

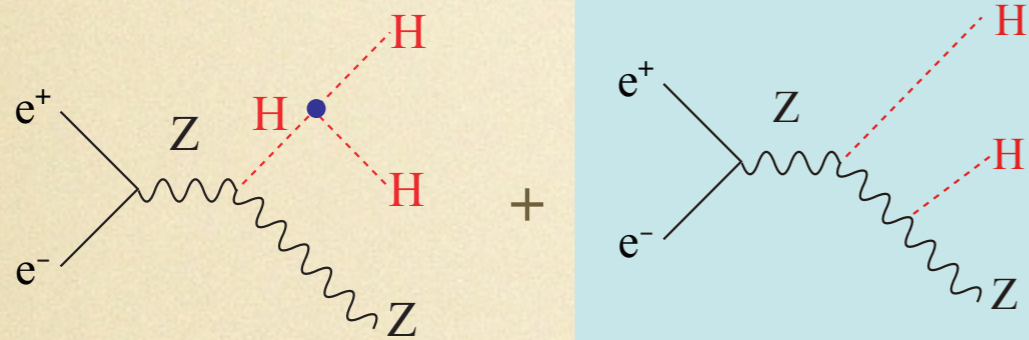
correlations between λ_{HHH}
and g_{HHVV} , g_{HVV}

Junping Tian (KEK)

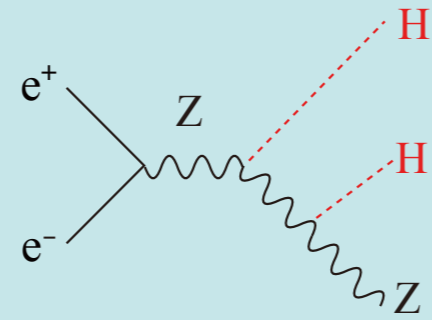
Asian Physics & Software Group Meeting, Dec. 18, 2015

double Higgs production

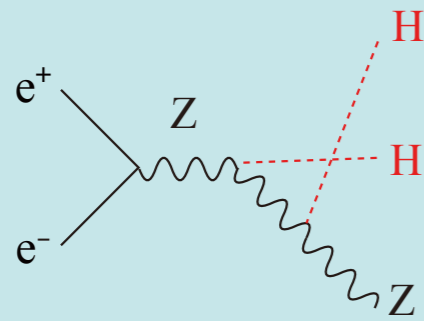
Signal diagram



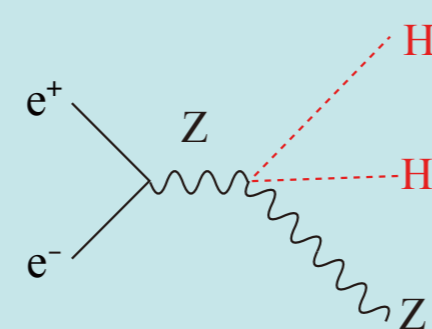
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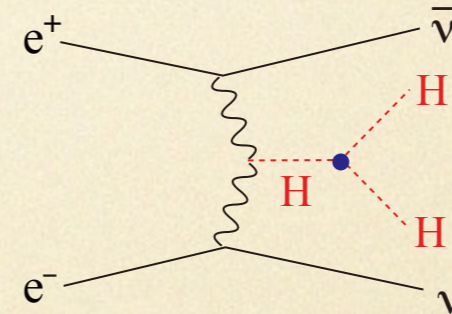
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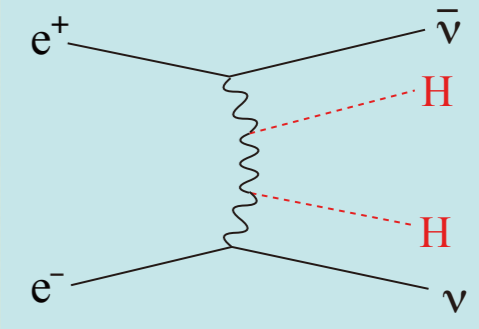
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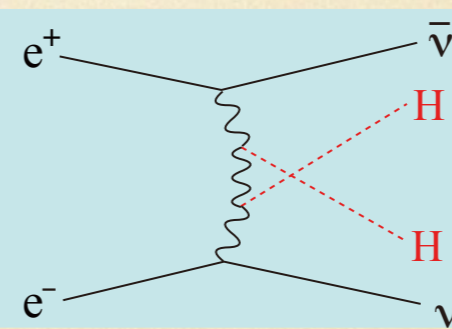
Signal diagram



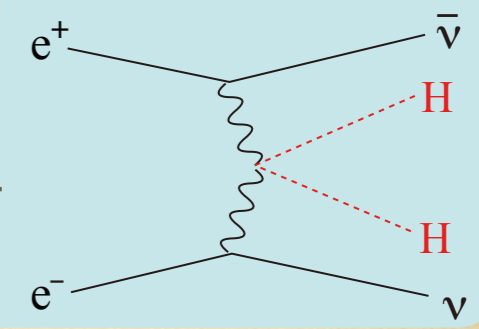
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- how the uncertainties of g_{HHVV} and g_{HVV} become systematic errors of λ_{HHH} measurement?

parametrisation

$$\sigma = S\kappa_\lambda^2 + Q\kappa_q^2 + B\kappa_b^2 + I_{SQ}\kappa_\lambda\kappa_q + I_{SB}\kappa_\lambda\kappa_b + I_{QB}\kappa_q\kappa_b$$

κ_λ : coupling λ_{HHH} scaled to SM value

κ_q : coupling $HHVV$ scaled to SM value

κ_b : coupling HVV scaled to SM value

S: contribution from λ_{HHH} diagram

Q: contribution from quartic $HHVV$ diagram

B: contribution from HVV diagram

I_{SQ}: interference between diagrams with λ_{HHH} and $HHVV$

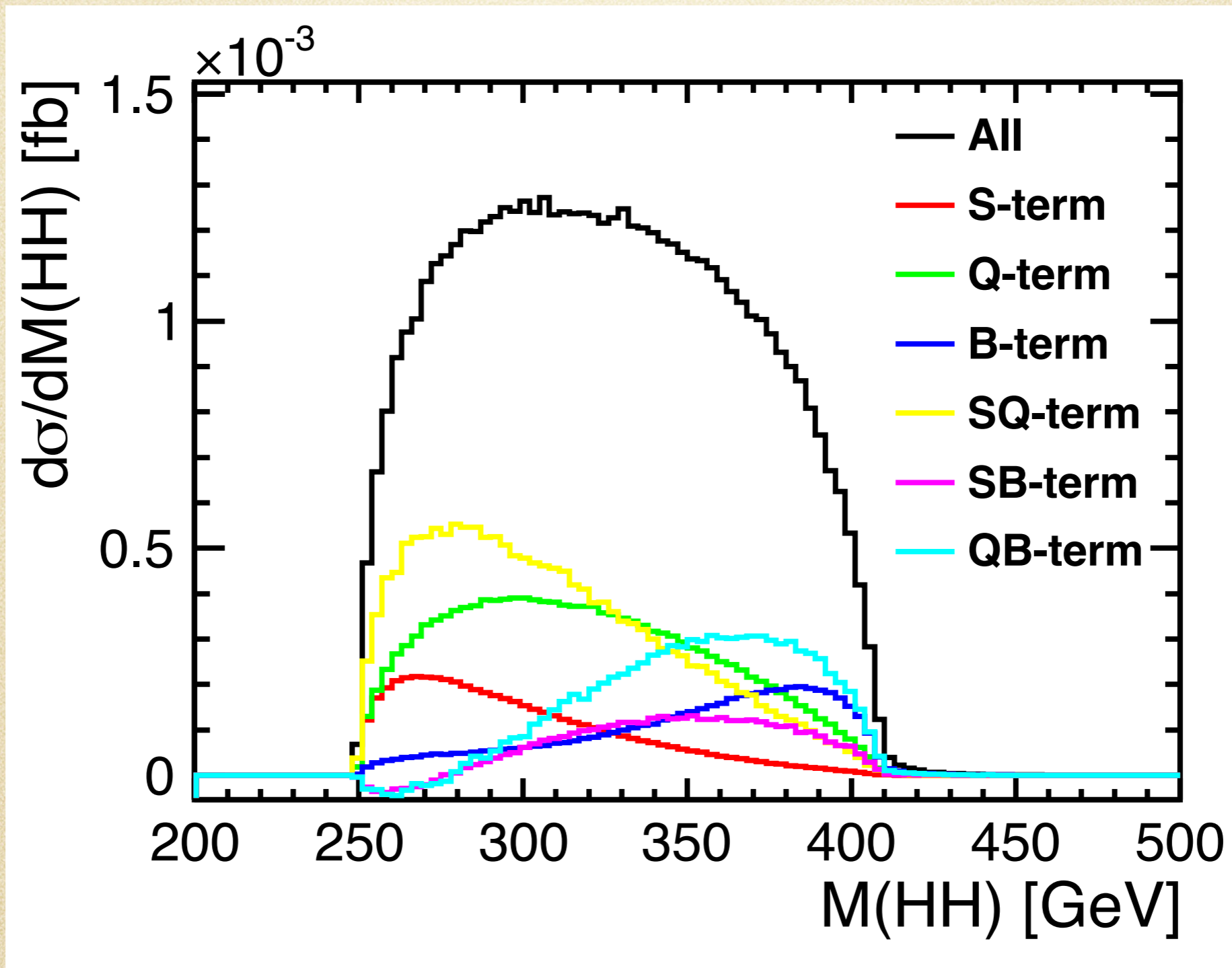
I_{SB}: interference between diagrams with λ_{HHH} and HVV

I_{QB}: interference between diagrams with $HHVV$ and HVV

(values calculated by physsim)

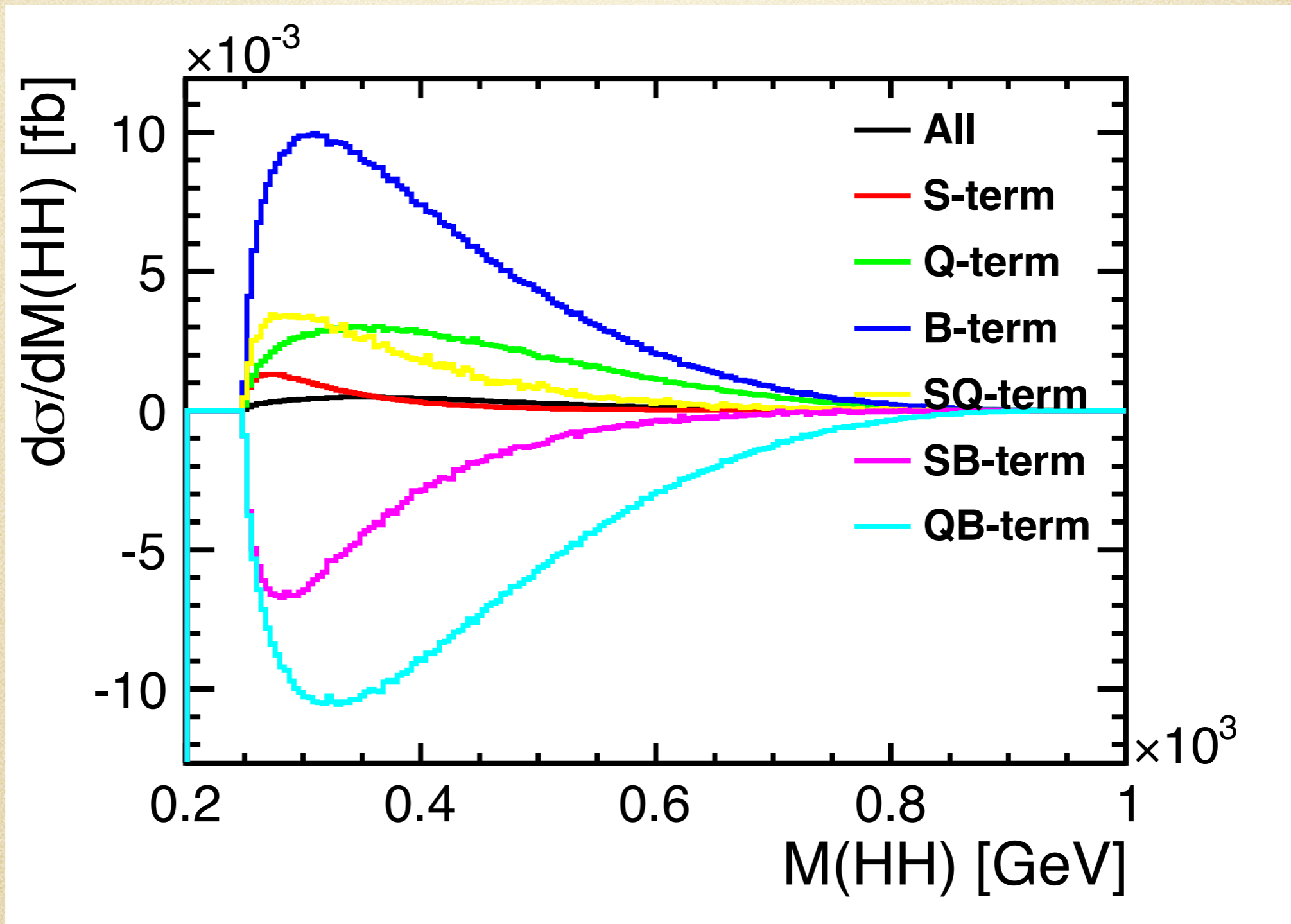
$d\sigma/dM(\text{HH})$ for each term: ZHH @ 500 GeV

$$\sigma = S\kappa_\lambda^2 + Q\kappa_q^2 + B\kappa_b^2 + I_{SQ}\kappa_\lambda\kappa_q + I_{SB}\kappa_\lambda\kappa_b + I_{QB}\kappa_q\kappa_b$$



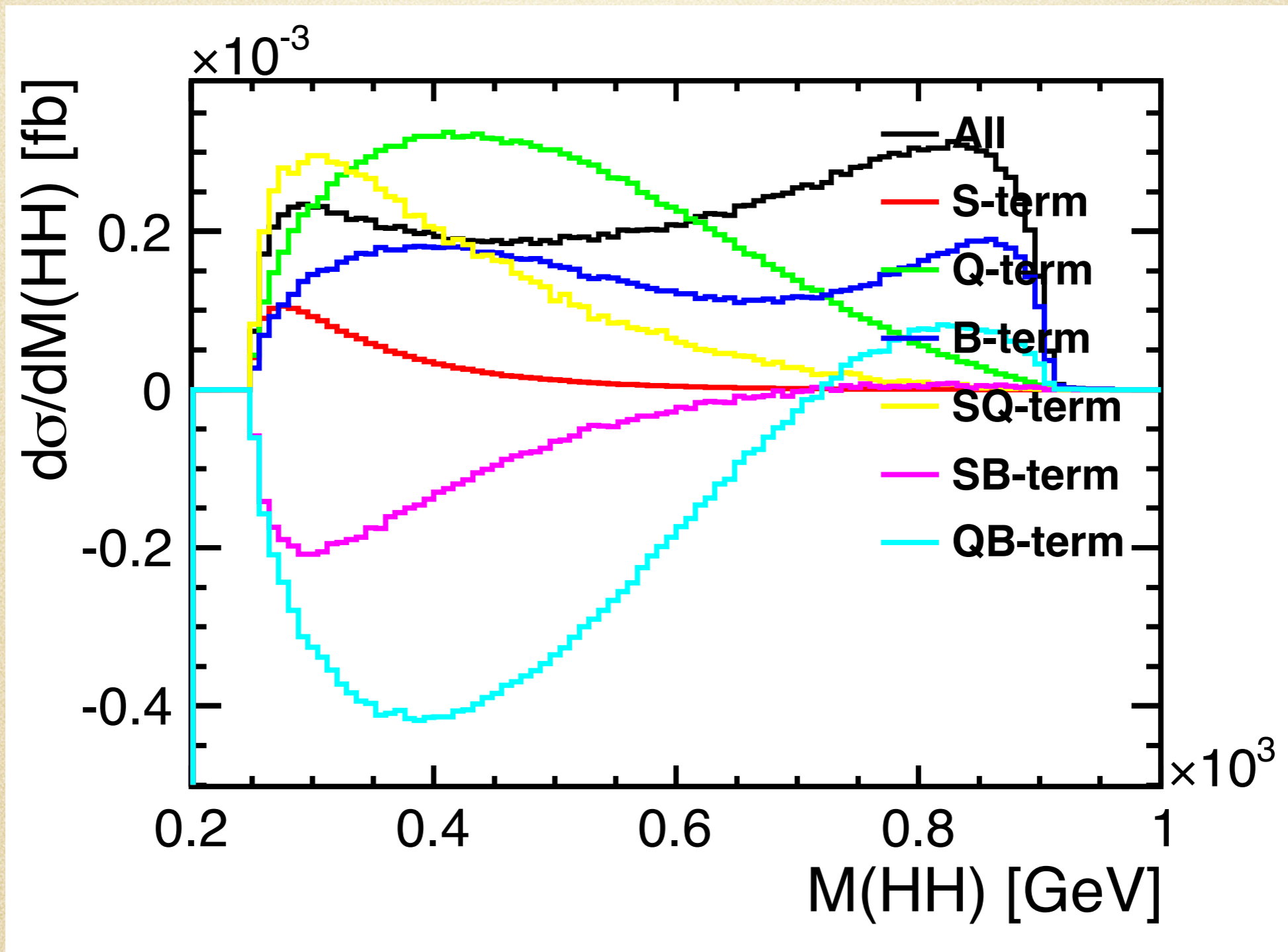
$d\sigma/dM(\text{HH})$ for each term: $\nu\nu\text{HH}$ @ 1 TeV

$$\sigma = S\kappa_\lambda^2 + Q\kappa_q^2 + B\kappa_b^2 + I_{SQ}\kappa_\lambda\kappa_q + I_{SB}\kappa_\lambda\kappa_b + I_{QB}\kappa_q\kappa_b$$



$d\sigma/dM(\text{HH})$ for each term: ZHH @ 1 TeV

$$\sigma = S\kappa_\lambda^2 + Q\kappa_q^2 + B\kappa_b^2 + I_{SQ}\kappa_\lambda\kappa_q + I_{SB}\kappa_\lambda\kappa_b + I_{QB}\kappa_q\kappa_b$$



fitting $\kappa_\lambda, \kappa_q, \kappa_b$

$$\sigma = S\kappa_\lambda^2 + Q\kappa_q^2 + B\kappa_b^2 + I_{SQ}\kappa_\lambda\kappa_q + I_{SB}\kappa_\lambda\kappa_b + I_{QB}\kappa_q\kappa_b$$

no constraint

$$\chi^2 = \sum_i^n \left(\frac{\sigma_i - \sigma'_i}{\Delta\sigma_i} \right)^2$$

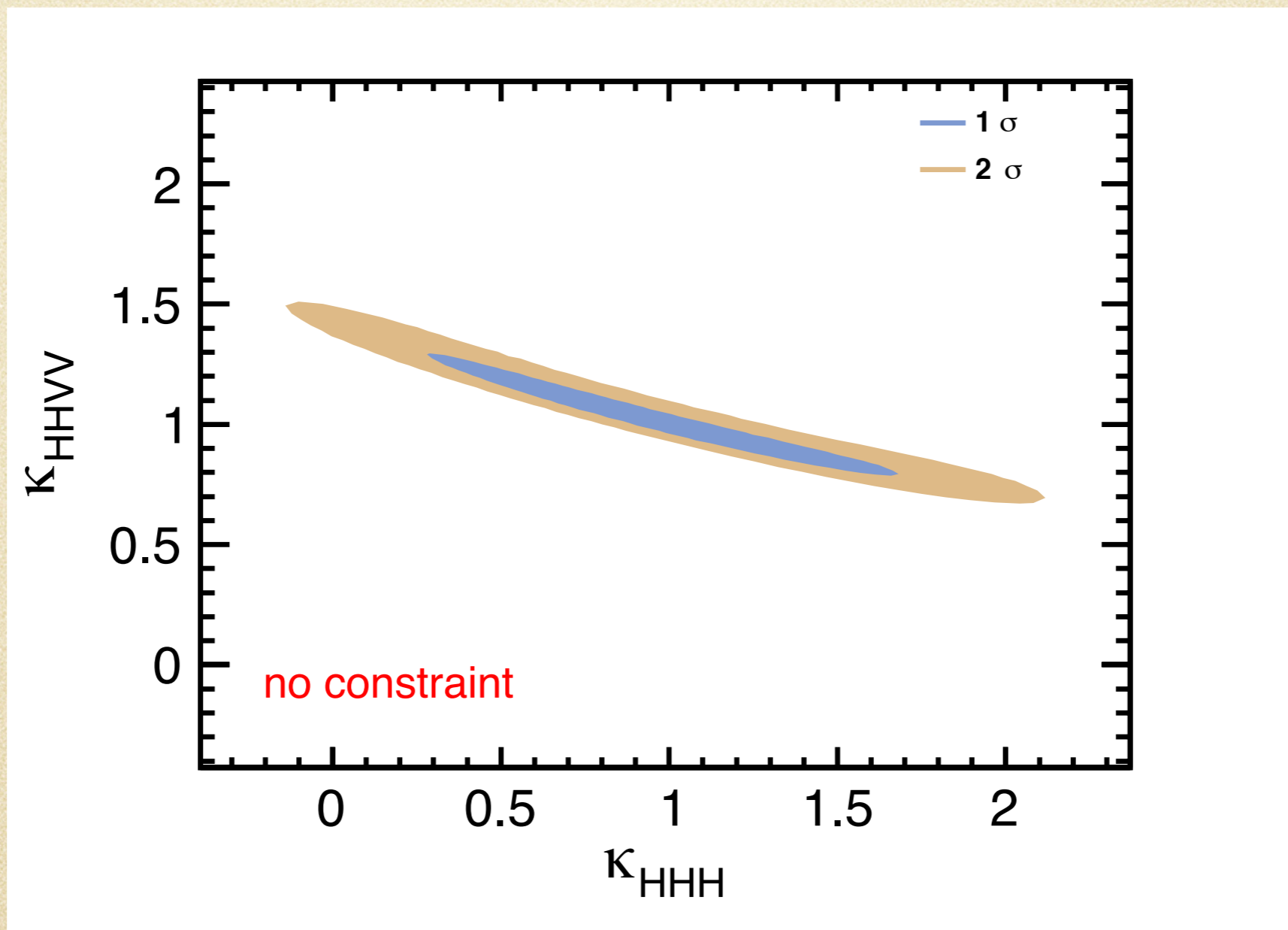
σ : measured value
 $\Delta\sigma$: measurement error
 σ' : predicted value

3 observables are considered		$\Delta\sigma/\sigma$
	$\sigma_{ZH\bar{H}} @ 500 \text{ GeV}$	20.2%
	$\sigma_{ZH\bar{H}} @ 1 \text{ TeV}$	19.2%
	$\sigma_{\nu\nu H\bar{H}} @ 1 \text{ TeV}$	15.2%

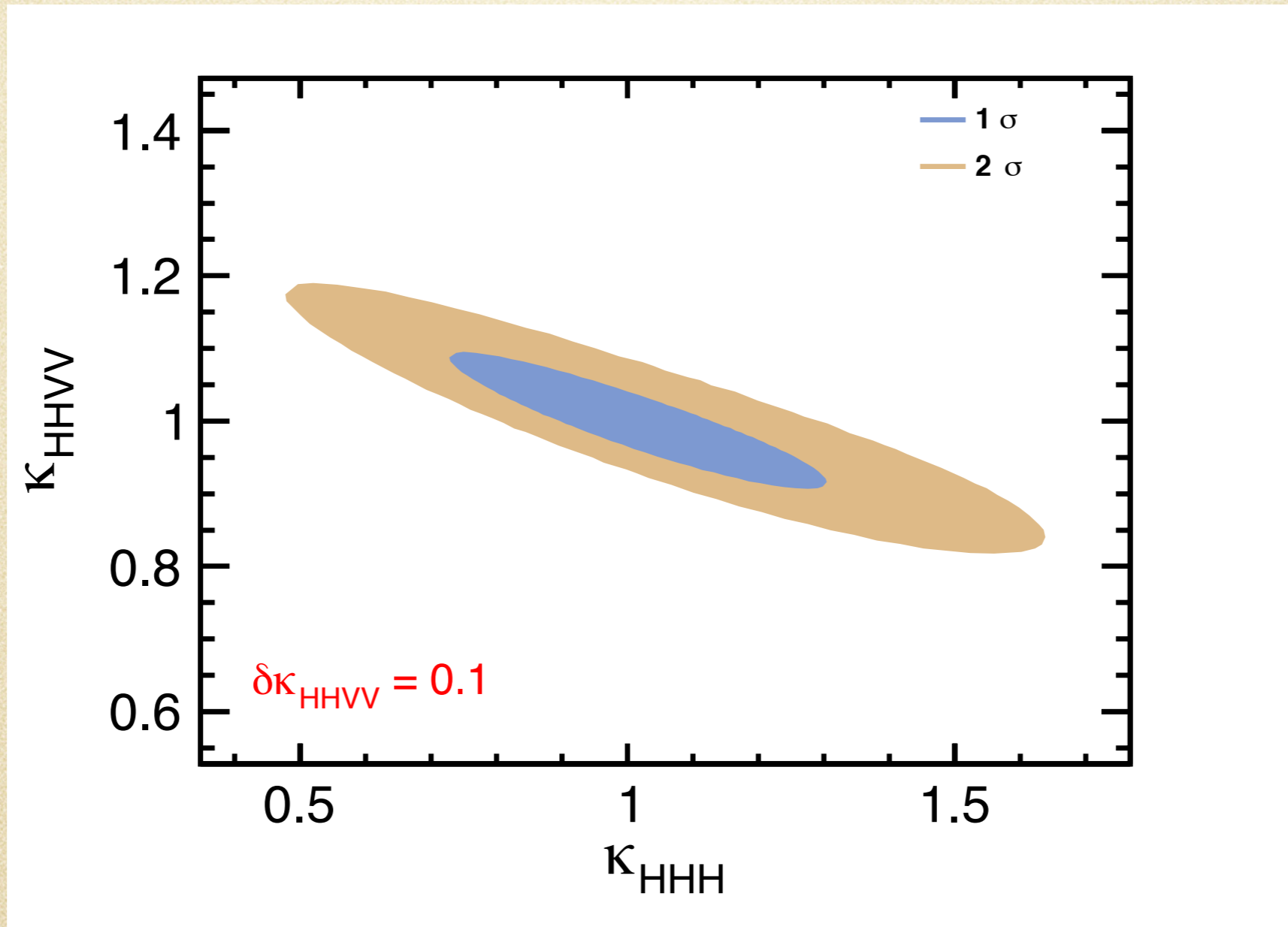
with constraints on κ_q, κ_b from other measurements

$$\chi^2 = \sum_i^n \left(\frac{\sigma_i - \sigma'_i}{\Delta\sigma_i} \right)^2 + \left(\frac{\kappa_q - \kappa'_q}{\delta\kappa_q} \right)^2 + \left(\frac{\kappa_b - \kappa'_b}{\delta\kappa_b} \right)^2$$

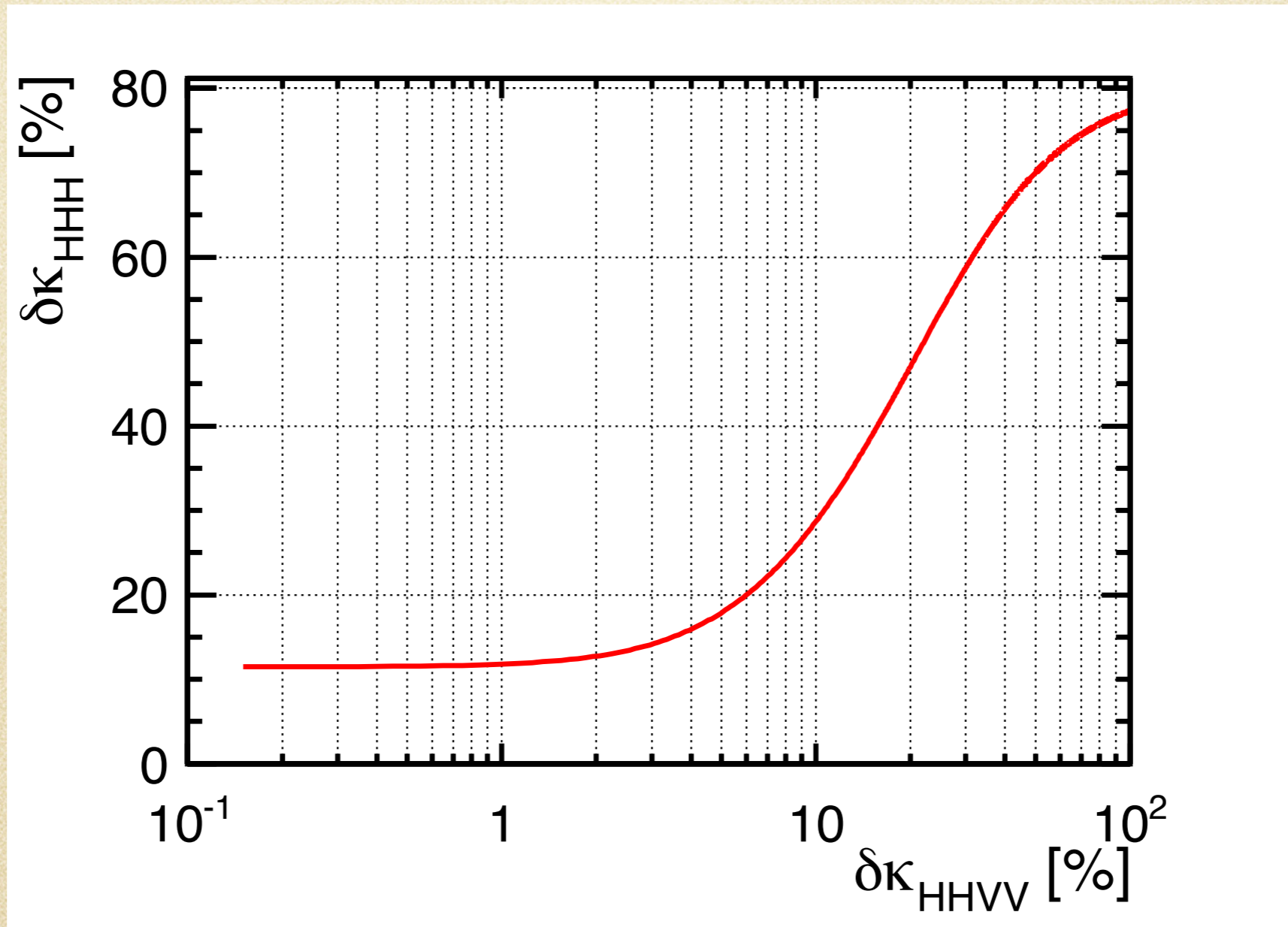
results: w/o constraint on κ_q (but κ_b fixed)
(3 observables)



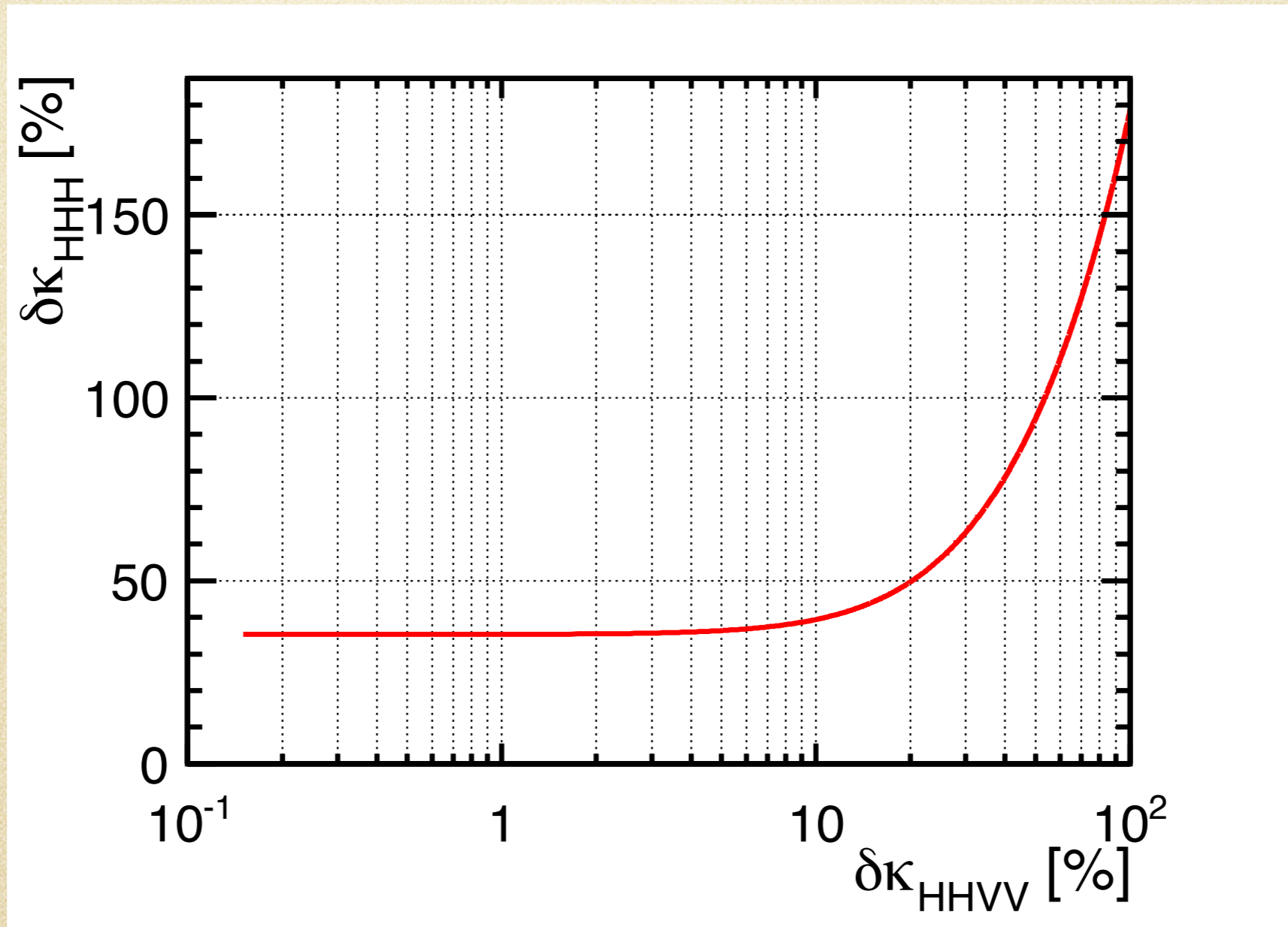
results: $\delta\kappa_q = 10\%$ (but κ_b fixed)
(3 observables)



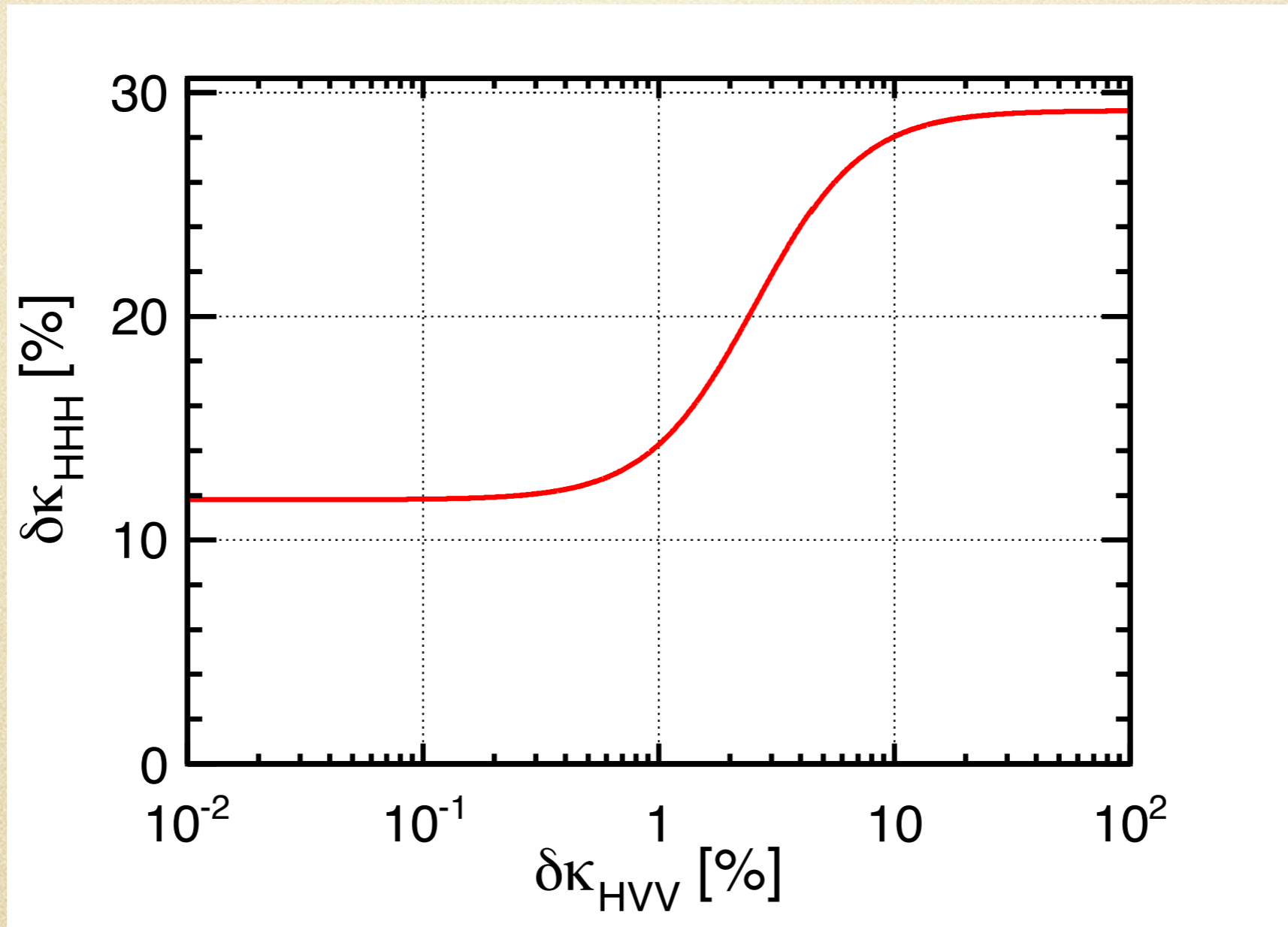
results: $\delta\kappa_\lambda$ versus $\delta\kappa_q$ (but κ_b fixed)
(3 observables)



results: $\delta\kappa_\lambda$ versus $\delta\kappa_q$ (but κ_b fixed)
(1 observable: ZHH @ 500 GeV only)

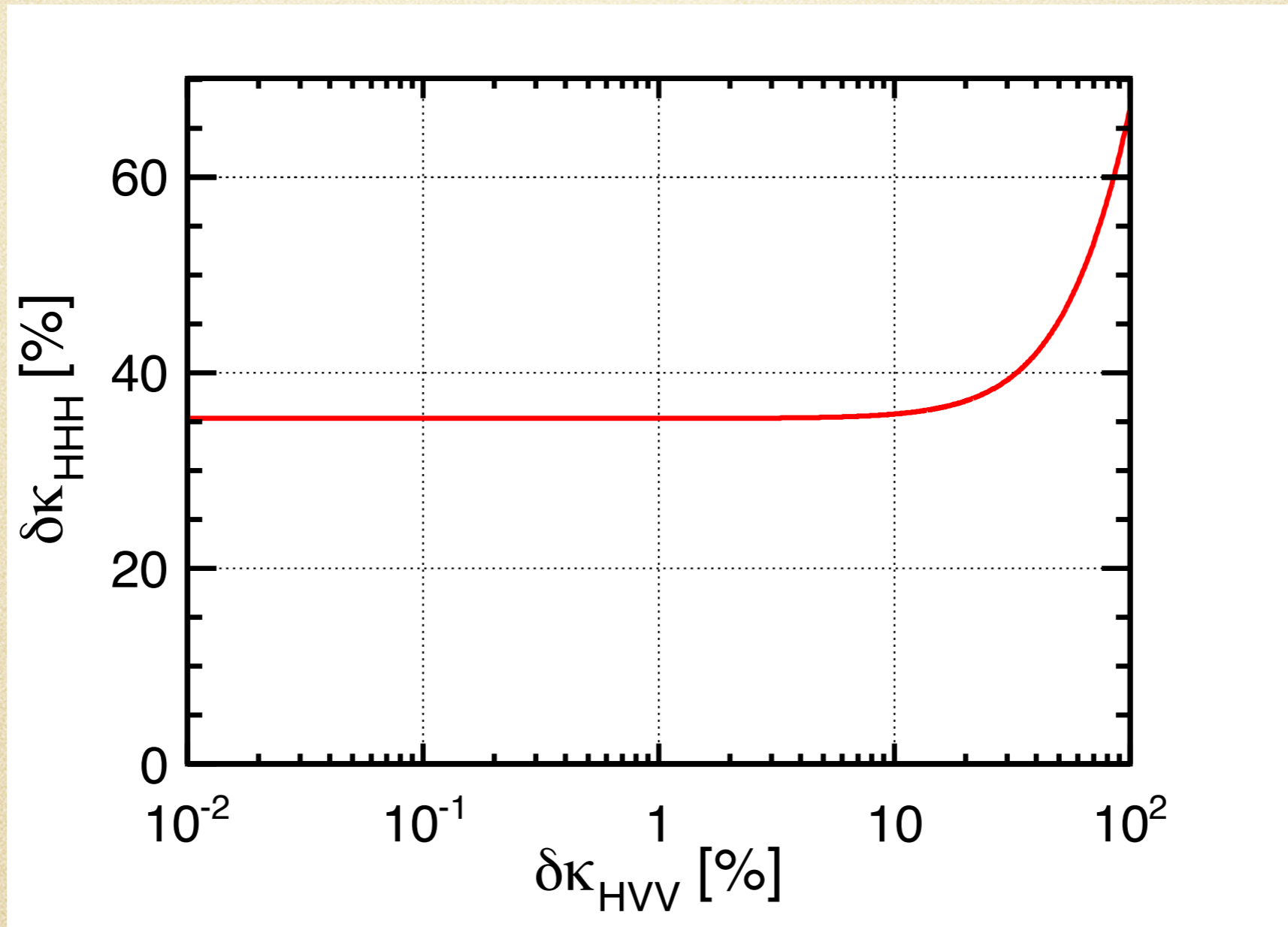


add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_b$ (w/ $\delta\kappa_q = 1\%$)
(3 observables)



add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_b$ (w/ $\delta\kappa_q = 1\%$)

(1 observable: ZHH @ 500 GeV only)



my observation

in order to get similar precision for HHH as obtained
assuming fixed both HVV and HHVV

when HVV is fixed

- 500 GeV only: HHVV < 10% (~5%) would be needed
- 500 GeV + 1 TeV: HHVV < 1% (~0.5%) would be needed

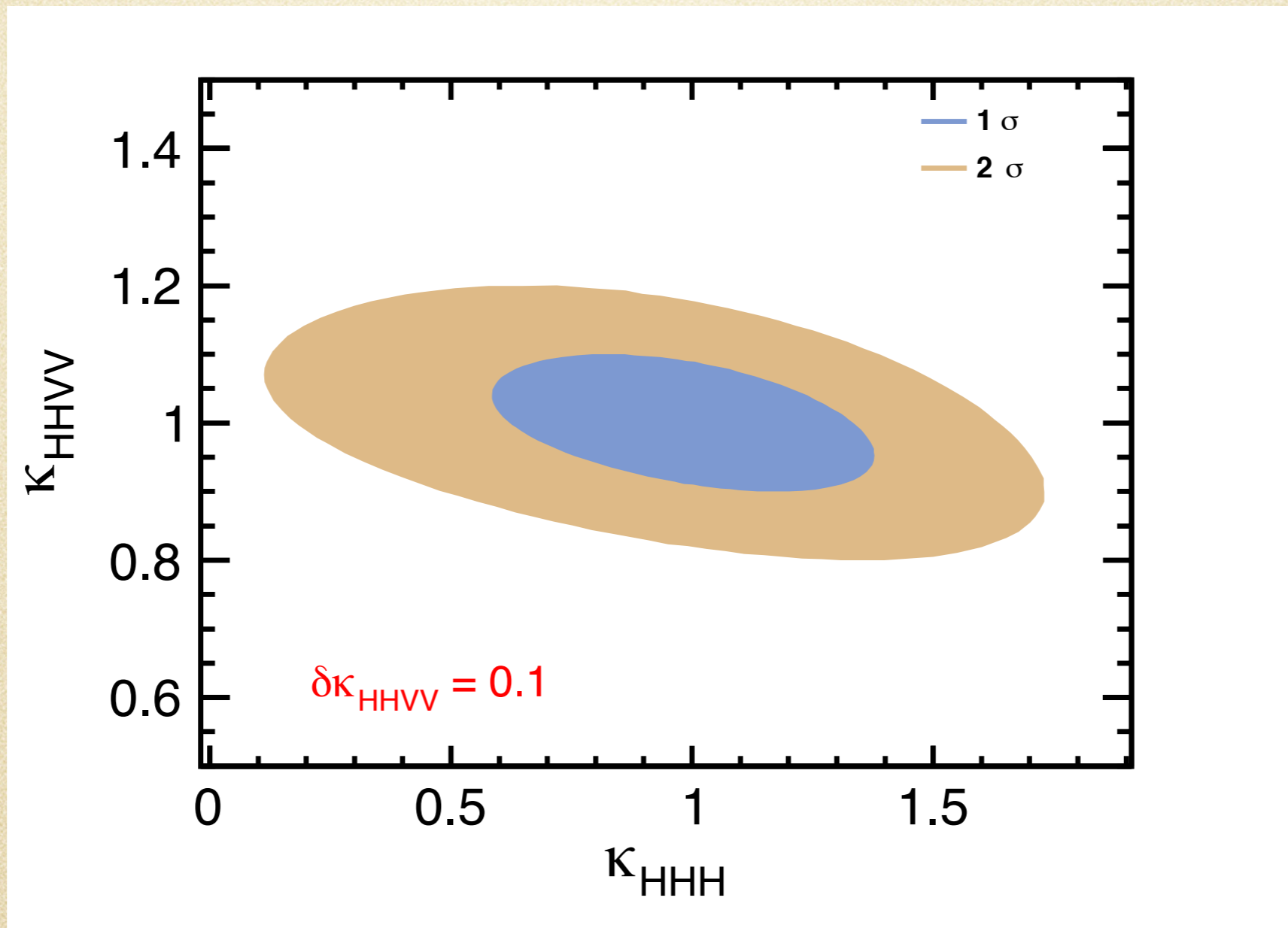
when HVV is fluctuated

- 500 GeV only: HVV ~ 10% would be needed
- 500 GeV + 1 TeV: HVV < 1% (~0.5%) would be needed

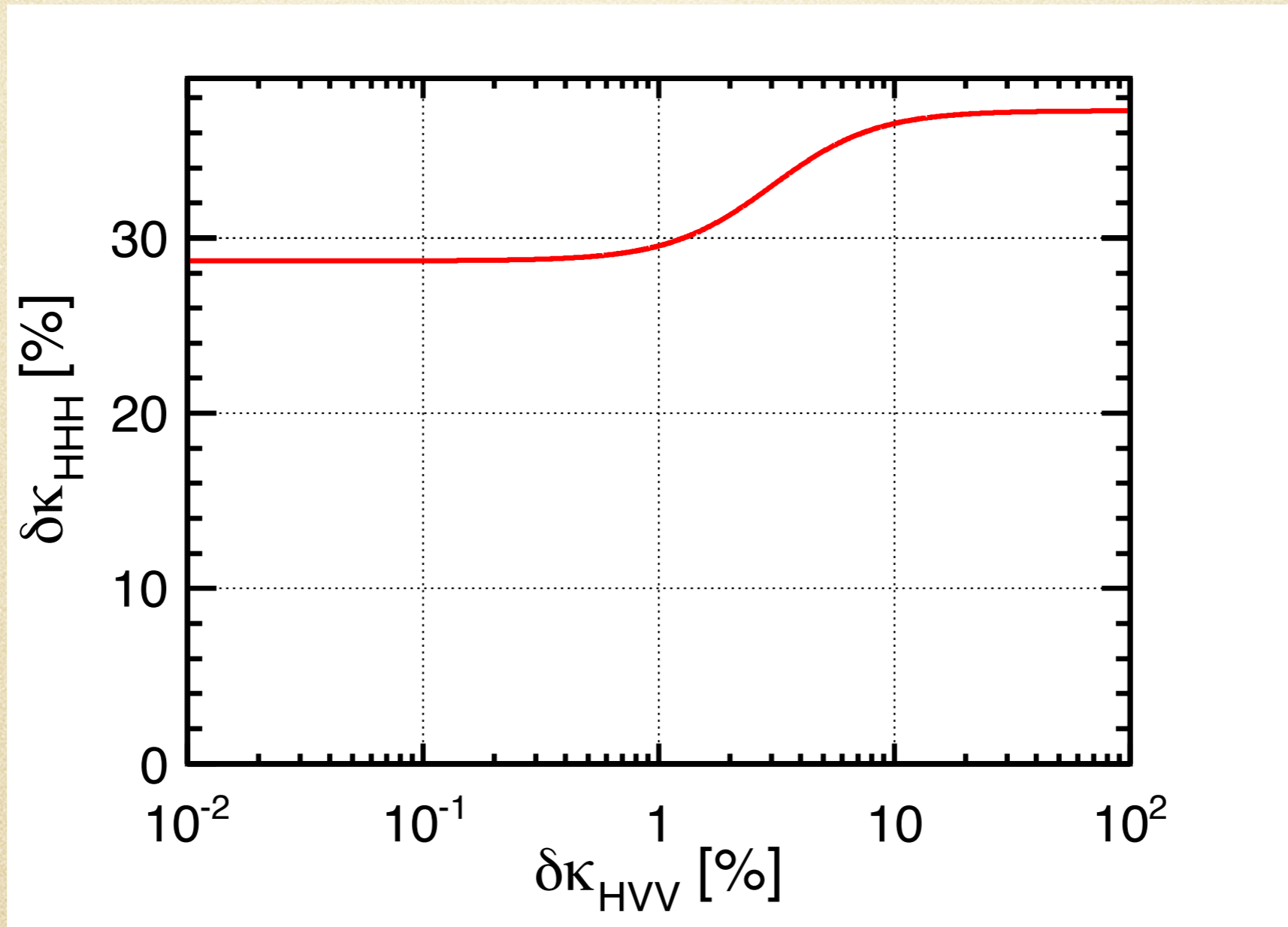
backup

results: $\delta\kappa_q = 10\%$ (but κ_b fixed)

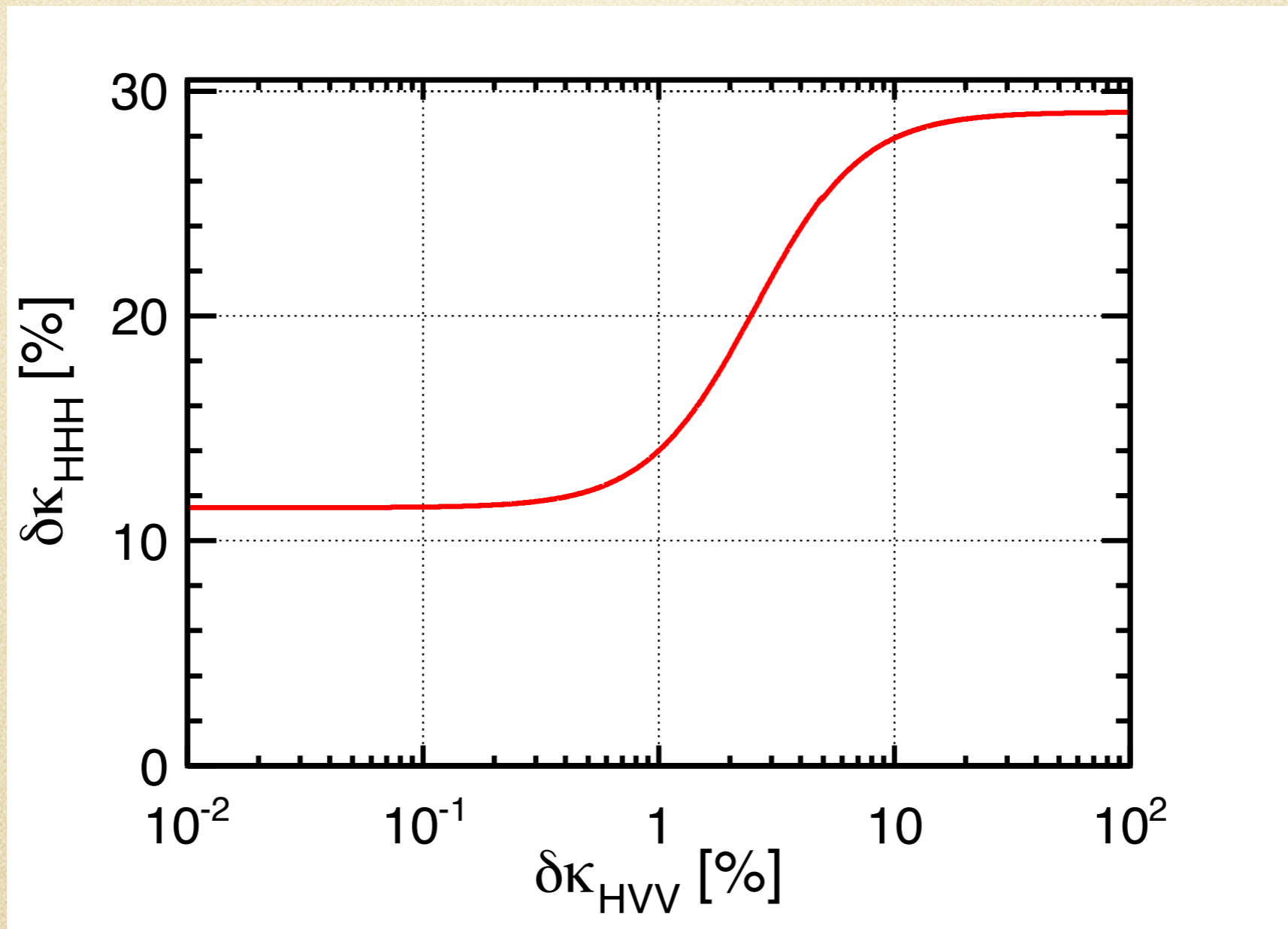
(1 observables: ZHH @ 500 GeV only)



add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_b$ (w/ $\delta\kappa_q = 10\%$)
(3 observables)

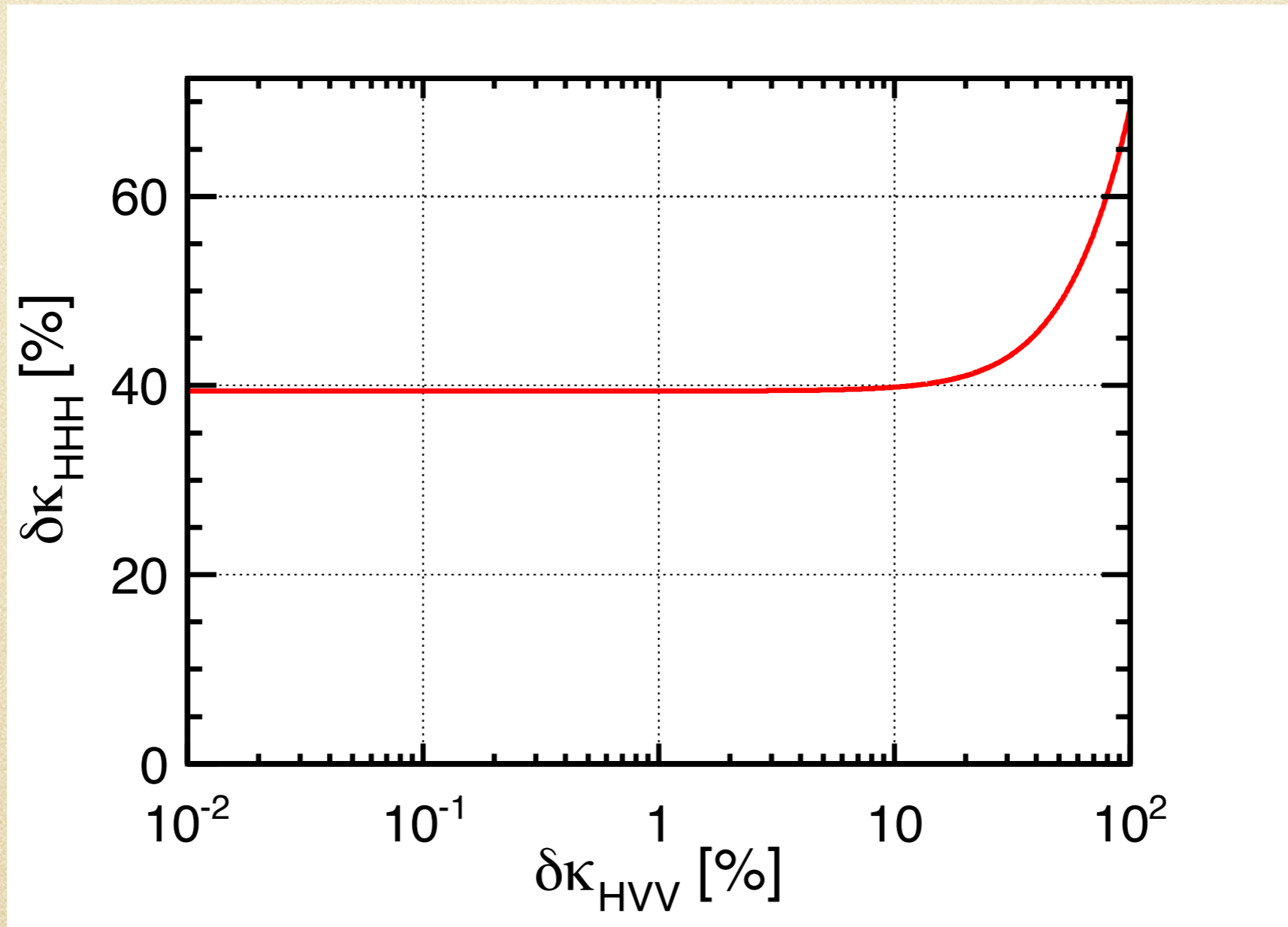


add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_b$ ($w/\delta\kappa_q = 0.1\%$)
(3 observables)



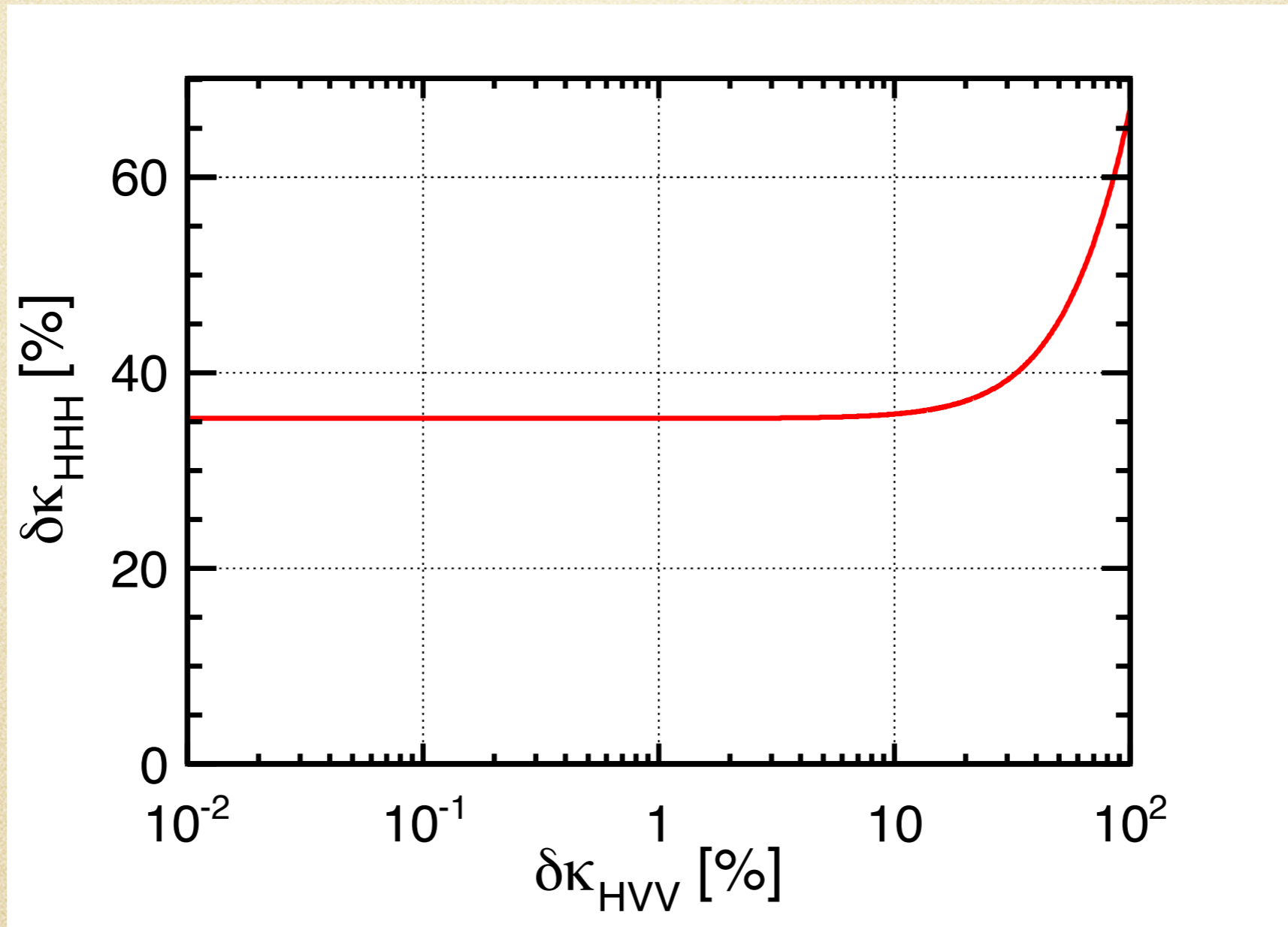
add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_b$ (w/ $\delta\kappa_q = 10\%$)

(1 observables: ZHH @ 500 GeV only)



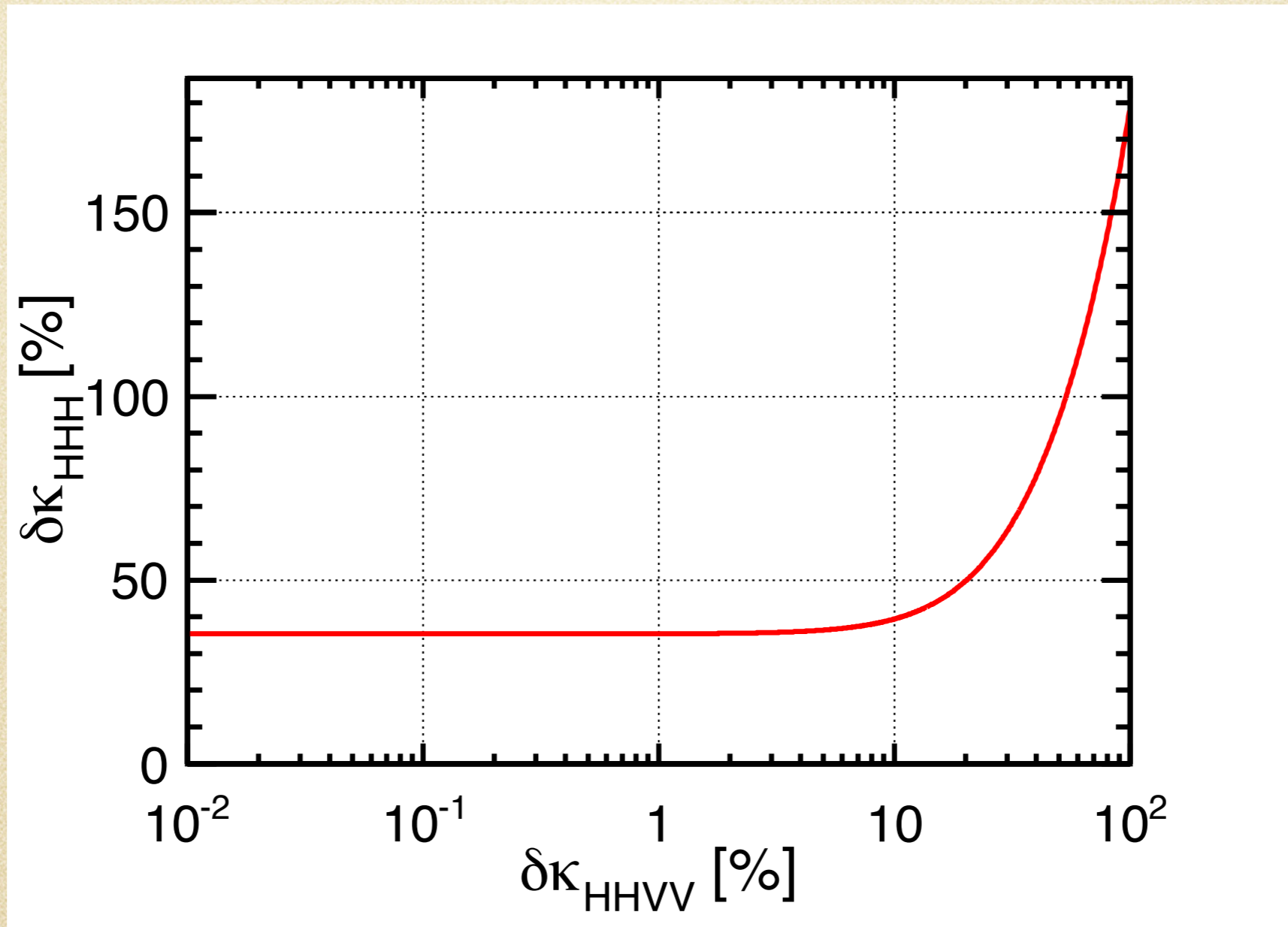
add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_b$ (w/ $\delta\kappa_q = 0.1\%$)

(1 observables: ZHH @ 500 GeV only)



add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_q$ (w/ $\delta\kappa_b = 1\%$)

(1 observables: ZHH @ 500 GeV only)



add in $\delta\kappa_b$: $\delta\kappa_\lambda$ versus $\delta\kappa_q$ (w/ $\delta\kappa_b = 10\%$)

(1 observables: ZHH @ 500 GeV only)

