Production and Decay of Higgs bosons in NLO SUSY-QCD

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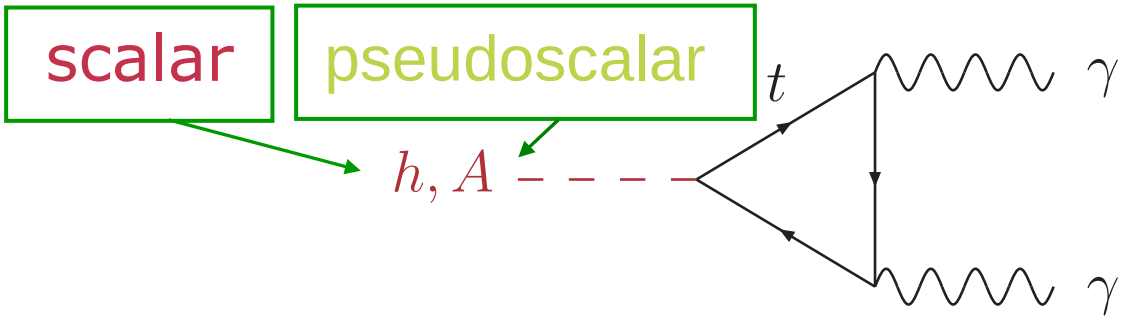
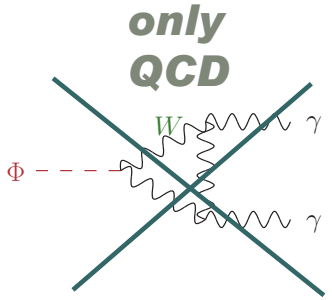
Content

- Decay of Higgs bosons
- Higher order corrections
- Methods
- Results

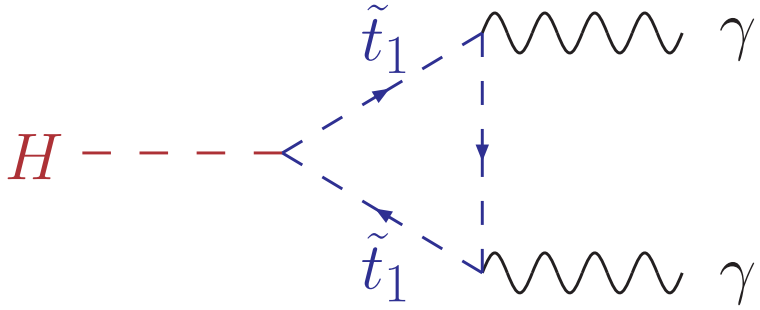
Decay of neutral Higgs bosons

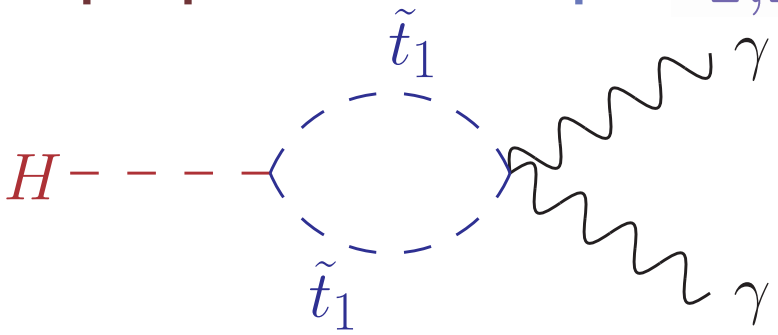
- SM contribution in LO:





- Superpartner of the top-quarks: Stops $\tilde{t}_{1,2}$





Dominant Contributions

- through Top-Quarks and Top-Squarks
- Couplings

$$y_{ht\bar{t}} \sim \frac{m_t}{\sin\beta}, \qquad y_{hb\bar{b}} \sim \frac{m_b}{\cos\beta}$$

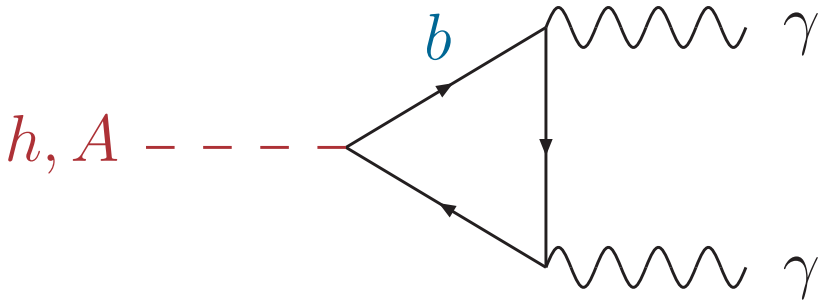
$$y_{At\bar{t}} \sim m_t \cot\beta, y_{Ab\bar{b}} \sim m_b \tan\beta$$

$\rightarrow \underline{tan\beta}$ large

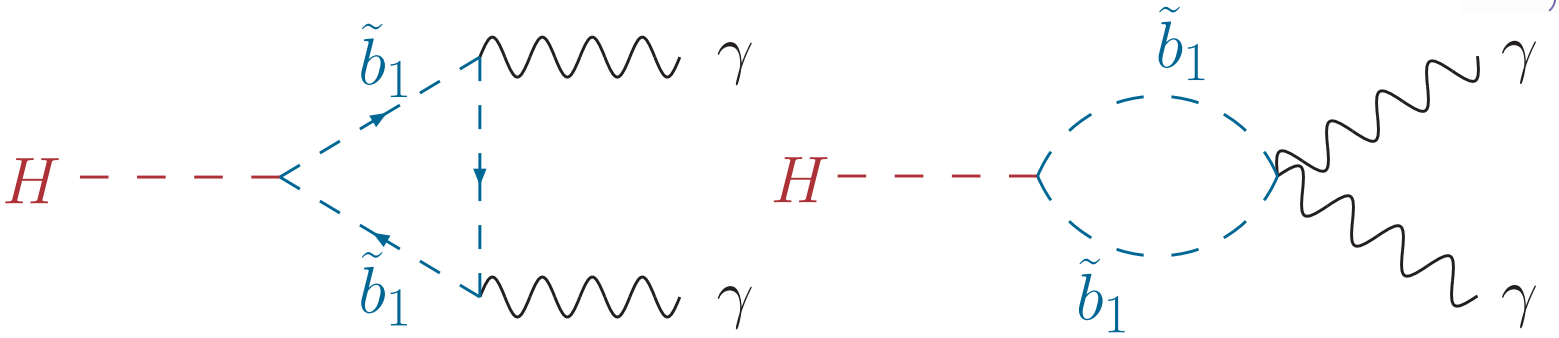
- Effects through Bottom-Quarks important

Leading order contributions

- SM contribution in LO:

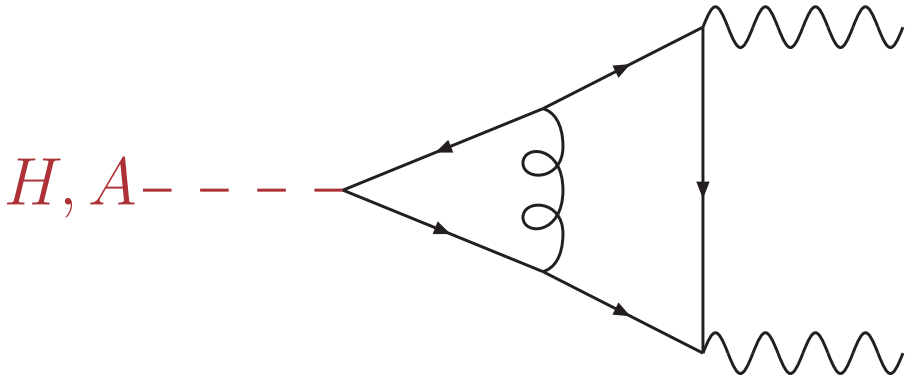


- Superpartner of the bottoms: sbottoms $\tilde{b}_{1,2}$

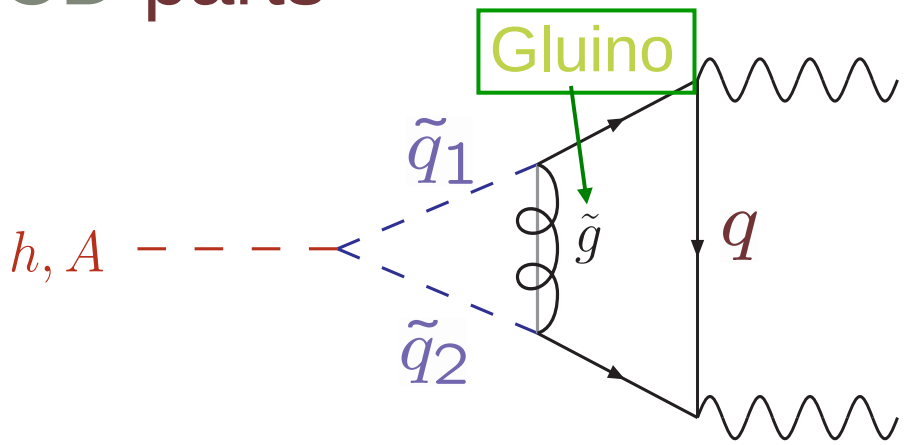


Diagrams in nlo SUSY-QCD

- QCD contributions



- SUSY-QCD parts



Results so far

$$h, A \longrightarrow \gamma\gamma$$

- NLO: QCD, elektro weak $\rightarrow$ following talk
- NNLO: limit of large top-masses
- NLO: large Top/Stop/Gluino-masses

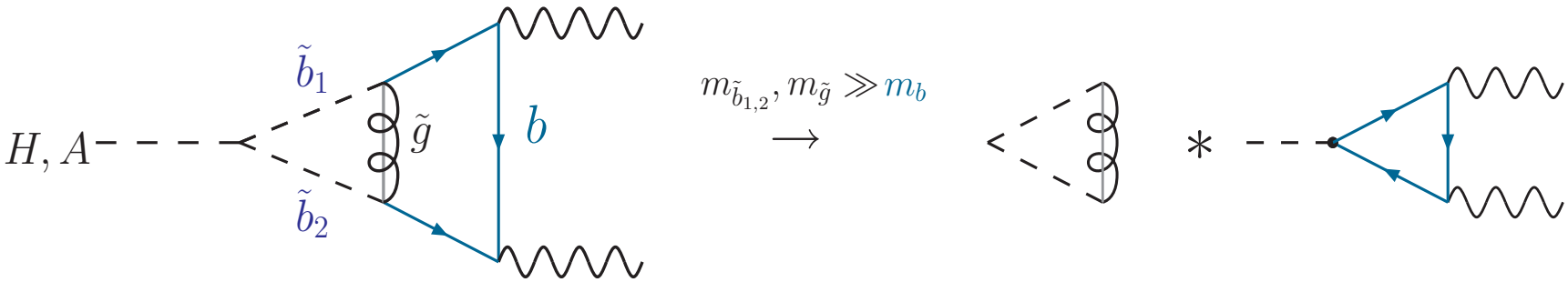
  [Harlander, Steinhauser,'03,'04]
  [Harlander, FH,'05]

- NLO: Squark contributions

  [Spira, Mühlleitner, '06]
  [Anastasiou et al. '06]
  [Bonciani,Degrassi,Vicini, '07]

Quark-Squark-Gluino Contributions

- leading order calculated exactly
- NLO: asymptotic expansions



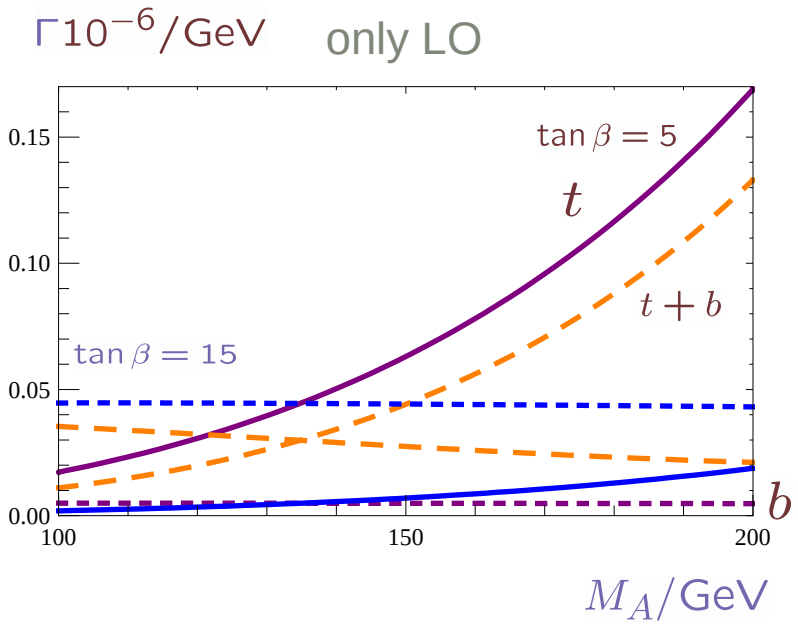
- quark-mass dependence explicitly
- external momenta ≠ 0

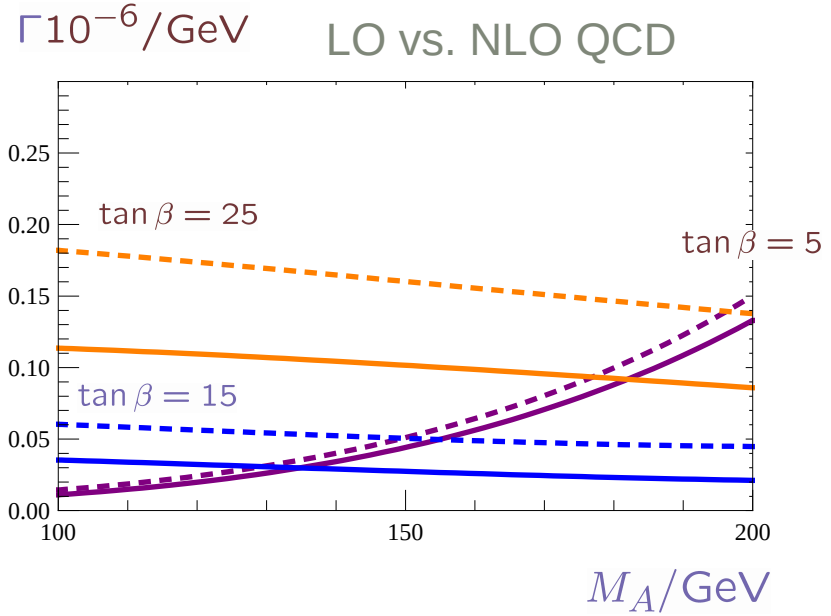
Checks

- NLO SUSY parts finite
- pure NLO SUSY parts have to
  contain at least one MSSM scale
- Top/Stop/Gluino parts
  limit of large top masses
  expand new results in $\frac{m^2_{h,A}}{4m^2_t}$

  $\rightarrow$ both agree

Partial decay width $\Gamma(A \to \gamma\gamma)$

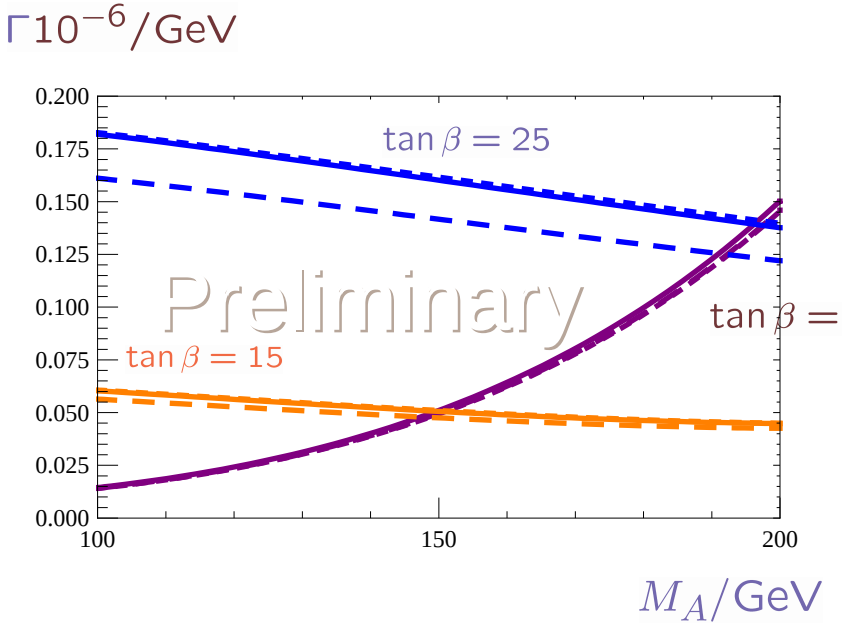




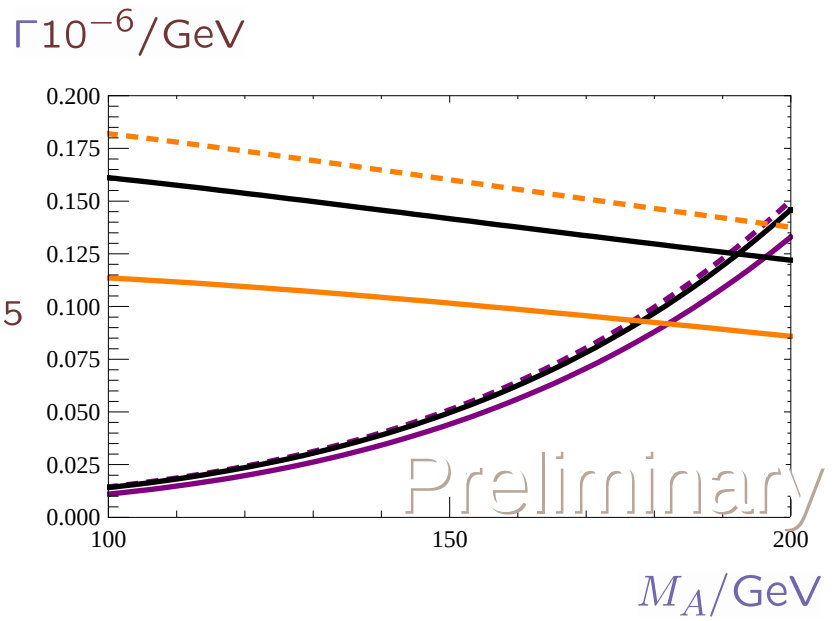
no SUSY part in LO

Partial decay width $\Gamma(A \to \gamma\gamma)$

NLO: QCD vs. QCD+Stops vs. SQCD



LO vs. NLO-QCD vs. SQCD

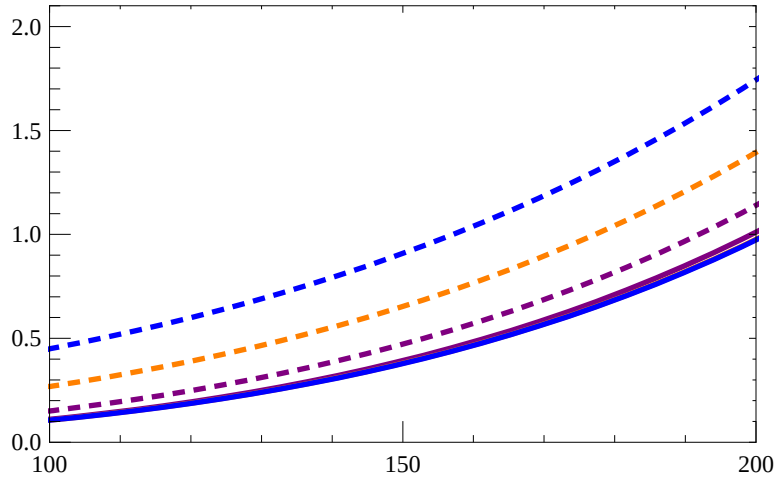


$$M_{susy} := m_{\tilde{q}_1} = m_{\tilde{q}_2} = m_{\tilde{g}}$$

in GeV: $M_{susy} = 350, \mu_{susy} = 100$

Partial decay width $\Gamma(h \to \gamma\,\gamma)$

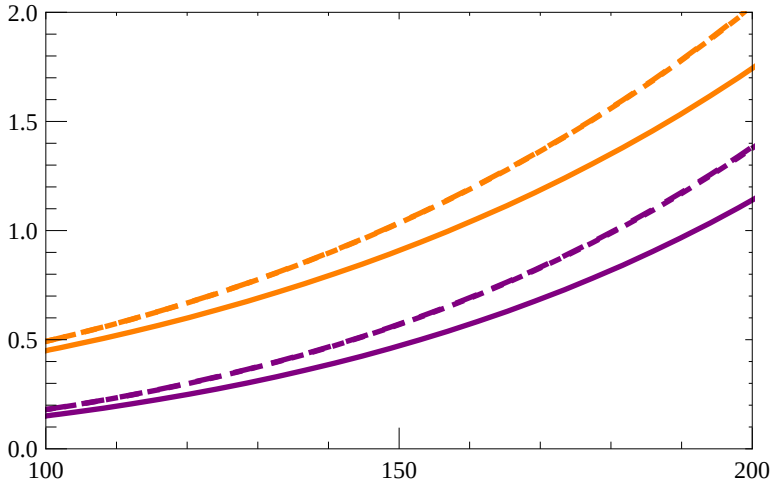
$\Gamma 10^{-6}/\mathrm{GeV}$ LO: top vs. bottom



$\tan\beta = 5, 15, 25$

M_h/GeV

$\Gamma 10^{-6}/\mathrm{GeV}$ LO: tb vs. tbstop vs. SQCD



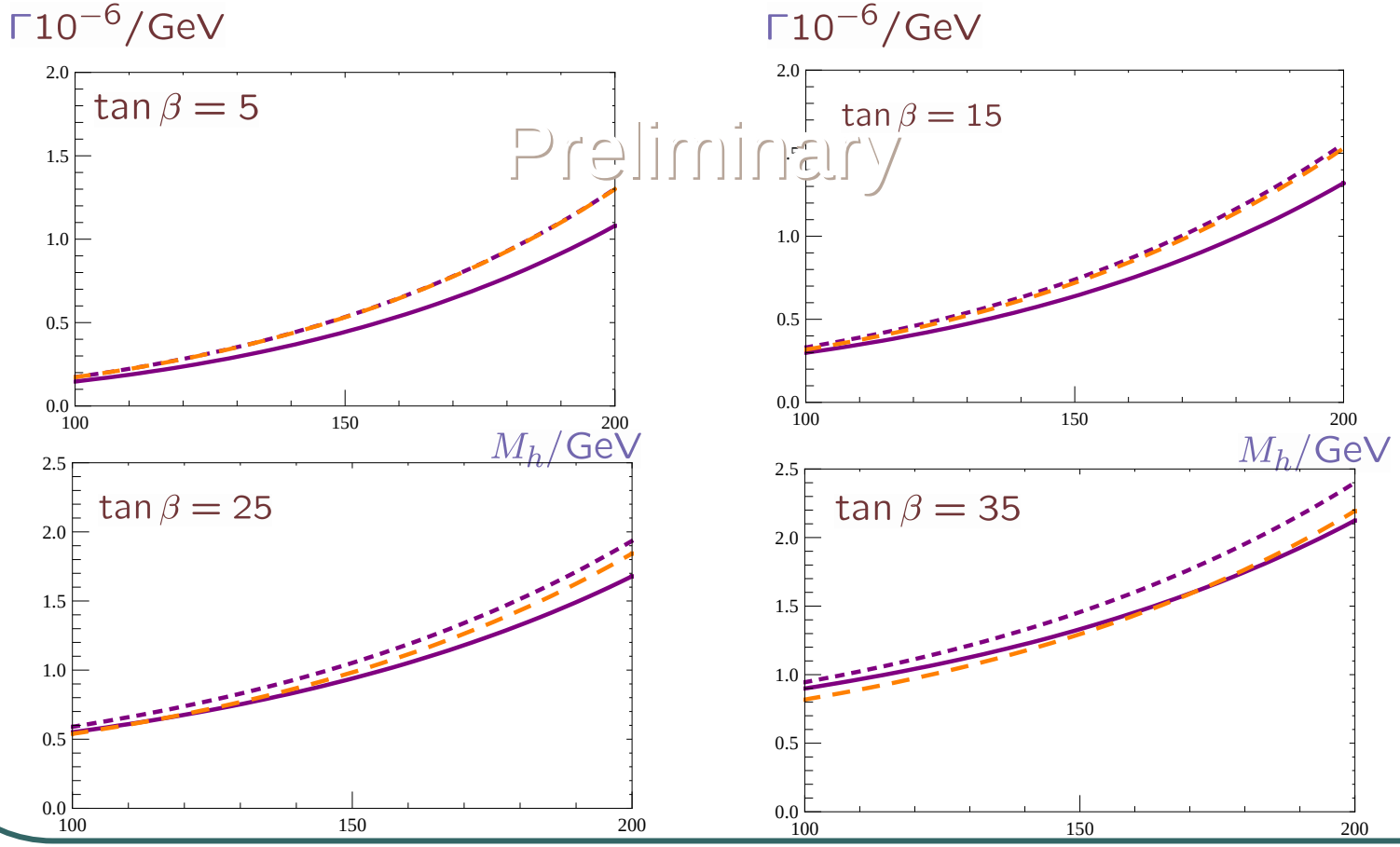
M_h/GeV

$M_{susy} := m_{\tilde{q}_1} = m_{\tilde{q}_2} = m_{\tilde{g}}$

in GeV: $M_{susy} = 350, \mu_{susy} = 100, \alpha = \pi/3$

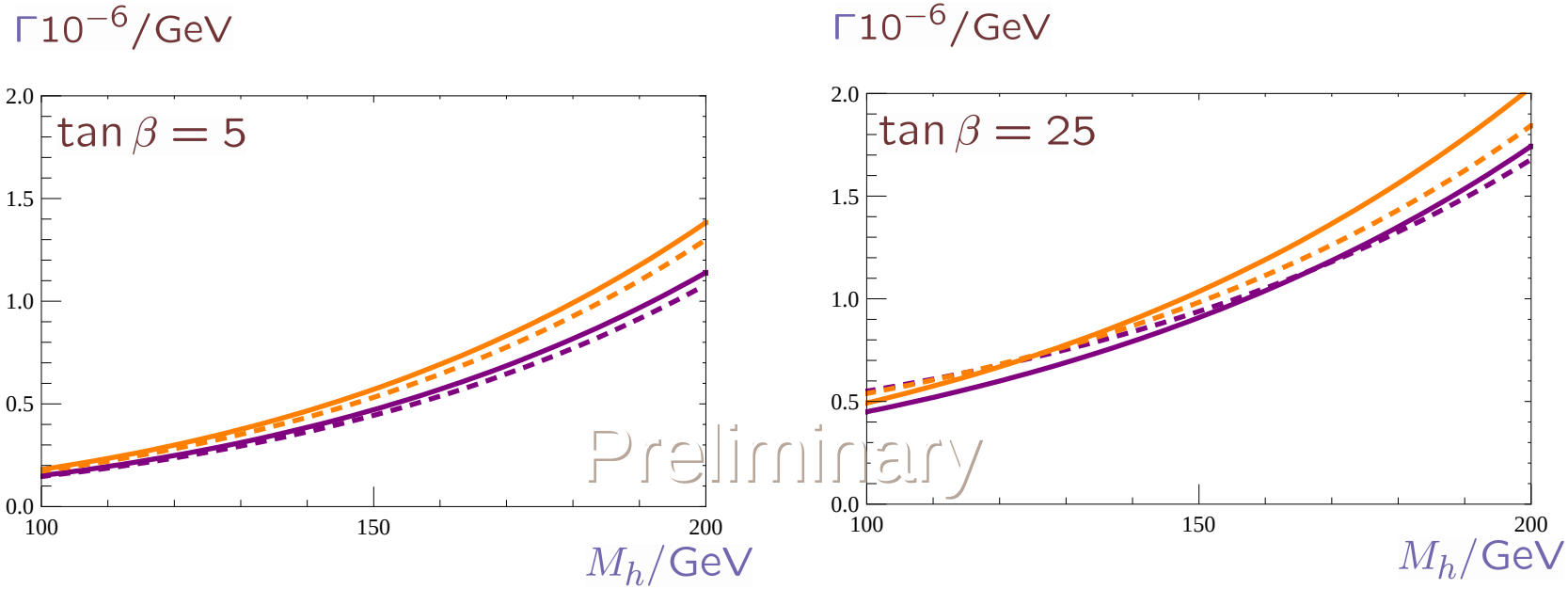
Partial decay width $\Gamma(h \to \gamma\gamma)$

NLO: QCD vs. +LO(stop)=+LO(SQCD)=+LO(SQCD)+NLO(stop) vs. SQCD



Partial decay width $\Gamma(h \to \gamma\,\gamma)$

QCD vs. SQCD



$$M_{susy} := m_{\tilde{q}_1} = m_{\tilde{q}_2} = m_{\tilde{g}}$$

in GeV: $M_{susy} = 350, \mu_{susy} = 100, \alpha = \pi/3$

Summary

Decay of scalar Higgs bosons: $A, H \to \gamma\gamma$

- Top-Stop contributions
- new: Bottom-Sbottom contributions

$\to$ Important for large $\tan\beta$

outlook:

Effects to the Higgs production via gluon fusion