PAUL SCHERRER INSTITUT

HIGGS BR

Michael Spira (PSI)

Theory convenors: Ansgar Denner, Sven Heinemeyer

Experimental convenors: Ivica Puljak (CMS), Daniela Rebuzzi (ATLAS)

Group members: A. Denner, S. Dittmaier, S. Heinemeyer, A. Mück, G. Passarino, Ivica Puljak, Daniela Rebuzzi, M. Spira, C. Sturm, S. Uccirati, M. Weber, G. Weiglein

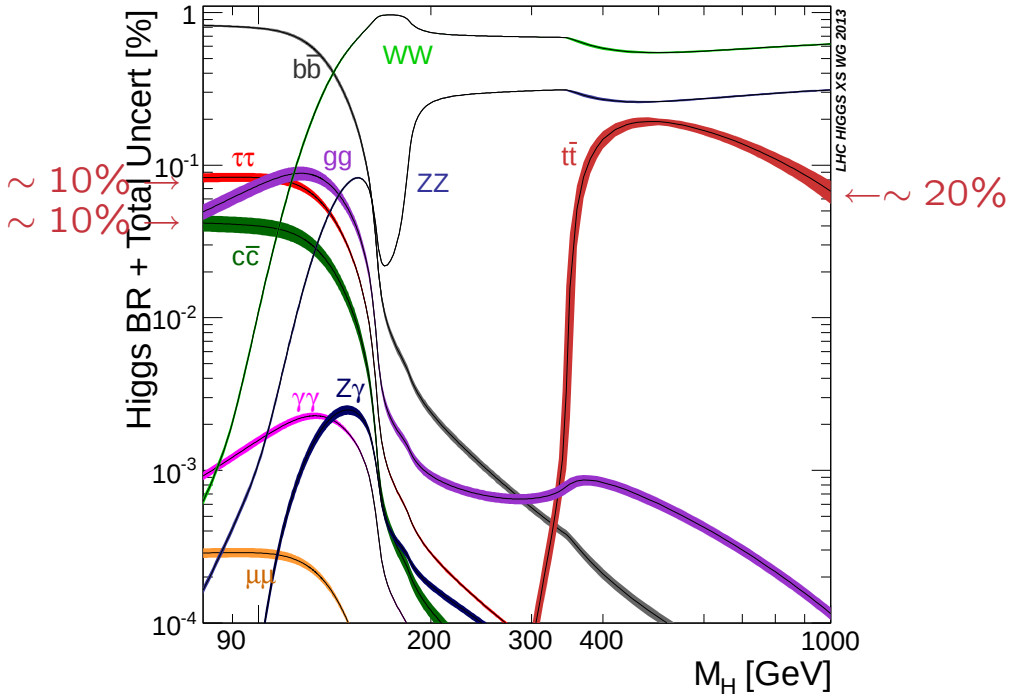
Partial Width	QCD	Electroweak	Total	
$H \to b\bar{b}/c\bar{c}$	$\sim 0.1\%$	$\sim$ 1–2% for $M_H \lesssim 135$GeV	$\sim 2\%$	NNNNLO / NLO
$H \to \tau^+\tau^-/\mu^+\mu^-$		$\sim$ 1–2% for $M_H \lesssim 135$GeV	$\sim 2\%$	NLO
$H \to t\bar{t}$	$\lesssim 5\%$	$\lesssim$ 2–5% for $M_H < 500$GeV	$\sim 5\%$	(NNN)NLO / LO
		$\sim 0.1(\frac{M_H}{1\text{TeV}})^4$ for $M_H > 500$GeV	$\sim$ 5–10%	
$H \to gg$	$\sim 3\%$	$\sim 1\%$	$\sim 3\%$	NNNLO approx. / NLO
$H \to \gamma\gamma$	$< 1\%$	$< 1\%$	$\sim 1\%$	NLO / NLO
$H \to Z\gamma$	$< 1\%$	$\sim 5\%$	$\sim 5\%$	(N)LO / LO
$H \to WW/ZZ \to 4f$	$< 0.5\%$	$\sim 0.5\%$ for $M_H < 500$GeV	$\sim 0.5\%$	(N)NLO
		$\sim 0.17(\frac{M_H}{1\text{TeV}})^4$ for $M_H > 500$GeV	$\sim$ 0.5–15%	

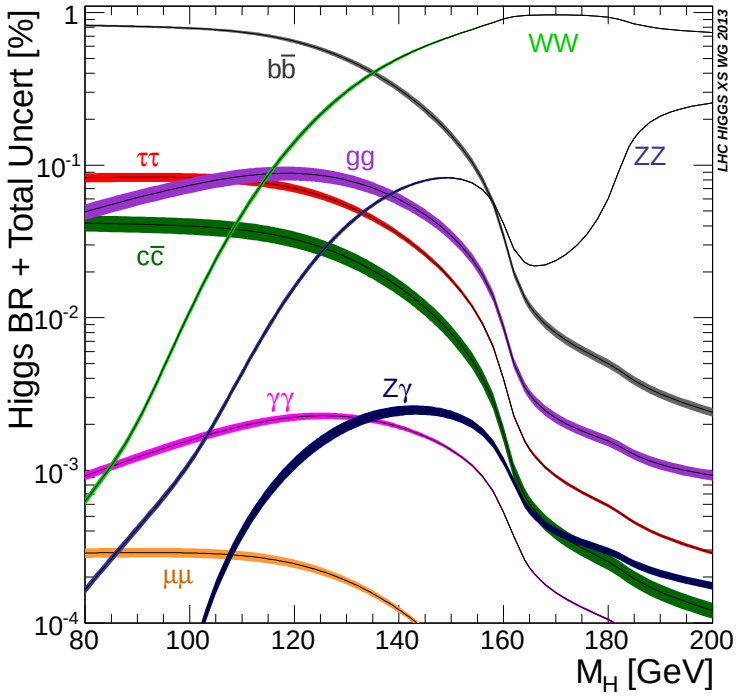
- QCD: variation of Higgs widths for scale by factor 2 and 1/2
  elw: missing HO estimated from known structure at NLO
  $M_H \gtrsim 500$ GeV: Higgs self-interactions dominate error
  different uncertainties added linearly for each channel

- parametric uncertainties:
  $m_t = 172.5 \pm 2.5$ GeV $\qquad \alpha_s(M_Z) = 0.119 \pm 0.002$
  $m_b(m_b) = 4.16 \pm 0.06$ GeV $\qquad m_c(m_c) = 1.28 \pm 0.03$ GeV
  different uncertainties added quadratically for each channel

- total uncertainties: parametric & theor. uncertainties added linearly

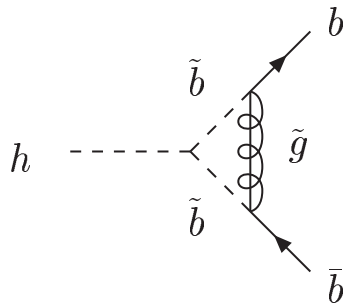
HDECAY & Prophecy4f





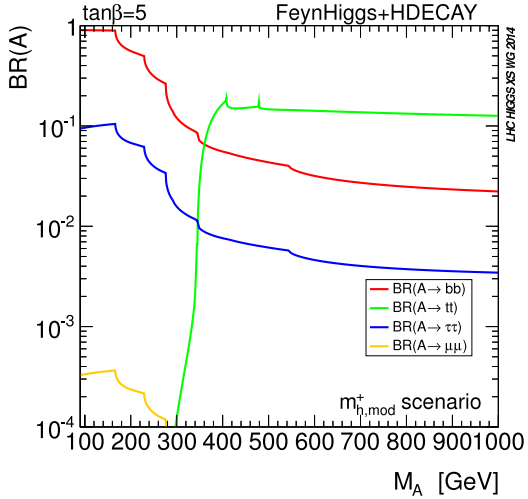
Denner, Heinemeyer, Puljak, Rebuzzi, S.

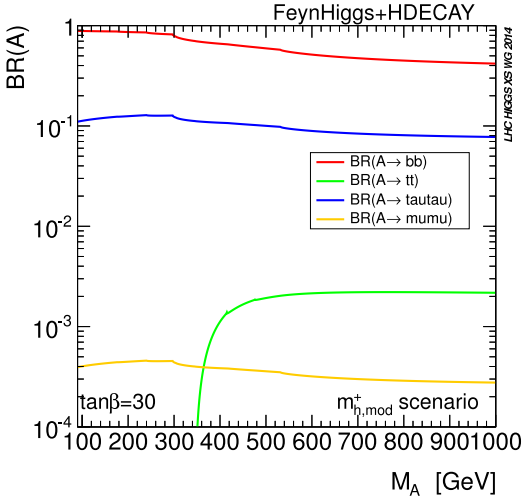
- MSSM: large SUSY–QCD corrections to $\phi^0 \to b\bar{b}$



$$\propto \frac{\alpha_s}{\pi} \frac{m_{\tilde{g}} \mu \, \mathrm{tg}\beta}{M^2_{SUSY}} \sim \Delta_b$$

Hall,. . .
Carena,. . .
Nierste,. . .
Häfliger,. . .
Noth, S.
Mihaila, Reisser
etc.


tanβ=5
FeynHiggs+HDECAY
BR(A)
BR(A→ bb)
BR(A→ tt)
BR(A→ ττ)
BR(A→ μμ)
m+h,mod scenario
MA [GeV]
LHC HIGGS XS WG 2014


FeynHiggs+HDECAY
BR(A)
BR(A→ bb)
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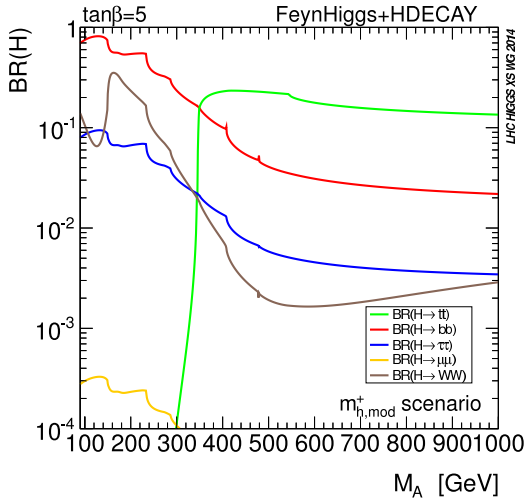
BR(A→ tautau)
BR(A→ mumu)
tanβ=30
m+h,mod scenario
MA [GeV]
LHC HIGGS XS WG 2014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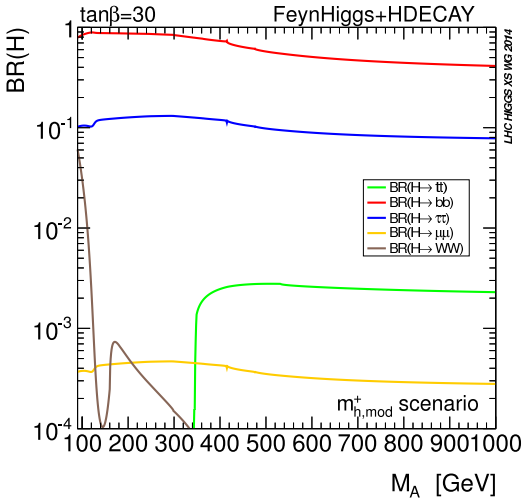
FeynHiggs+HDECAY
BR(H)
BR(H→ tt)
BR(H→ bb)
BR(H→ ττ)
BR(H→ μμ)
BR(H→ WW)
m+h,mod scenario
MA [GeV]
LHC HIGGS XS WG 2014


tanβ=30
FeynHiggs+HDECAY
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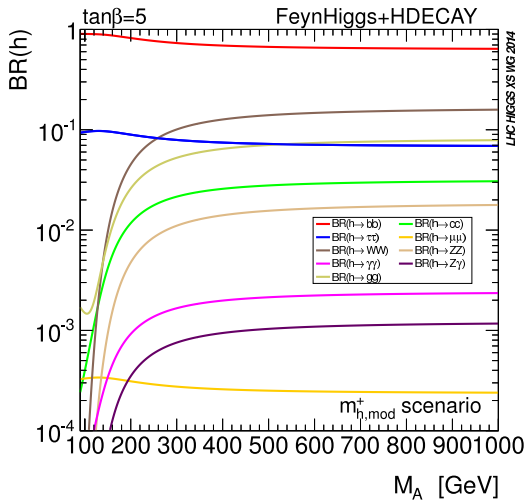
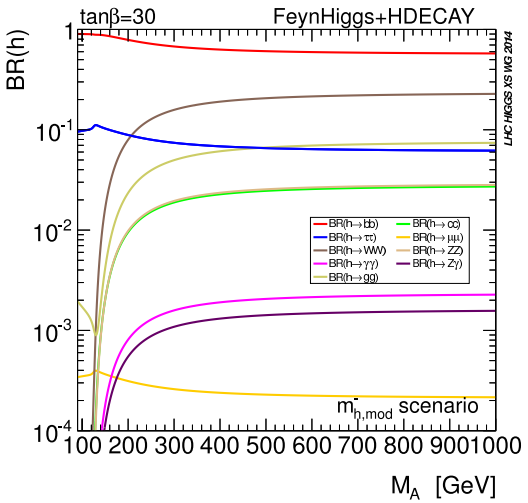
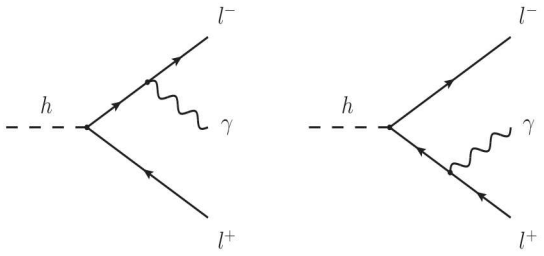

tanβ=5
FeynHiggs+HDECAY
BR(h)
BR(h→ bb)
BR(h→ ττ)
BR(h→ WW)
BR(h→ γγ)
BR(h→ gg)
BR(h→ cc)
BR(h→ μμ)
BR(h→ ZZ)
BR(h→ Zγ)
m+h,mod scenario
MA [GeV]
LHC HIGGS XS WG 2014


tanβ=30
FeynHiggs+HDECAY
BR(h)
BR(h→ bb)
BR(h→ ττ)
BR(h→ WW)
BR(h→ γγ)
BR(h→ gg)
BR(h→ cc)
BR(h→ μμ)
BR(h→ ZZ)
BR(h→ Zγ)
m-h,mod scenario
MA [GeV]
LHC HIGGS XS WG 2014

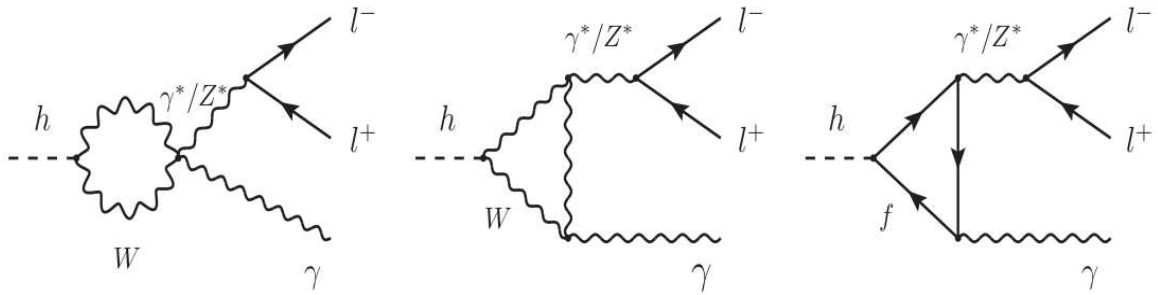
open issues in HDECAY:

- full elw. corrections to $H \to f\bar{f}$ (now: approx.)
- Dalitz decays ($H \to Z\gamma \Leftrightarrow H \to \ell^+\ell^-\gamma$)
- mass effects and further HO corrections in MSSM

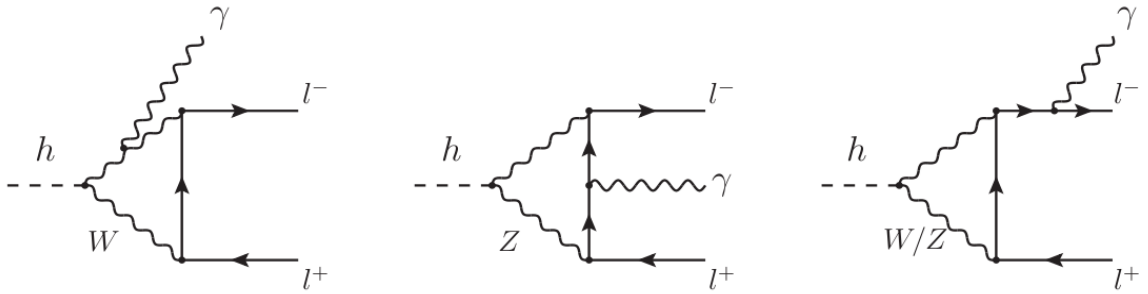
HIGGS DALITZ DECAYS



tree



off-shell



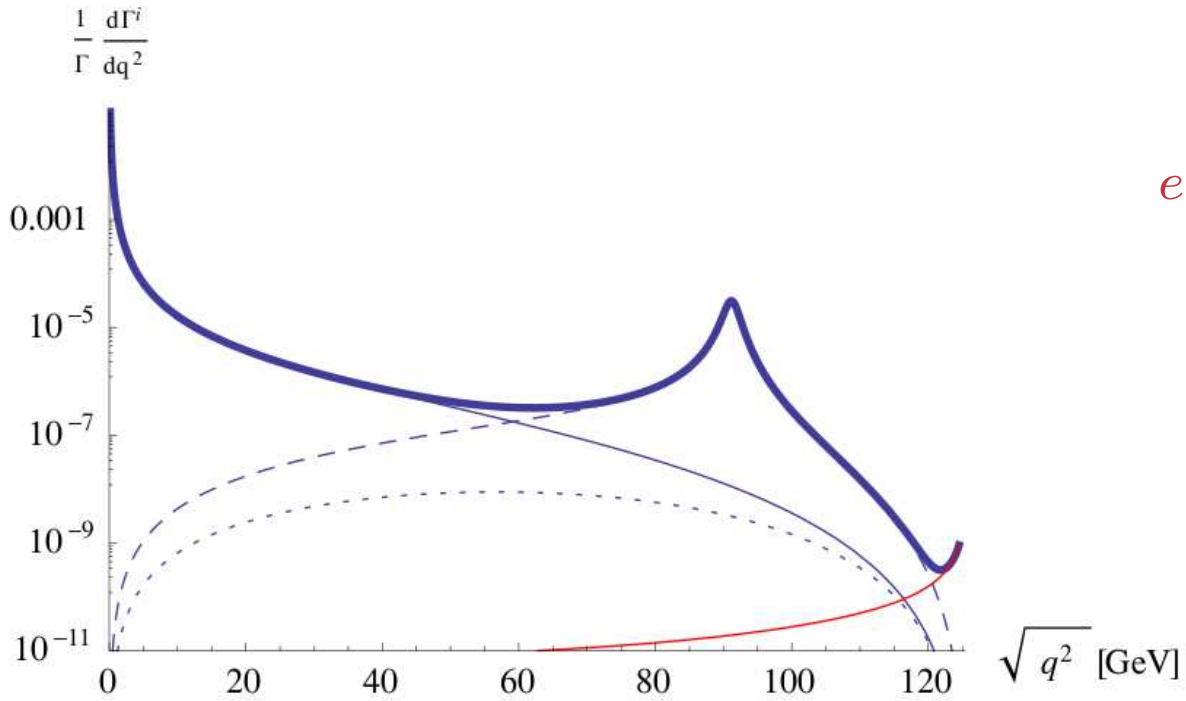
boxes

Abbasabadi, Bowser–Chao, Dicus, Repko
Sun, Chang, Gao
Passarino

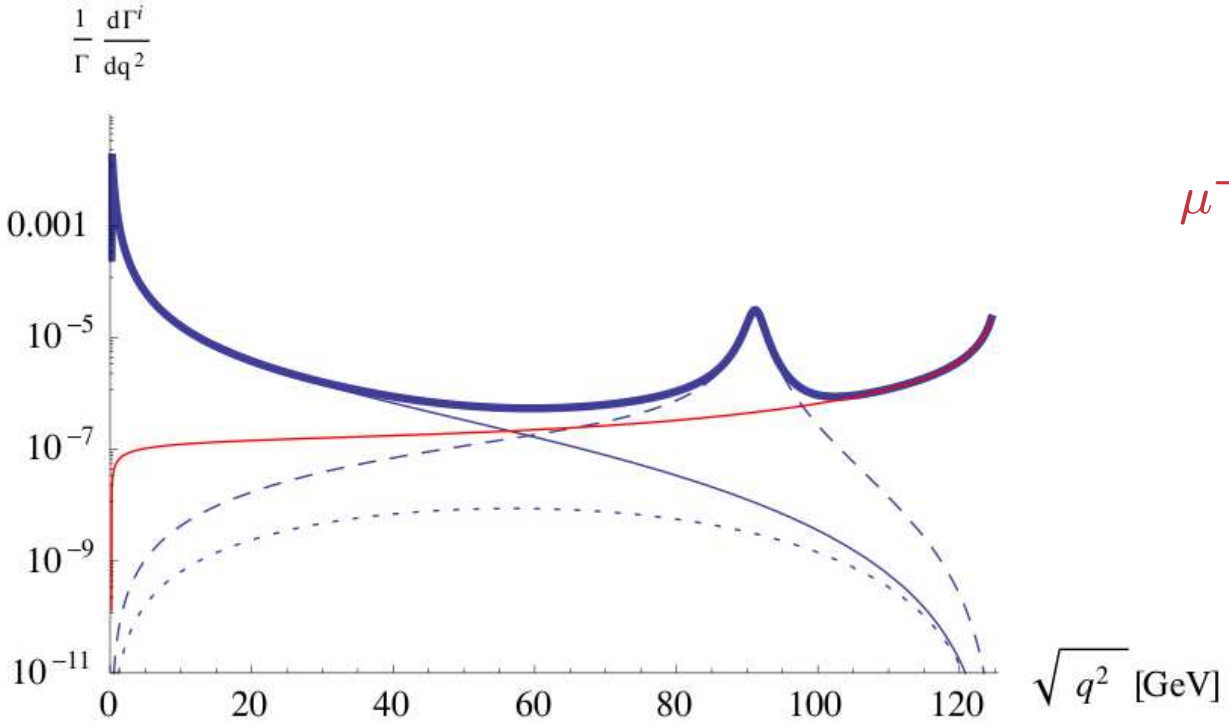
$$\frac{\Gamma(h \to \gamma e^+ e^-)}{\Gamma(h \to \gamma\gamma)} = 5.7\%$$

$$\frac{\Gamma(h \to \gamma \mu^+ \mu^-)}{\Gamma(h \to \gamma\gamma)} = 5.8\% \qquad (E_\gamma > 1 \text{ GeV})$$

$$\frac{\Gamma(h \to \gamma \tau^+ \tau^-)}{\Gamma(h \to \gamma\gamma)} = 3.04$$

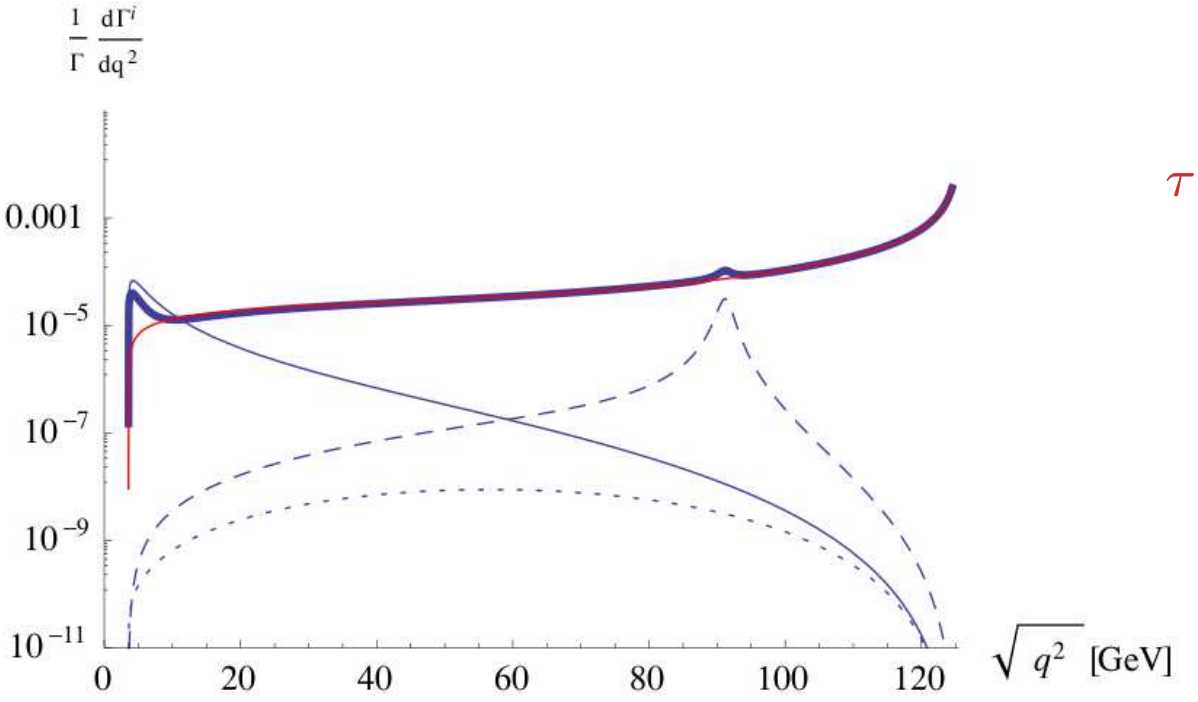


$e^+e^-\gamma$



Sun, Chang, Gao

$\mu^+\mu^-\gamma$



$\tau^+\tau^-\gamma$

Sun, Chang, Gao