

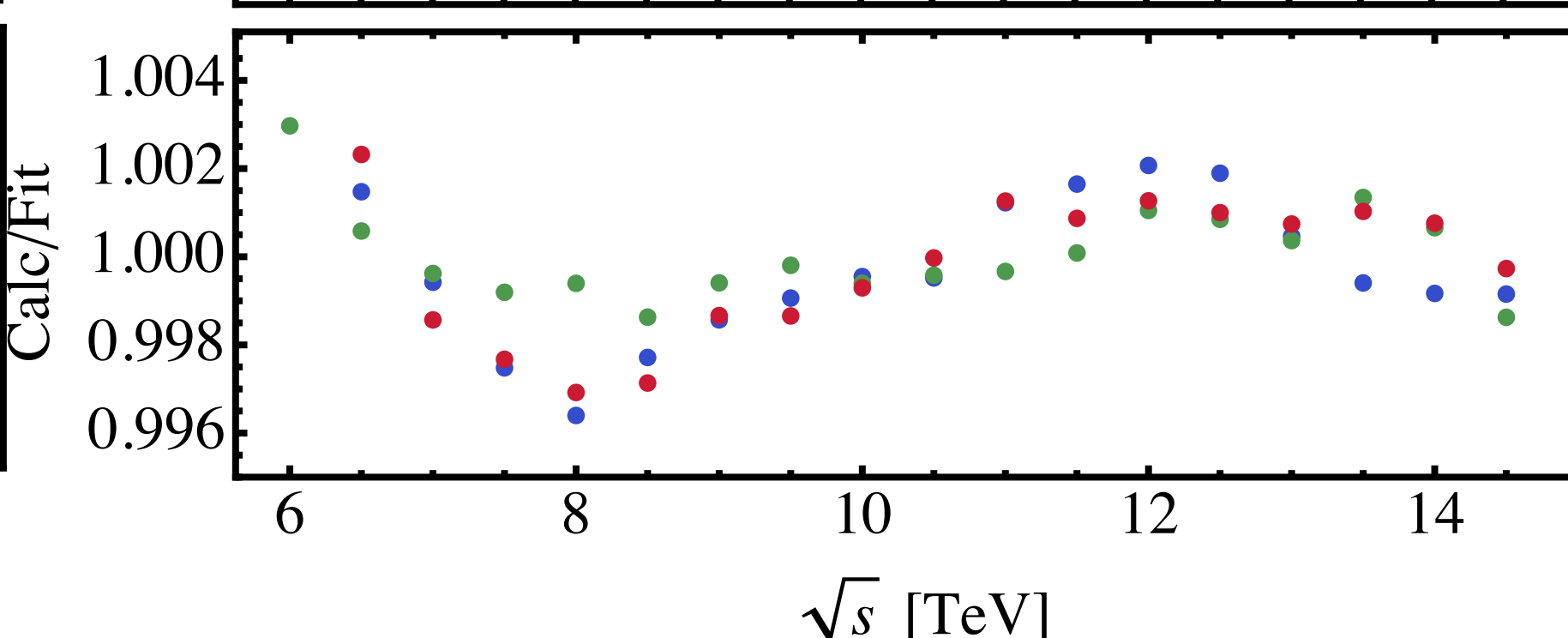
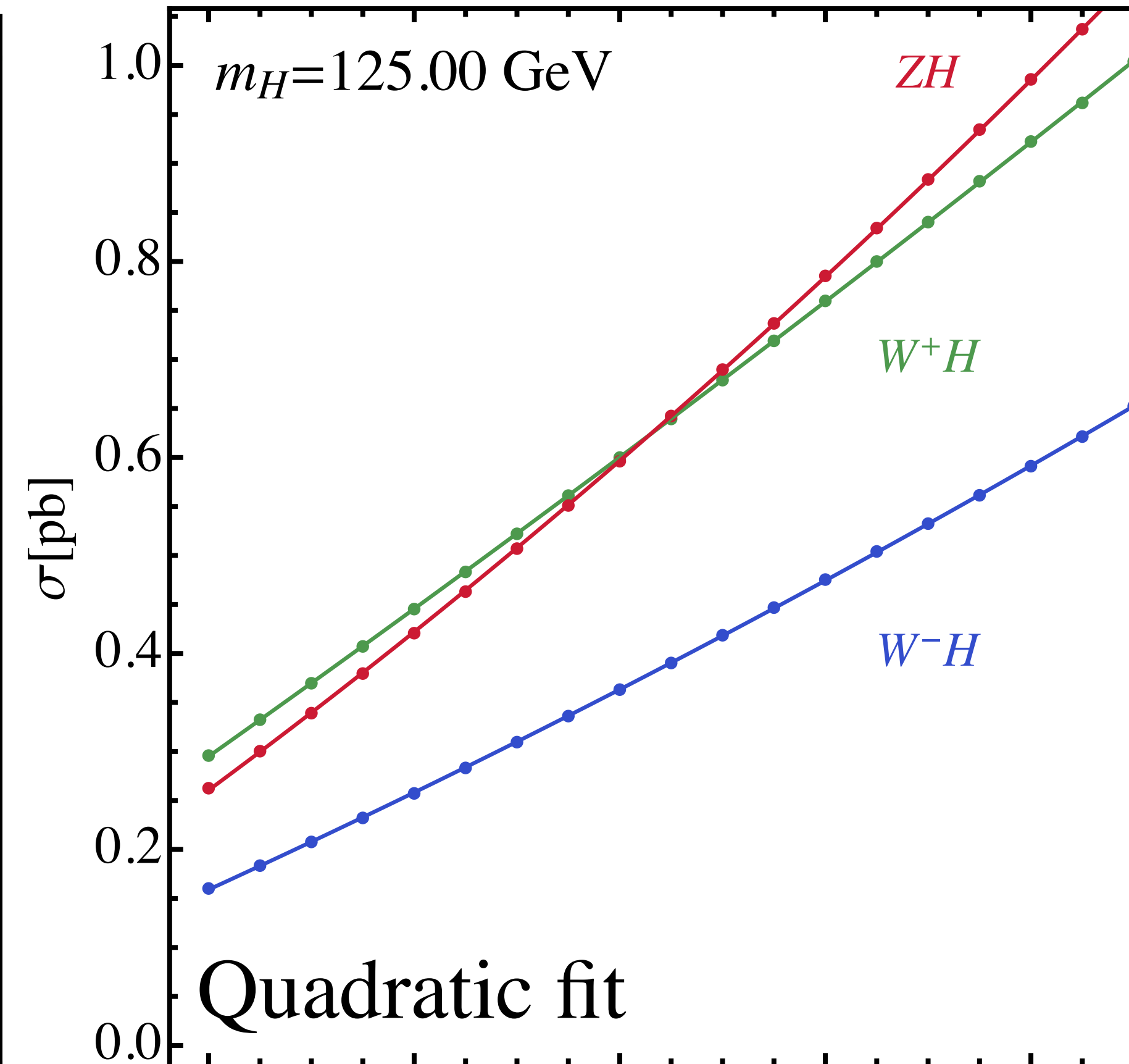
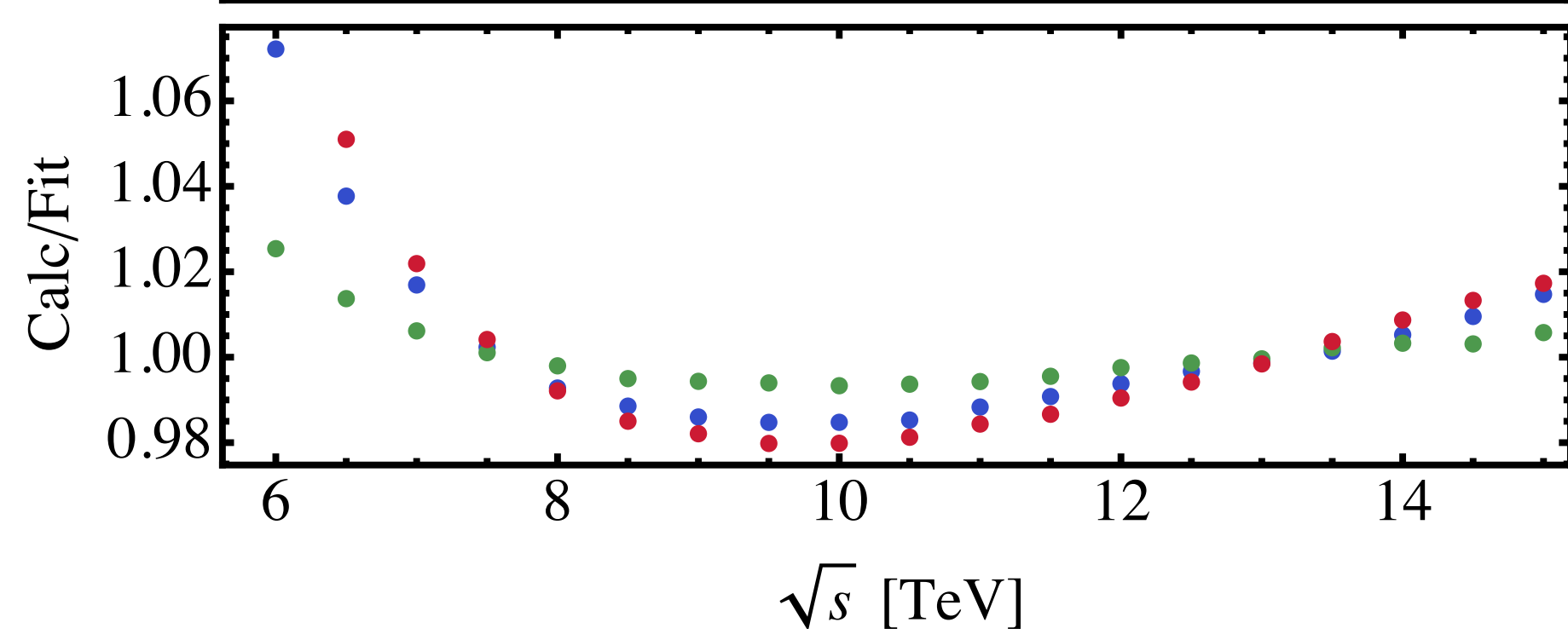
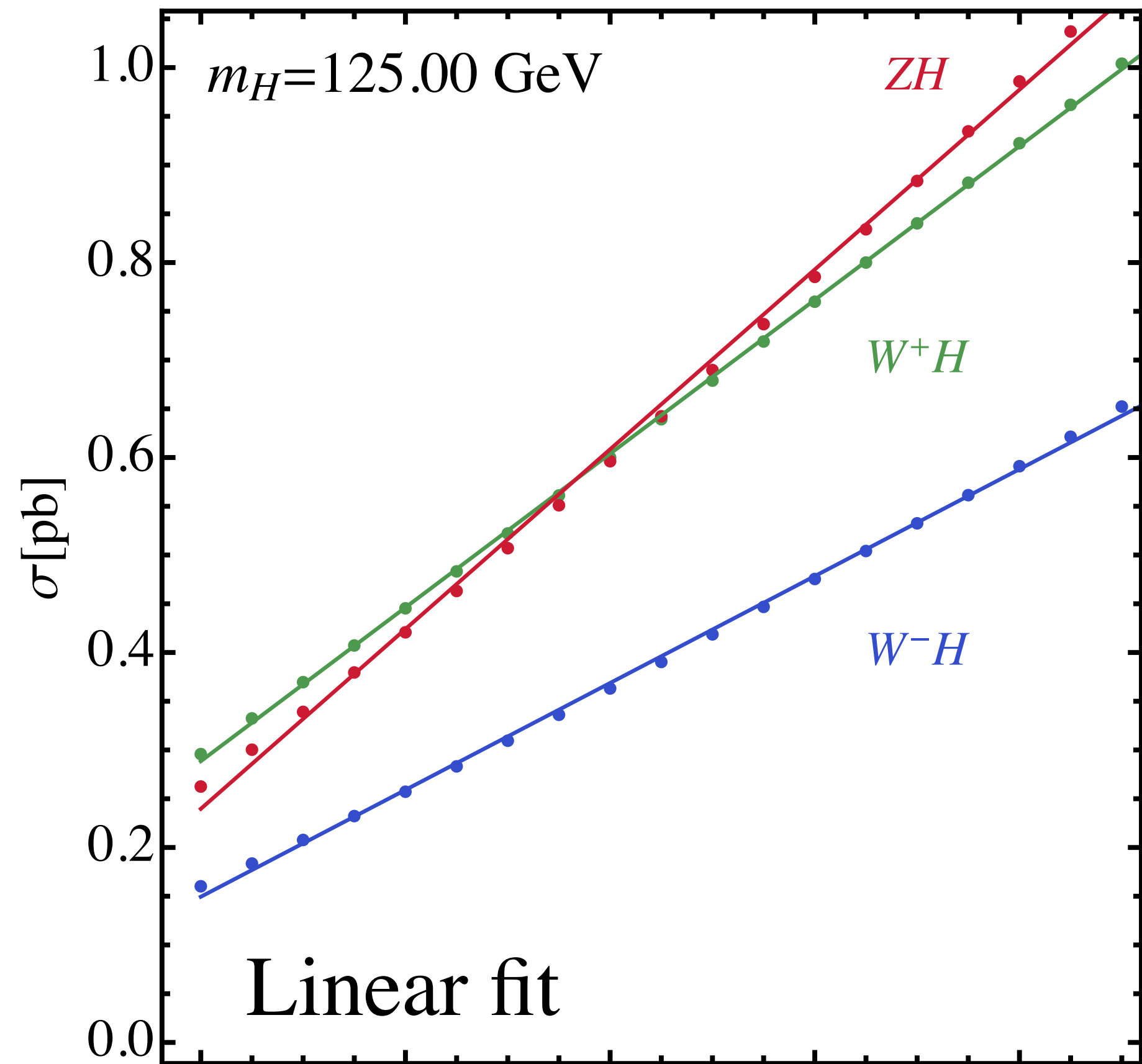
Update on VH cross sections @ 13.6 TeV

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for the VH WG1 subgroup (Hannah Arnold , Alessandro Calandri and Giancarlo Ferrera)

February 3rd 2022

$$m_H = 125.00 \text{ GeV}$$



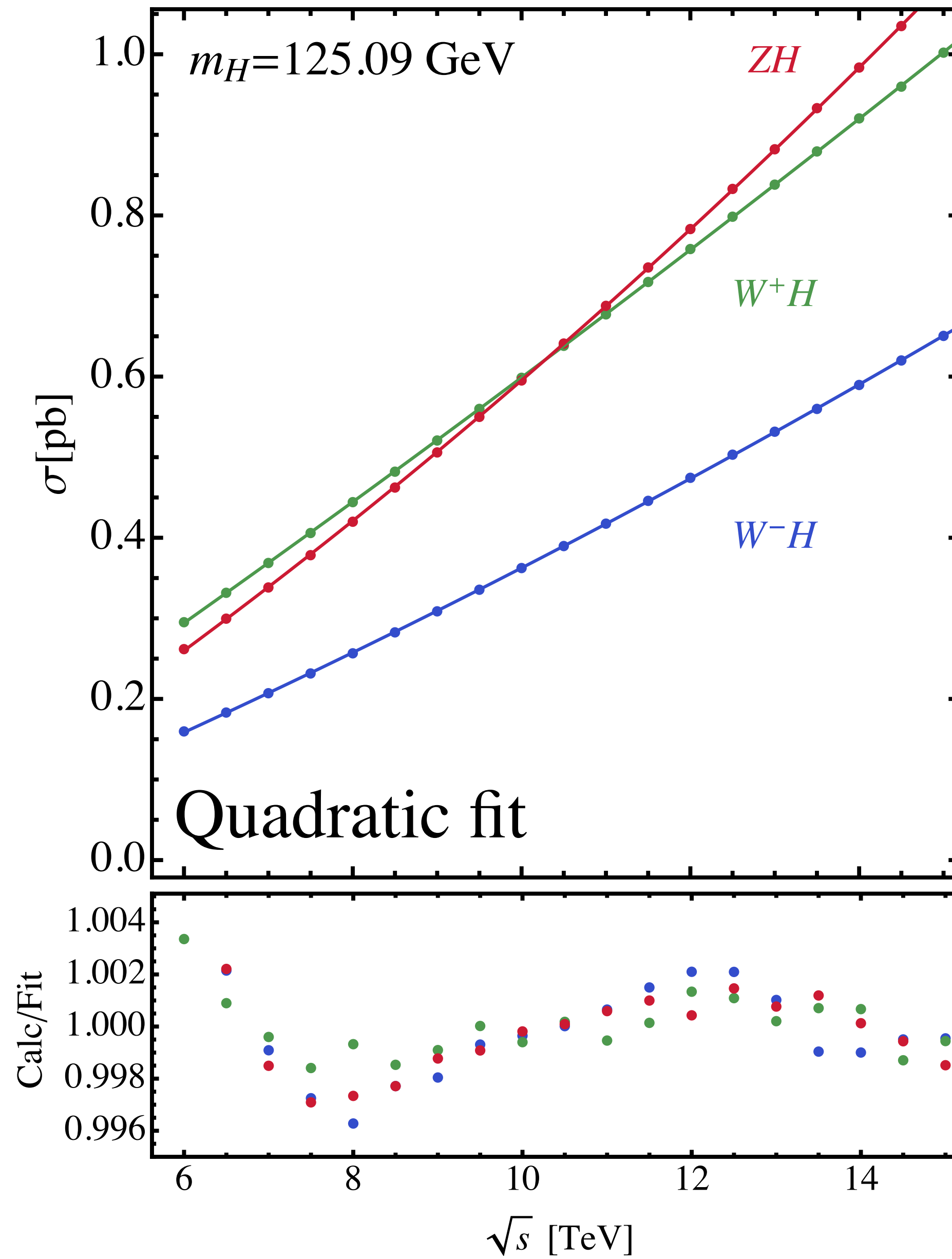
Perform fits to cross sections reported in the YR4

Appears that a 3-parameter quadratic fit describes the data rather well with fitting errors seemingly of the order of 0.2%.

Other (physics) uncertainties do not change much between 13 and 14 TeV, so report values for 13.5 TeV

$$m_H = 125.09 \text{ GeV}$$

Of course the picture is similar at 125.09
since we also have an energy scan

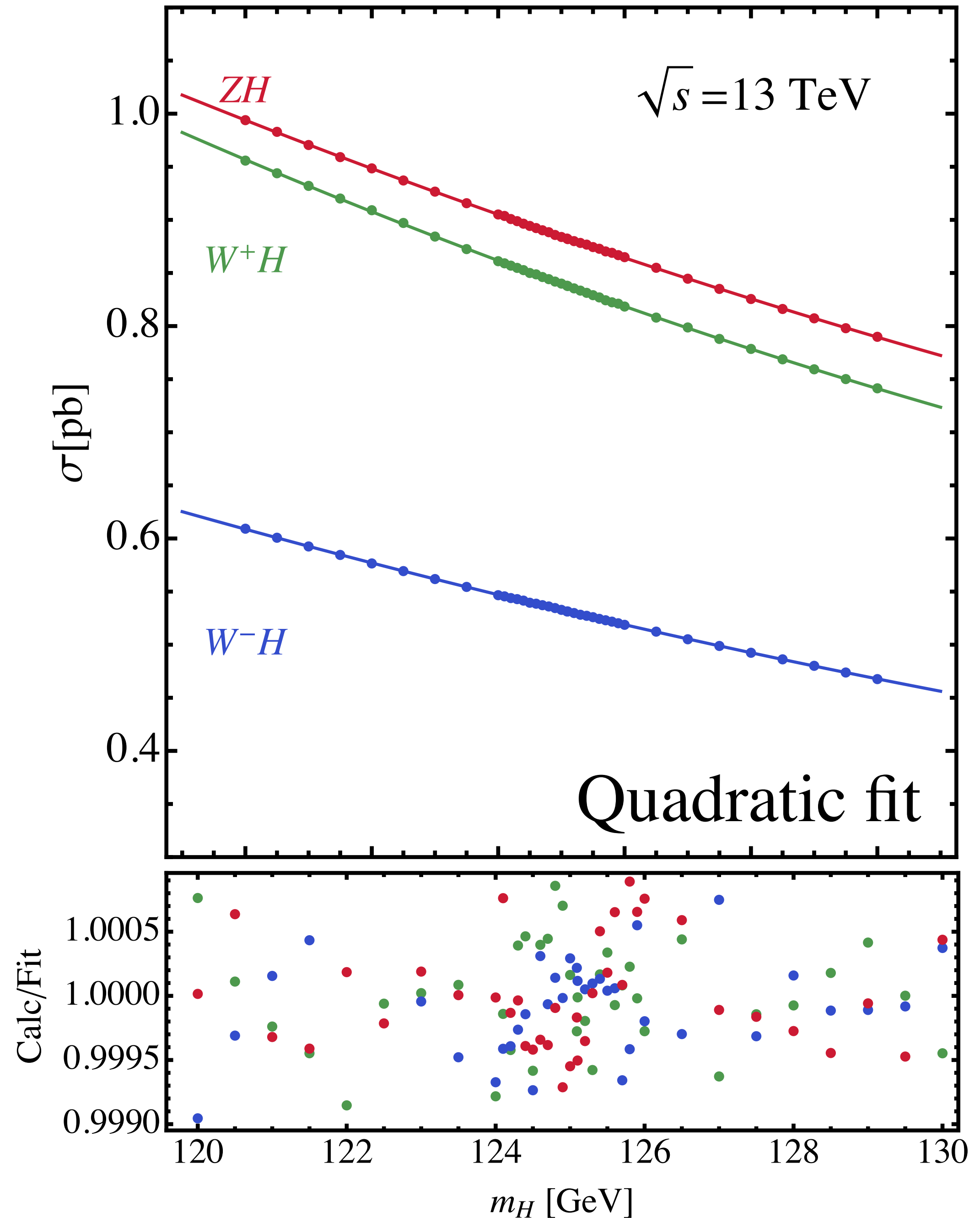


$$m_H = 125.38 \text{ GeV}$$

Slightly trickier for 3rd value of the mass, since no energy scan available. Instead extract value at this mass from fit to cross sections as a function of Higgs mass.

Only gives 4 points @ 7,8, 13 and 14 TeV, so use linear fit for final answer.

For remaining uncertainties use envelope of 13 and 14 TeV results at similar mass points.



Summary

Here are our extracted numbers for total cross sections for the three mass points using the interpolation and error extraction

WH									
MH [GeV]	Cross Section [pb]	Uncertainty						W+H	W-H
		Scale		PDF+as	PDF	as	σ [pb]	σ [pb]	
		pos [%]	neg [%]	[%]	[%]	[%]			
125.00	1.457E+00	+0.4	0.7	± 1.8	± 1.6	± 0.9	8.889E-01	5.677E-01	
125.09	1.453E+00	+0.4	0.7	± 1.8	± 1.6	± 0.9	0.88696	0.566359	
125.38	1.442E+00	+0.4	0.7	± 1.8	± 1.6	± 0.9	0.880114	0.562032	

ZH								
MH [GeV]	Cross Section [pb]	Uncertainty						gg→ZH (box diag.)
		Scale		PDF+as	PDF	as	[pb]	
		pos [%]	neg [%]	[%]	[%]	[%]		
125.00	9.439E-01	+3.7	3.2	± 1.6	± 1.3	± 0.9	1.360E-01	
125.09	9.422E-01	+3.8	3.2	± 1.6	± 1.3	± 0.9	1.359E-01	
125.38	9.361E-01	+3.8	3.2	± 1.6	± 1.3	± 0.9	1.347E-01	

Summary

Same thing, but including the decay of the W boson (here each one computed using linear fit)

W-H → l-vH							
MH [GeV]	Cross Section [pb]	Uncertainty					σ _γ [pb]
		Scale		PDF+αs	PDF	αs	
		pos [%]	neg [%]	[%]	[%]	[%]	
125.00	6.380E-02	0.4	-0.6	1.9	1.7	0.8	2.19E-03
125.09	6.366E-02	0.4	-0.6	1.9	1.7	0.8	2.19E-03
125.38	6.318E-02	0.4	-0.6	1.9	1.7	0.8	2.18E-03
W+H → l+vH							
MH [GeV]	Cross Section [pb]	Uncertainty					σ _γ [pb]
		Scale		PDF+αs	PDF	αs	
		pos [%]	neg [%]	[%]	[%]	[%]	
125.00	9.896E-02	0.4	-0.6	1.9	1.7	0.8	3.34E-03
125.09	9.874E-02	0.6	-0.6	1.9	1.7	0.8	3.34E+05
125.38	9.803E-02	0.6	-0.6	1.9	1.7	0.8	3.33E-03

Summary

Same thing, but including the decay of the Z boson (here each one computed using linear fit)

ZH → l+l-H								
MH [GeV]	Cross Section [pb]	Uncertainty					gg→ZH (box diag.) [pb]	σ _γ [pb]
		Scale pos [%]	neg [%]	PDF+α _s [%]	PDF [%]	α _s [%]		
125.00	3.174E-02	3.8	-3.2	1.6	1.3	1.0	4.55E-03	1.16E-04
125.09	3.168E-02	3.8	-3.2	1.6	1.3	1.0	4.54E-03	1.16E-04
125.38	3.147E-02	3.8	-3.2	1.6	1.3	1.0	4.53E-03	1.16E-04
ZH → ννH								
MH [GeV]	Cross Section [pb]	Uncertainty					gg→ZH (box diag.) [pb]	σ _γ [pb]
		Scale pos [%]	neg [%]	PDF+α _s [%]	PDF [%]	α _s [%]		
125.00	1.891E-01	3.8	-3.2	1.6	1.3	1.0	2.697E-02	0.00E+00
125.00	1.887E-01	3.8	-3.2	1.6	1.3	1.0	2.695E-02	0.00E+00
125.00	1.874E-01	3.8	-3.2	1.6	1.3	1.0	2.686E-02	0.00E+00

Going Forward

Running $vh@nnlo$ and MCFM within the WG to obtain numbers free of interpolation. Reproducing numbers in YR4 and distributed spreadsheet.

Some partial results obtained so far, will likely need to reach out to broader community to obtain NLL predictions for $gg \rightarrow ZH$ (or interpolation can be performed on this piece only).

Longer term, DY result at N_3LO suggests VH result maybe available within the next few years. Decay@ N_3LO could also be included.