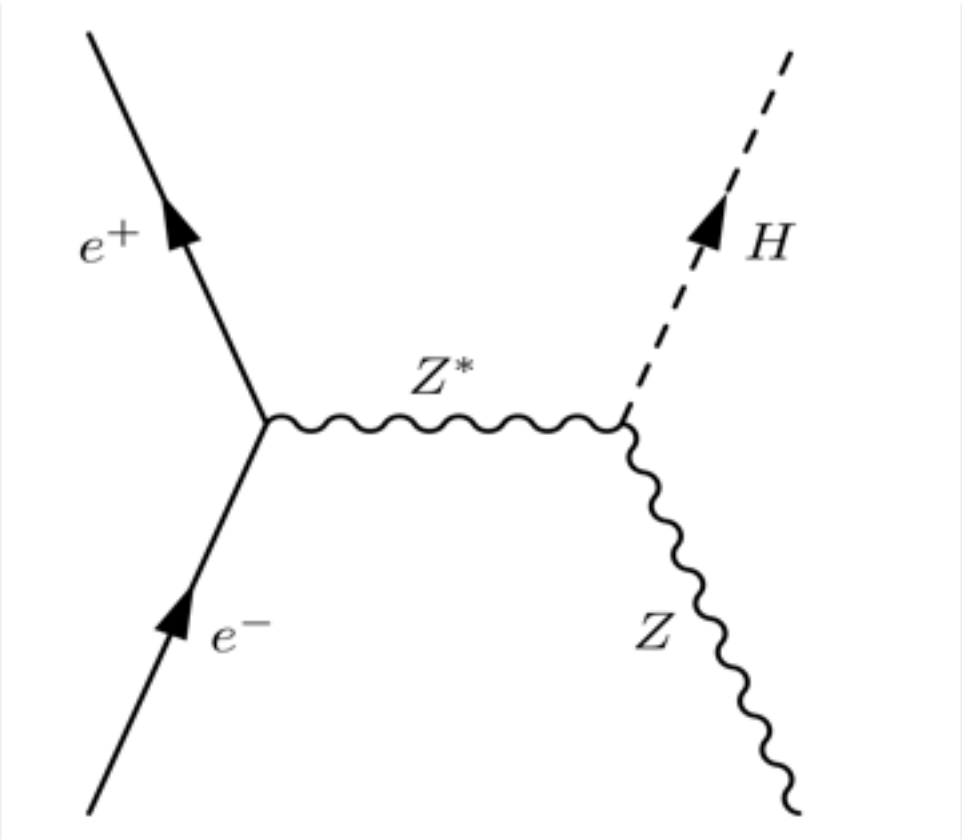
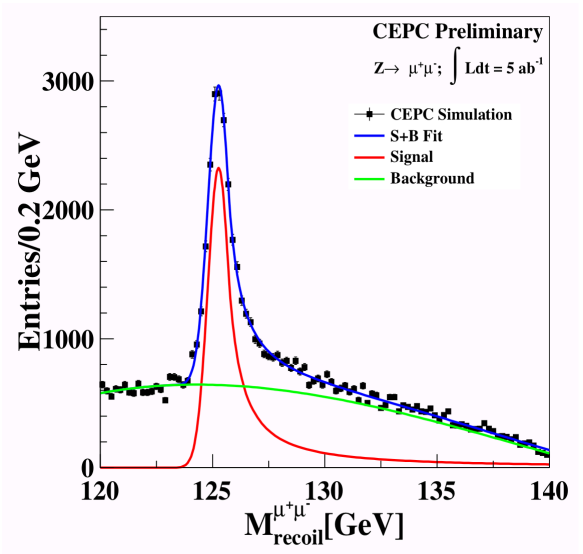
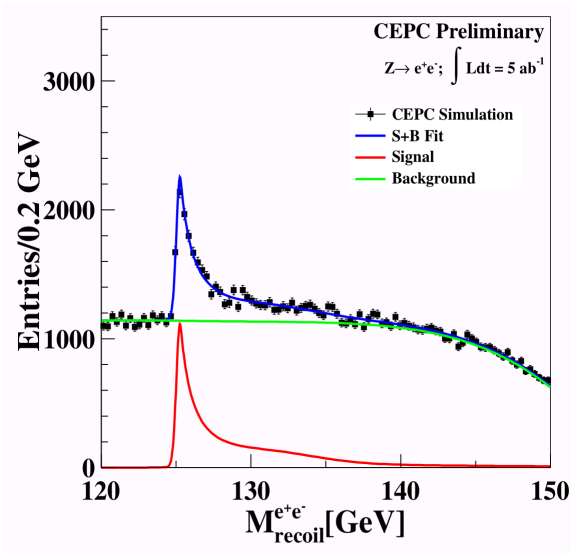


Fig 1: Feynman diagram of the $e^+e^- \rightarrow ZH$

The measurement of $\sigma(e^+ e^- \to Z\,H)$





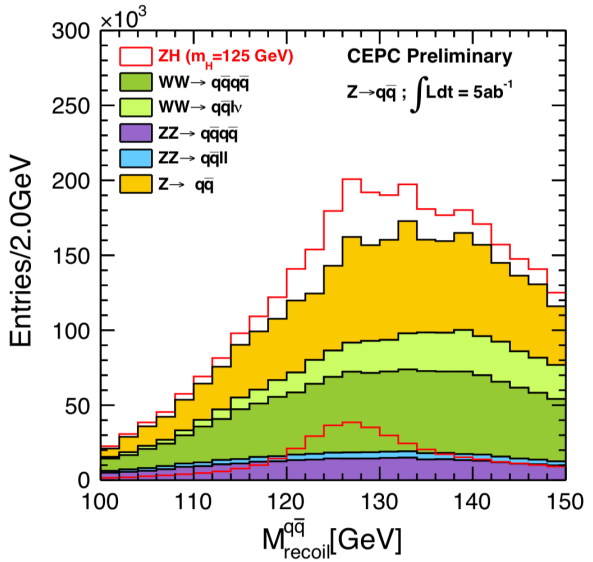
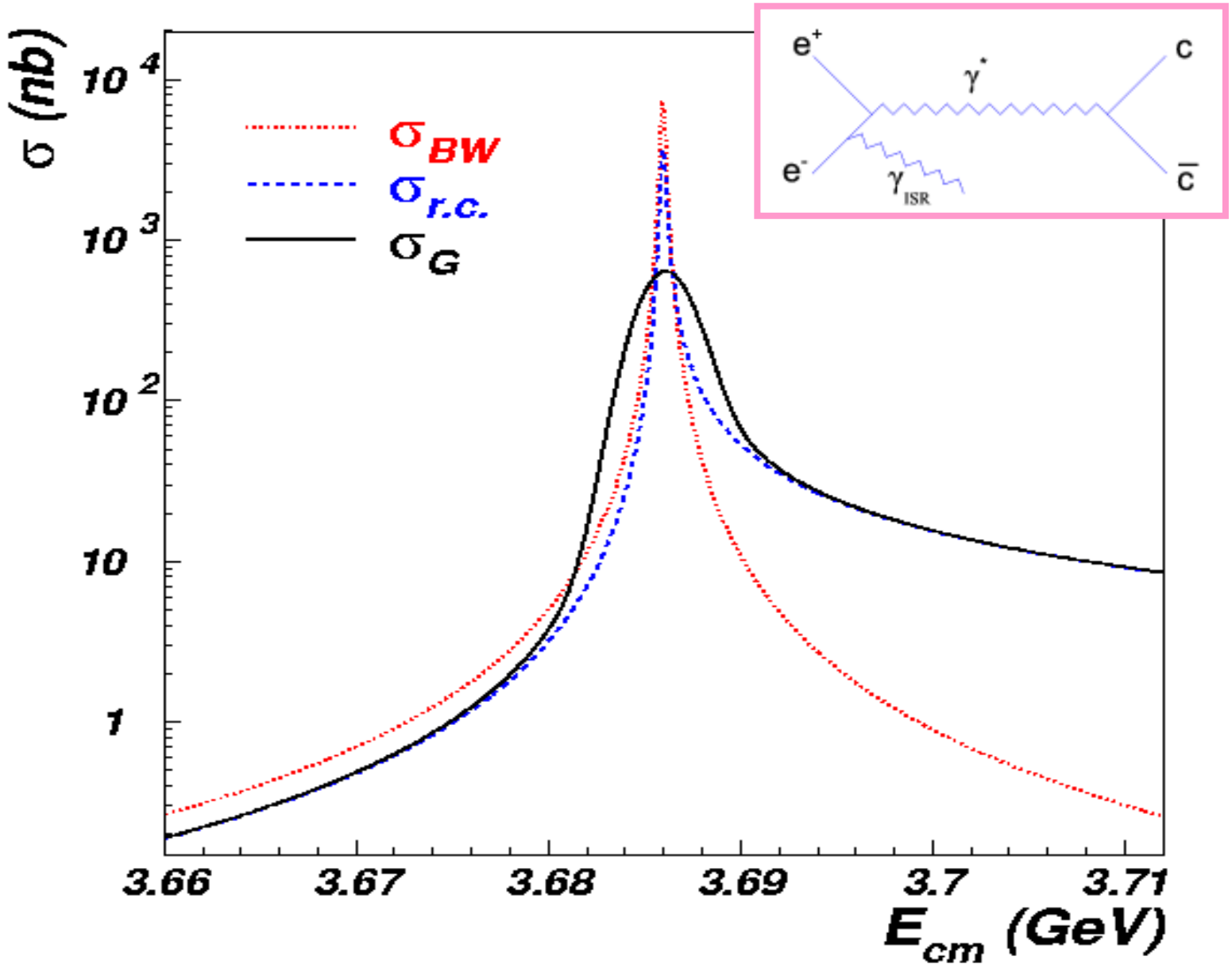


Table 3.3 Estimated precisions of the Higgs boson mass, $\sigma(ZH)$ and Higgs-Z boson coupling with 5 ab^{-1} integrated luminosity.

Z decay mode	ΔM_H (MeV)	$\Delta\sigma(ZH)/\sigma(ZH)$	$\Delta g(HZZ)/g(HZZ)$
ee	14	2.1%	
$\mu\mu$	6.5	0.9%	
$ee + \mu\mu$	5.9	0.8%	0.4%
$q\bar{q}$		0.65%	0.32%
$ee + \mu\mu + q\bar{q}$		0.51%	0.25%

The initial state radiation in $e^+ e^-$ collider



The ISR correction factor

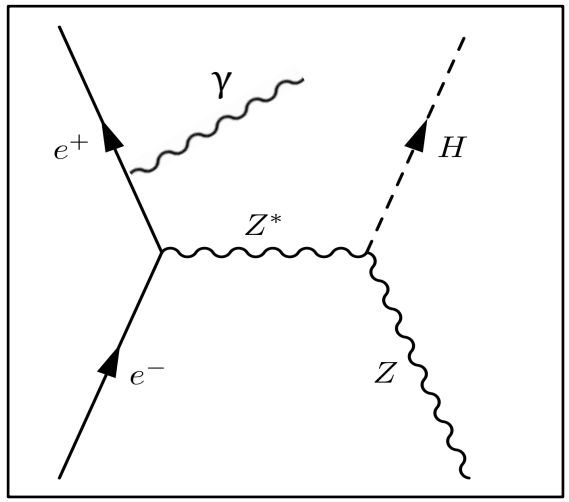
1. The experimental observed cross section:

$$\sigma^{\rm obs}(s) = \int_0^{x_{\rm m}} F(x,s)\sigma^{\rm dre}(s(1-x))\ {\rm d}x \qquad (1)$$

$$= \int_0^{x_{\rm m}} F(x,s)\frac{\sigma^{\rm B}(s(1-x))}{|1-\Pi(s(1-x))|^2}\ {\rm d}x, \qquad (2)$$

2. The ISR correction factor is defined:

$$1+\delta(s) = \sigma^{\rm dre}(s)/\sigma^{\rm obs}(s)$$

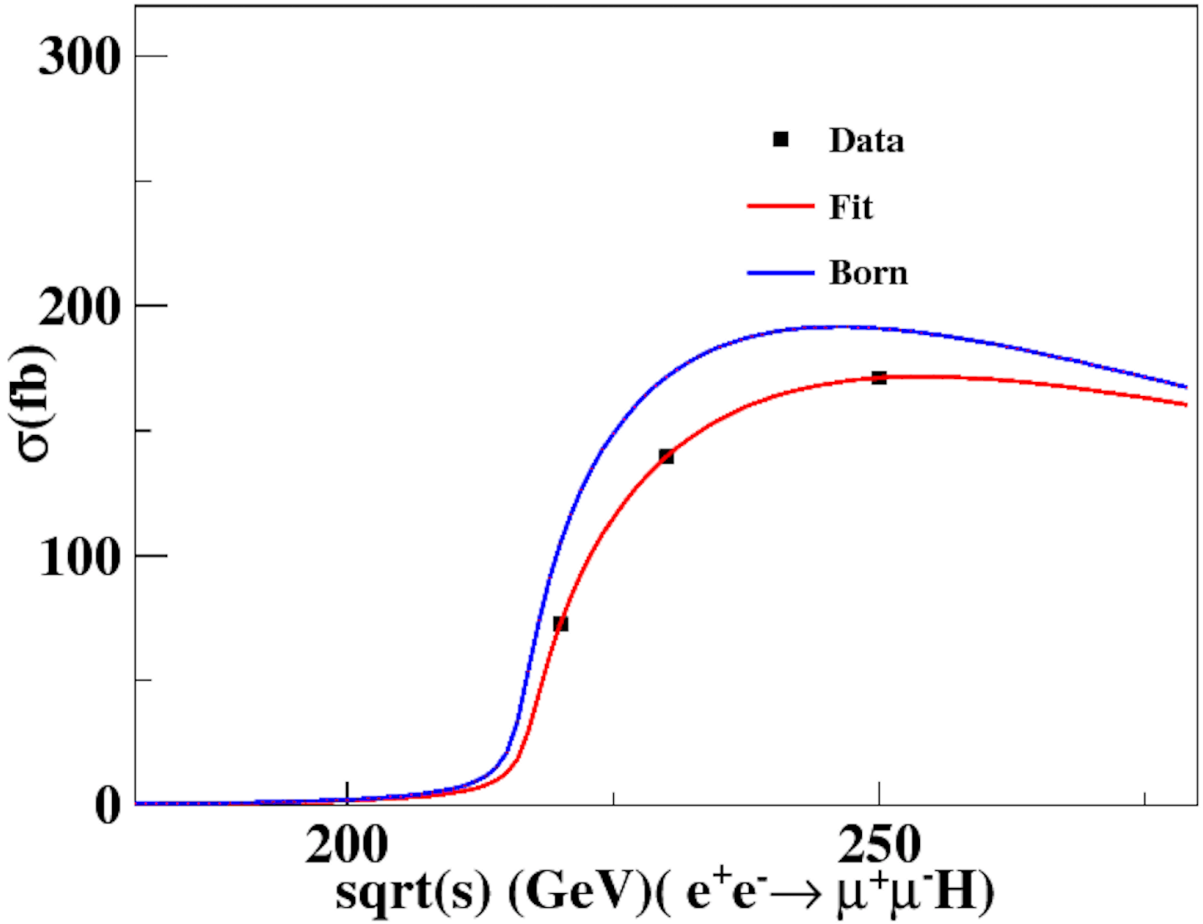


3. The factorized born cross section:

$$\sigma^{\rm B}(s) = (1+\delta(s))\frac{\sigma^{\rm obs}(s)}{1/|1-\Pi(s)|^2}$$

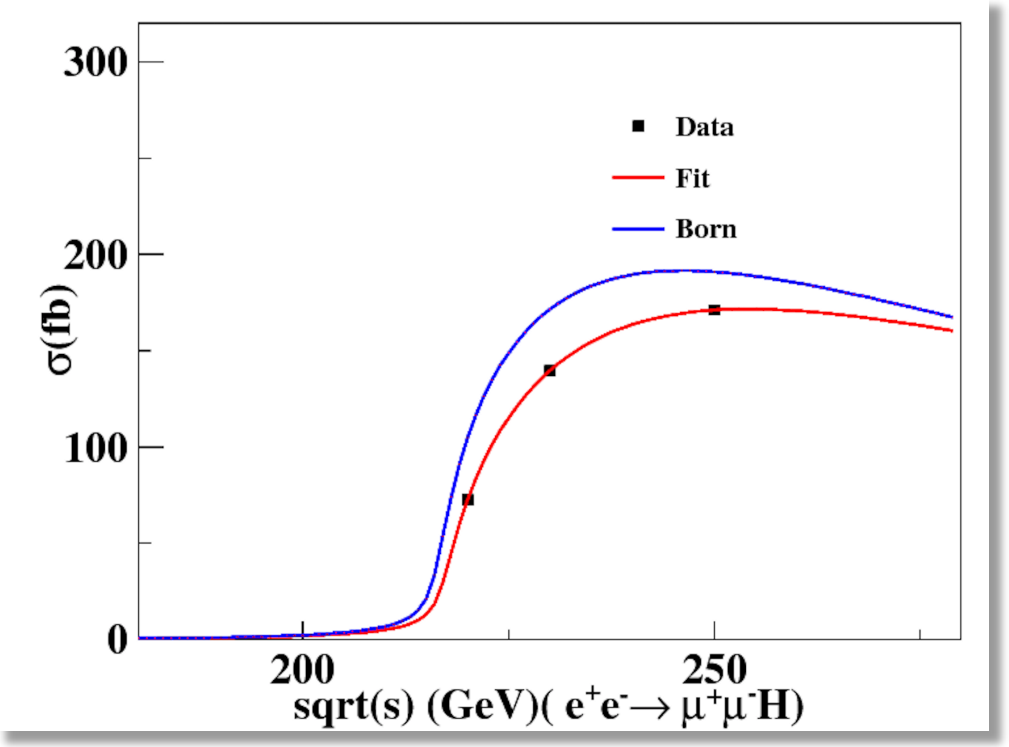
The lineshape of $\sigma(e^+ e^- \rightarrow Z\ H)$

1. The strategy is to take a series of scan data above the threshold to fix the line shape of the $\sigma(e^+ e^- \rightarrow Z\ H)$



Model dependent fit

1. The parameters in the formula are Z mass, Z width, higgs mass and the weak mixing angle θ_w
2. The four parameters are float in the fit to propagate the uncertainties of the observed cross section.
3. Fit result shows that by collecting data sets list on the right table, the uncertainty of 1+σ is 0.5%



Scan data above ZH threshold			
$\sqrt{s}$ (GeV)	220	230	250
L (fb^{-1})	50	50	500

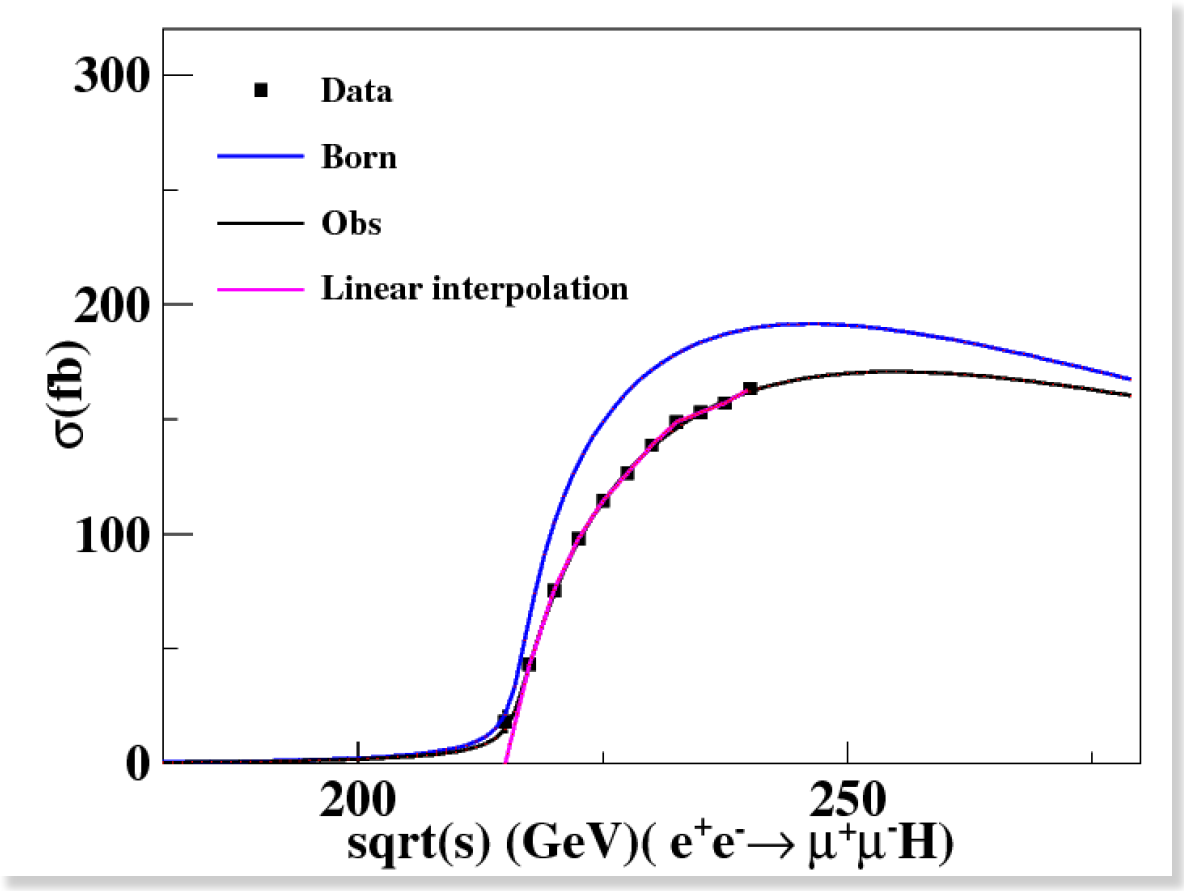
Direct measurement

The ISR correction factor is obtained in a iterative method via

$$\sigma_{i+1}^{\rm obs}(s) = \int_0^{x_{\rm m}} F(x,s)\sigma_i^{\rm dre}(s(1-x))\ {\rm d}x,$$
$$1+\delta_{i+1}(s) = \sigma_i^{\rm dre}(s)/\sigma_{i+1}^{\rm obs}(s),$$
$$\sigma_{i+1}^{\rm dre}(s) = (1+\delta_{i+1}(s))\sigma^{\rm obs}(s)$$

with $\sigma_0^{\mathbf{dre}}(s) = \sigma^{\mathbf{obs}}(s)$. The iteration is continued until the difference between the two consecutive result is smaller than the given upper limit, 1% of the statistical error of the observation. The result from the last iteration, denoted by $\sigma_f^{\mathbf{dre}}(s)$ and $1+\sigma_f(s)$, are regarded as the final dressed cross section and ISR correction factor, respectively.

Direct measurement



Scan data above ZH threshold										
$\sqrt{s}$ (GeV)	217.5	220	222.5	225	227.5	230	232.5	235	237.5	240
L (fb^{-1})										500

To be determined