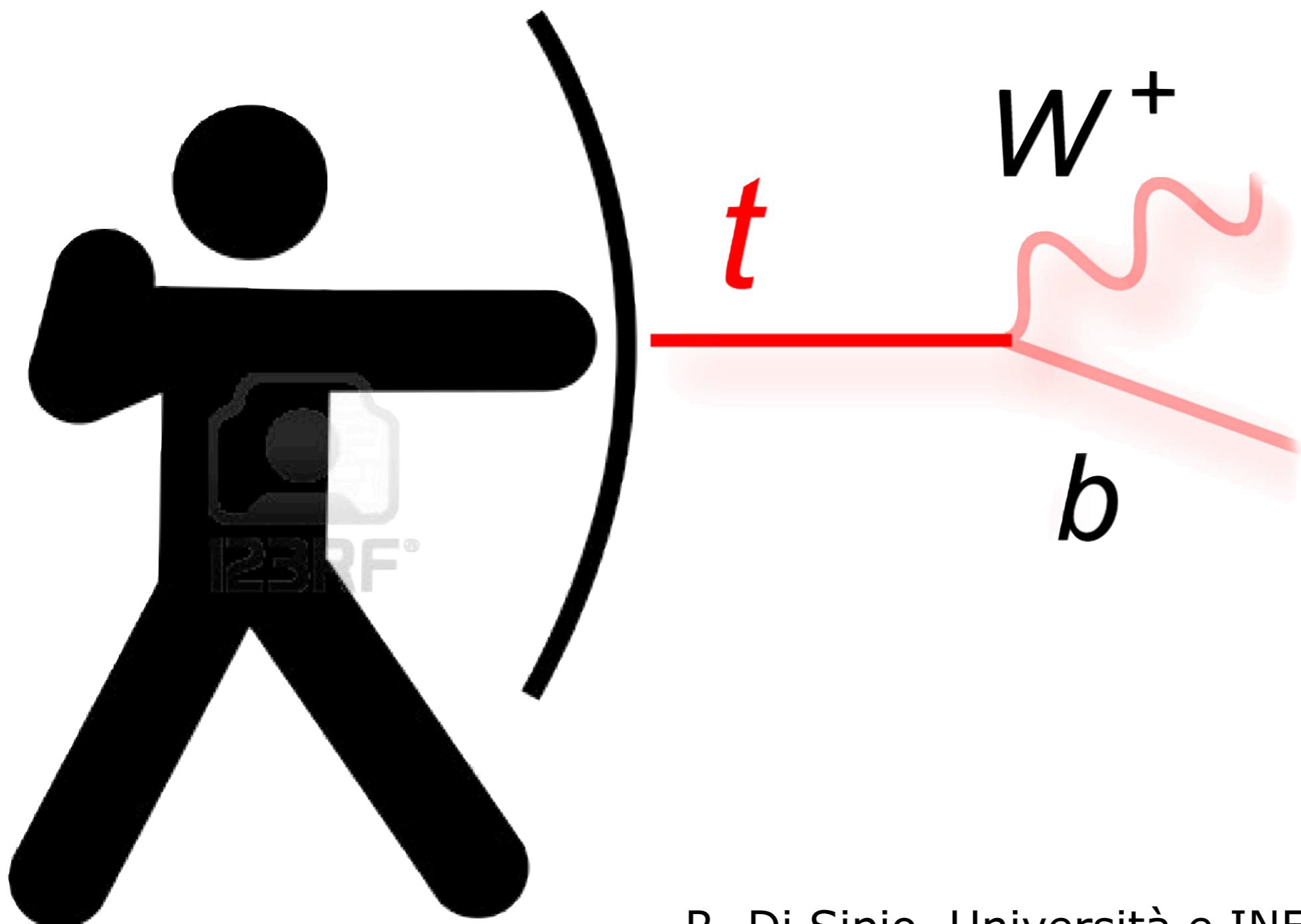


# Discussione: Quark Top @ LHC



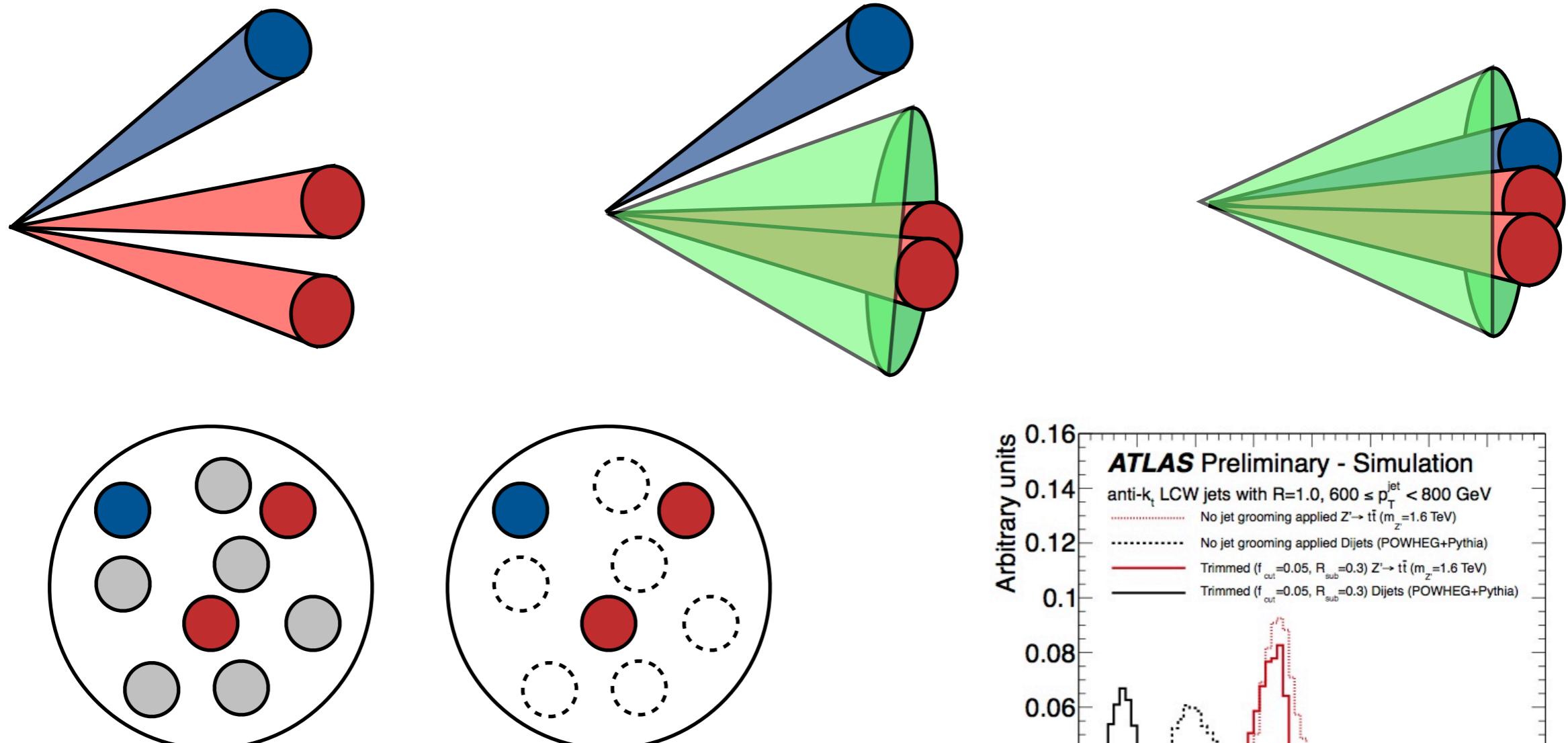
R. Di Sipio, Università e INFN sez. Bologna  
O. A. M. Iorio, INFN Sez. Napoli

Prospettive	innovazioni tecniche	nuove topologie	interpretazione
top tagging (boosted)	x	x	
relazione tra top e higgs ( $m_t/m_H$ , $y_t$ )		x	x
combinazione delle misure (BLUE)	x		
top luminometro gluon PDF			x
separazione meccanismi di produzione (gg/qq)	x		x

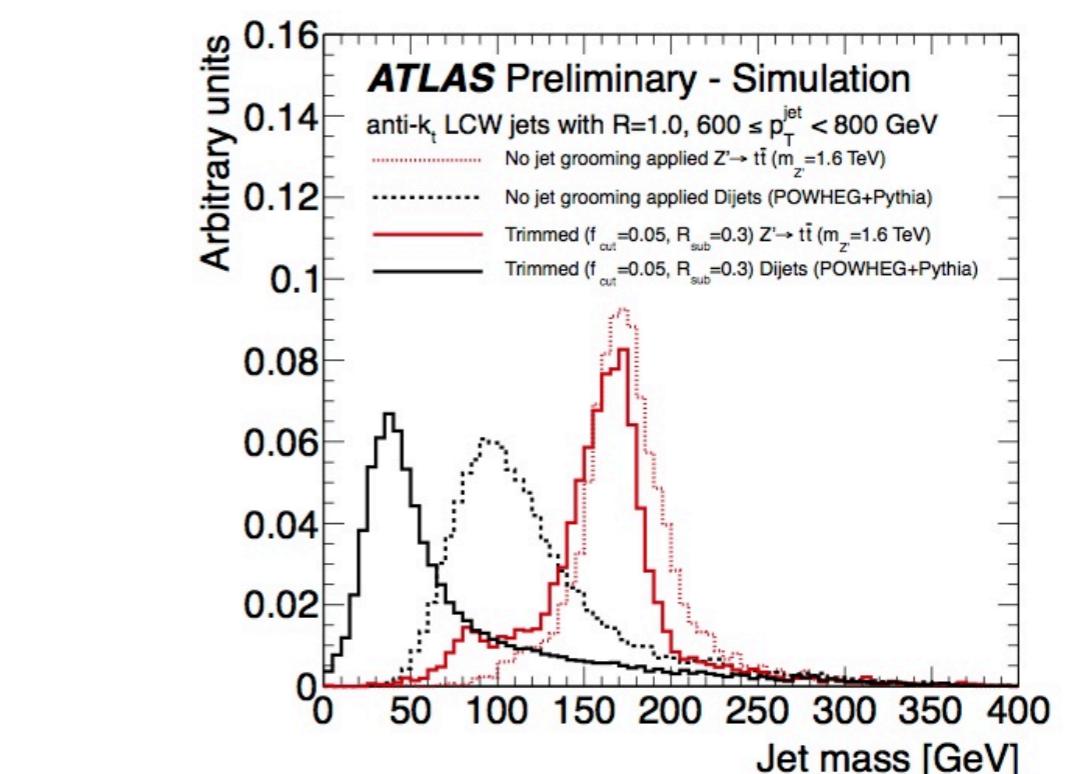
top tagging

# Boosted Tops

$$\Delta R \sim 2 \frac{M}{p_T}$$

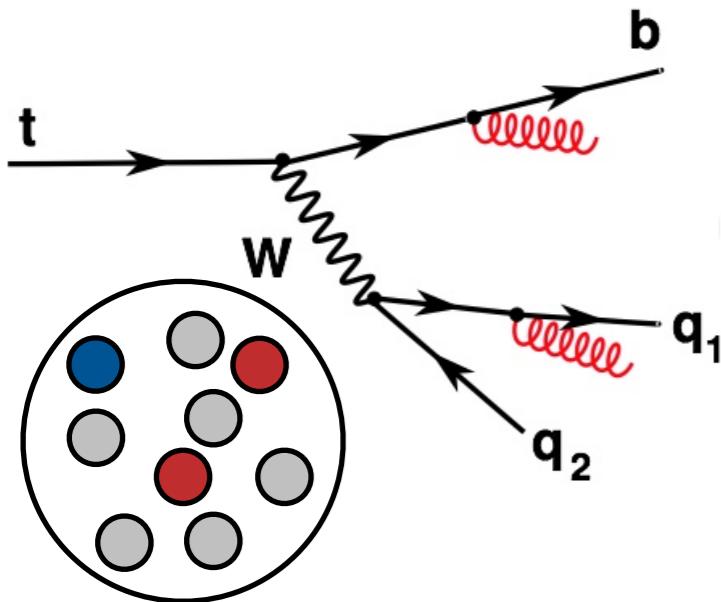


grooming/trimming/pruning =  
rimozione cluster bassa energia/  
grande distanza angolare



migliora risoluzione in massa  
migliora reiezione fondo QCD

# Boosted Tops



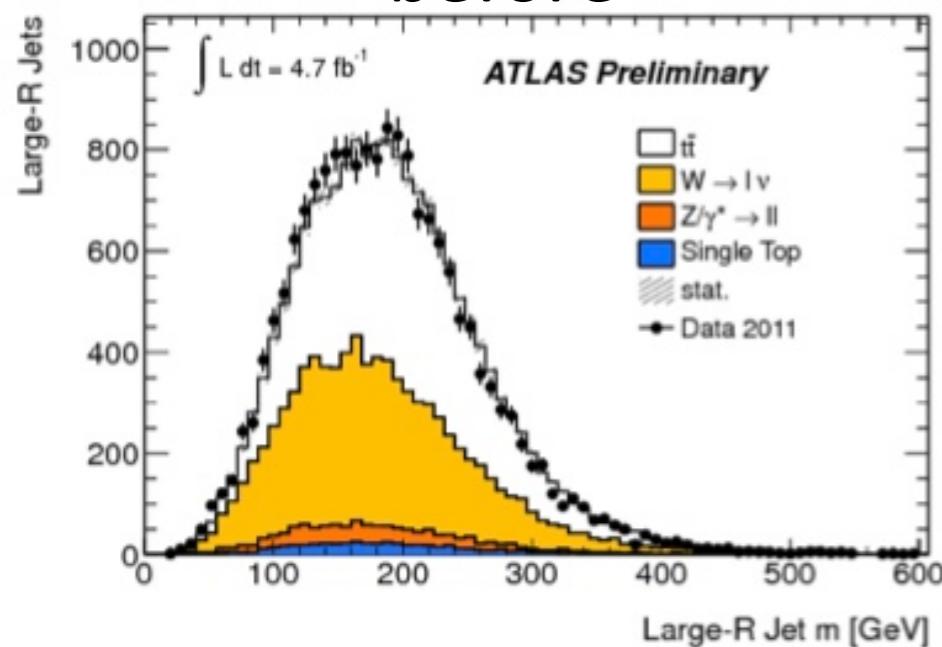
HEPTopTagger, CMS top  
tagger  
Decomposizione e iterazione

- jet mass
- no. of subjets
- min  $m_{jj}$

Template Tagging  
Associazione partone-cluster

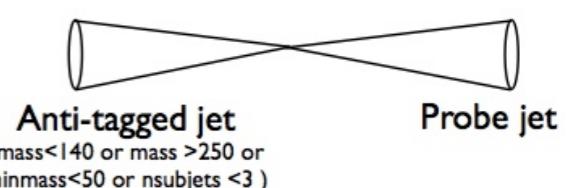
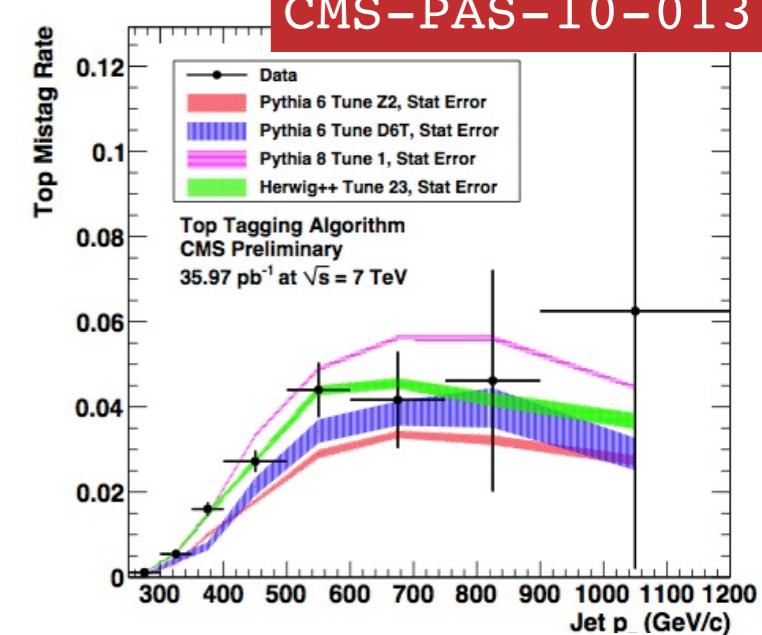
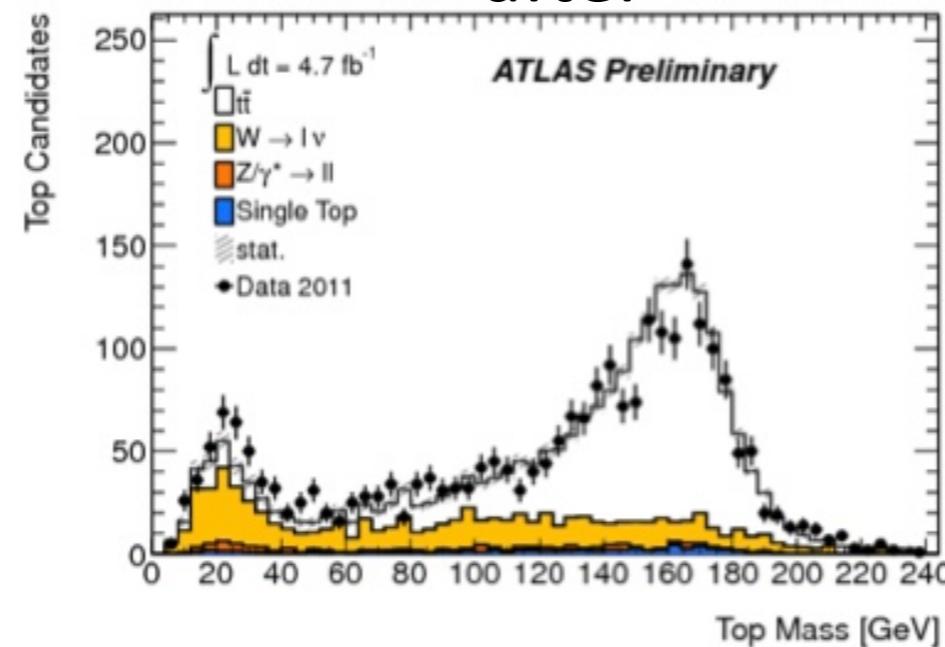
- $p_T$
- $\Delta R$
- top template da generatore MC

before

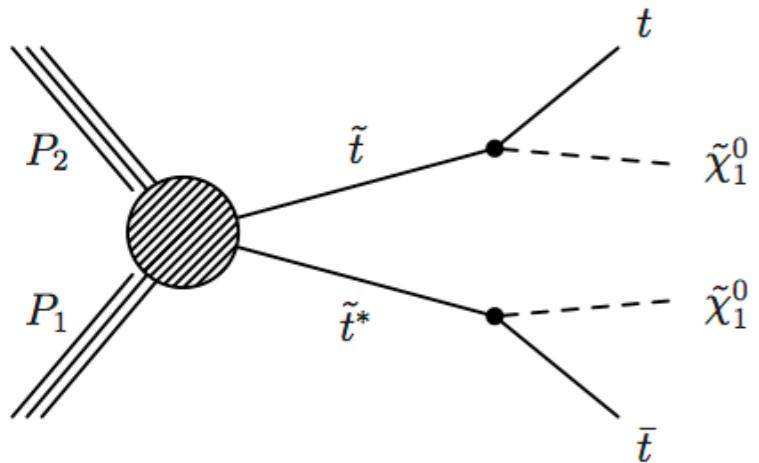


ATLAS-CONF-2012-065

after

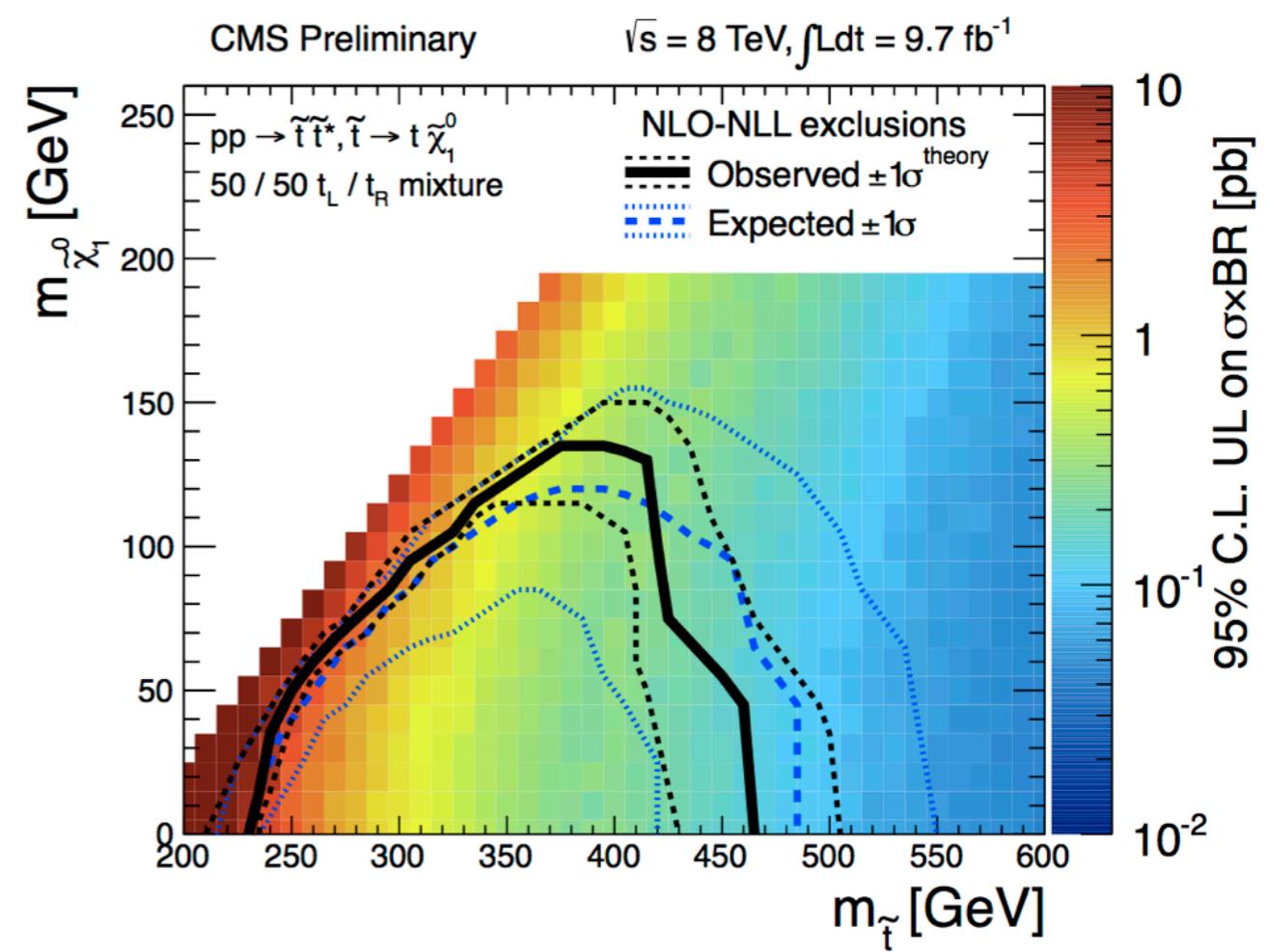
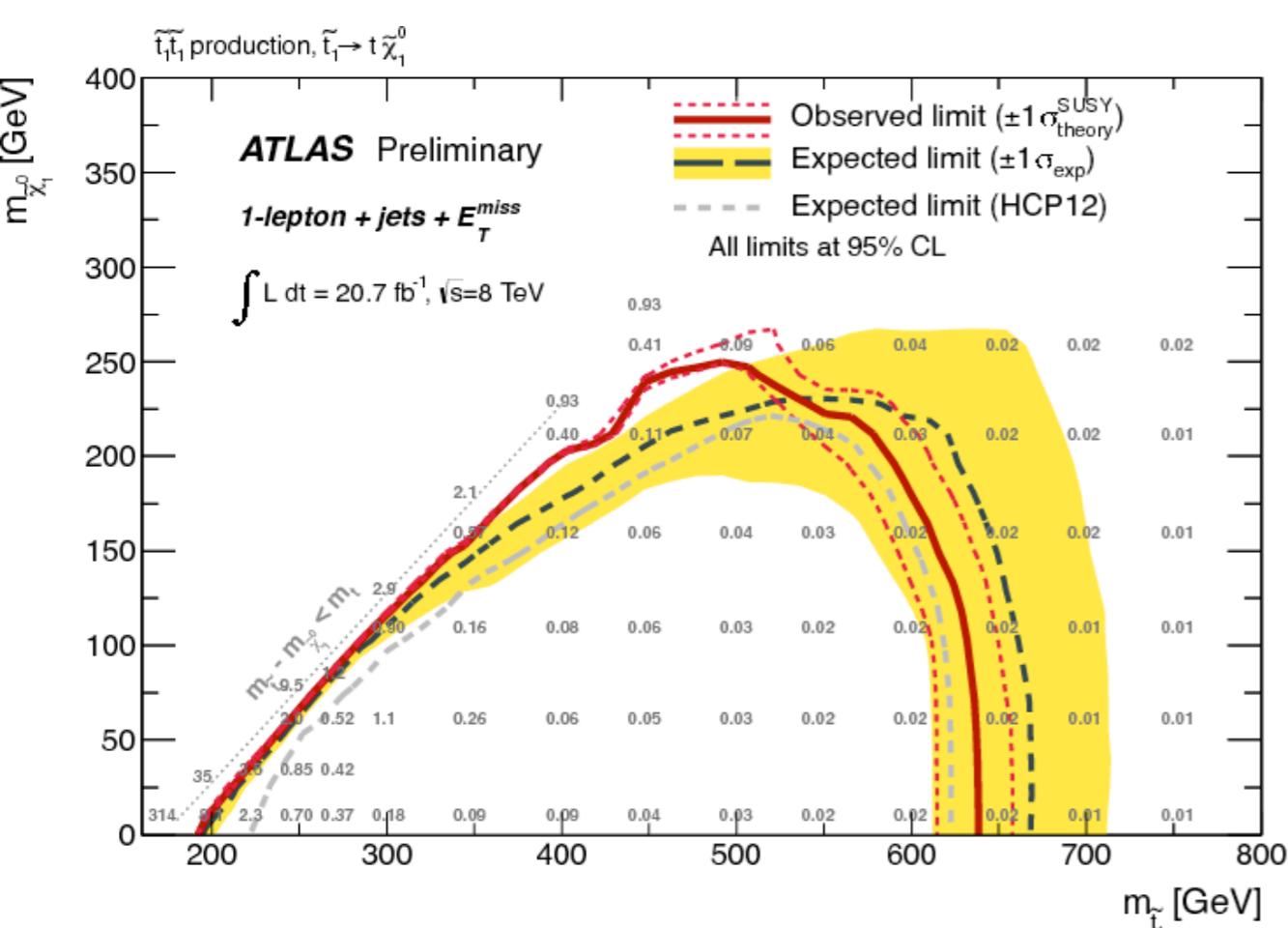


# Ricerche di s-top



$m(\tilde{t}) \approx 1 \text{ TeV} \rightarrow \text{top boosted}$

“naturalezza”  
SUSY: relazione tra mH, mt, mt~ ?



# Combinazioni

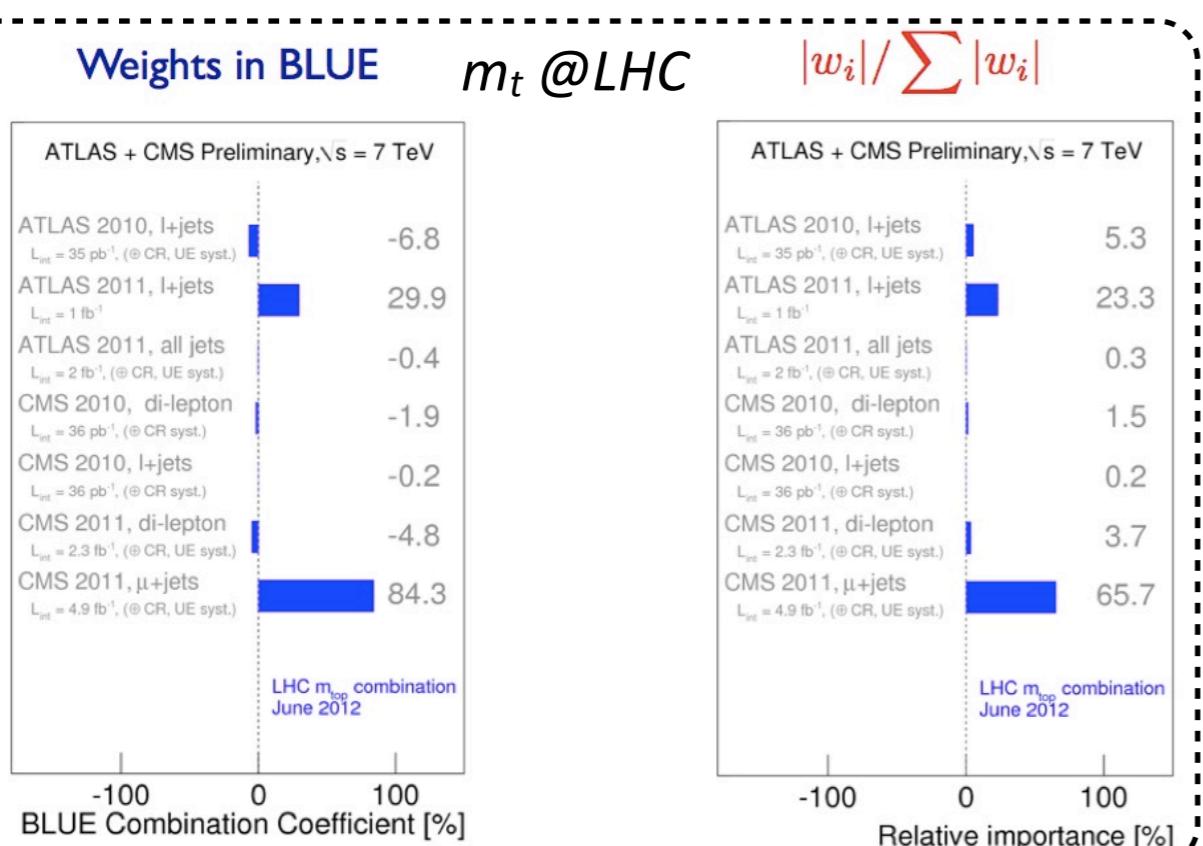
# Combinazioni

Importante sforzo nella definizione e nel trattamento comune delle sistematiche (TOPLHCWG)

- $m_t$ : combinato 9% più preciso della misura più precisa ne vale davvero la pena!

Definizione di cosa sia ciascuna sistematica

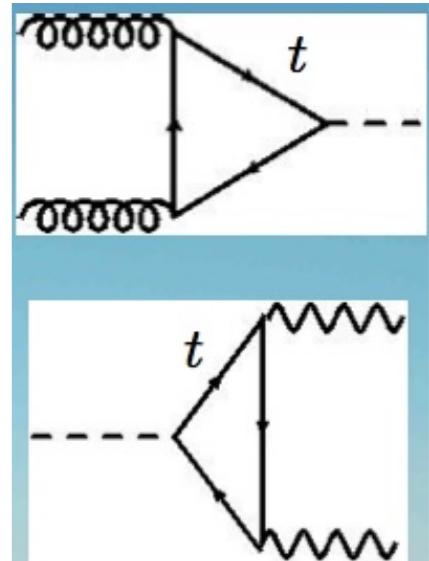
Correlazione 0% oppure 100% estremi, “tuning 4 precision”



- Best Linear Unbiased Estimator (BLUE)
  - calcola pesi della somma lineare
  - tiene conto delle syst (gauss) e delle correlazioni [0-1]
  - anche per N parametri (distribuzioni differenziali!)

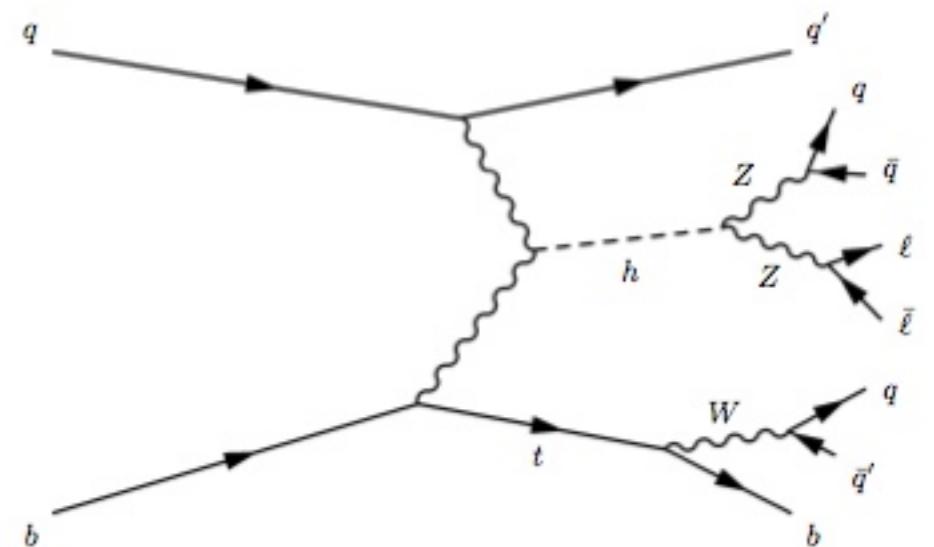
top e Higgs

# Top & Higgs



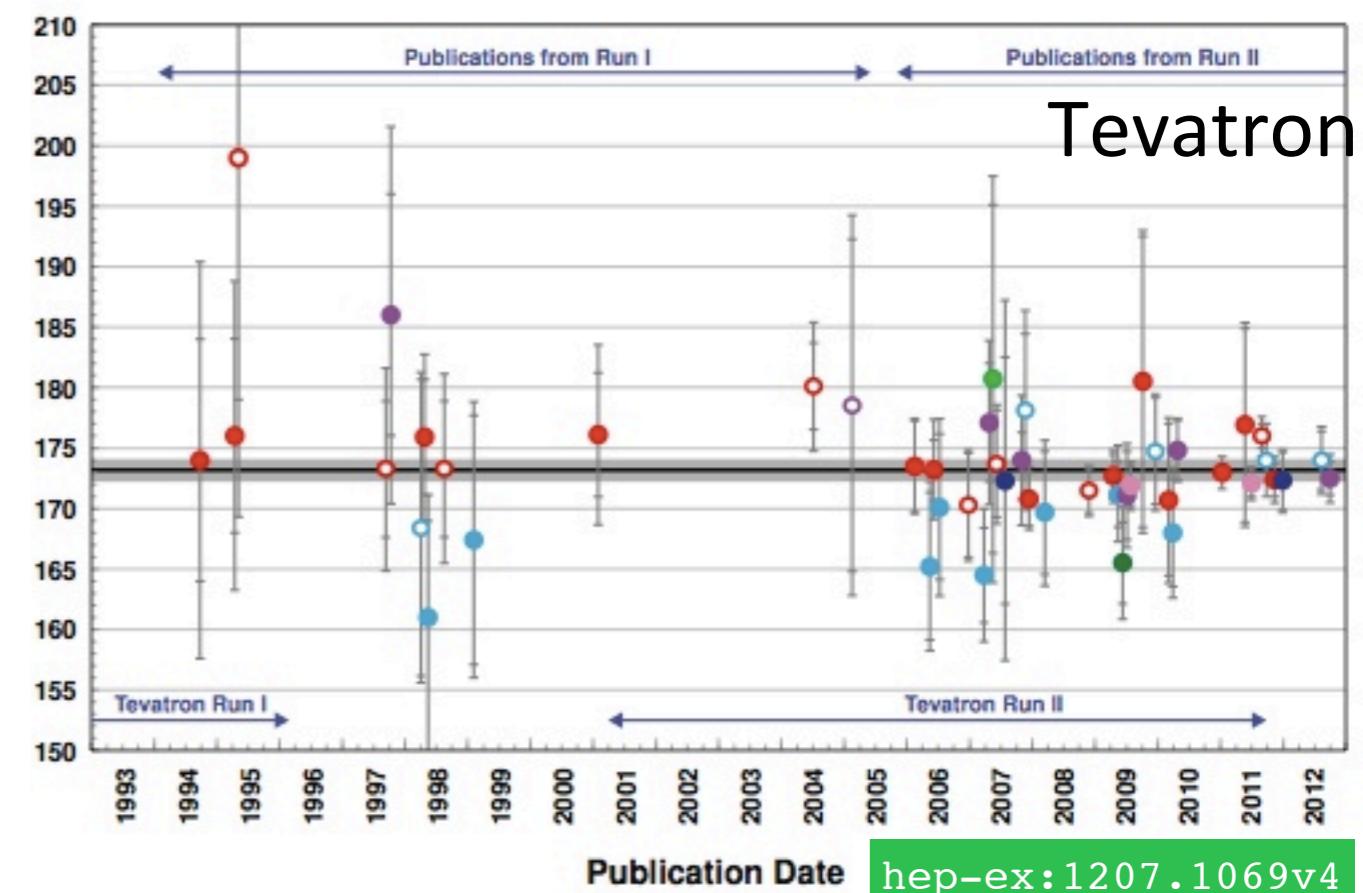
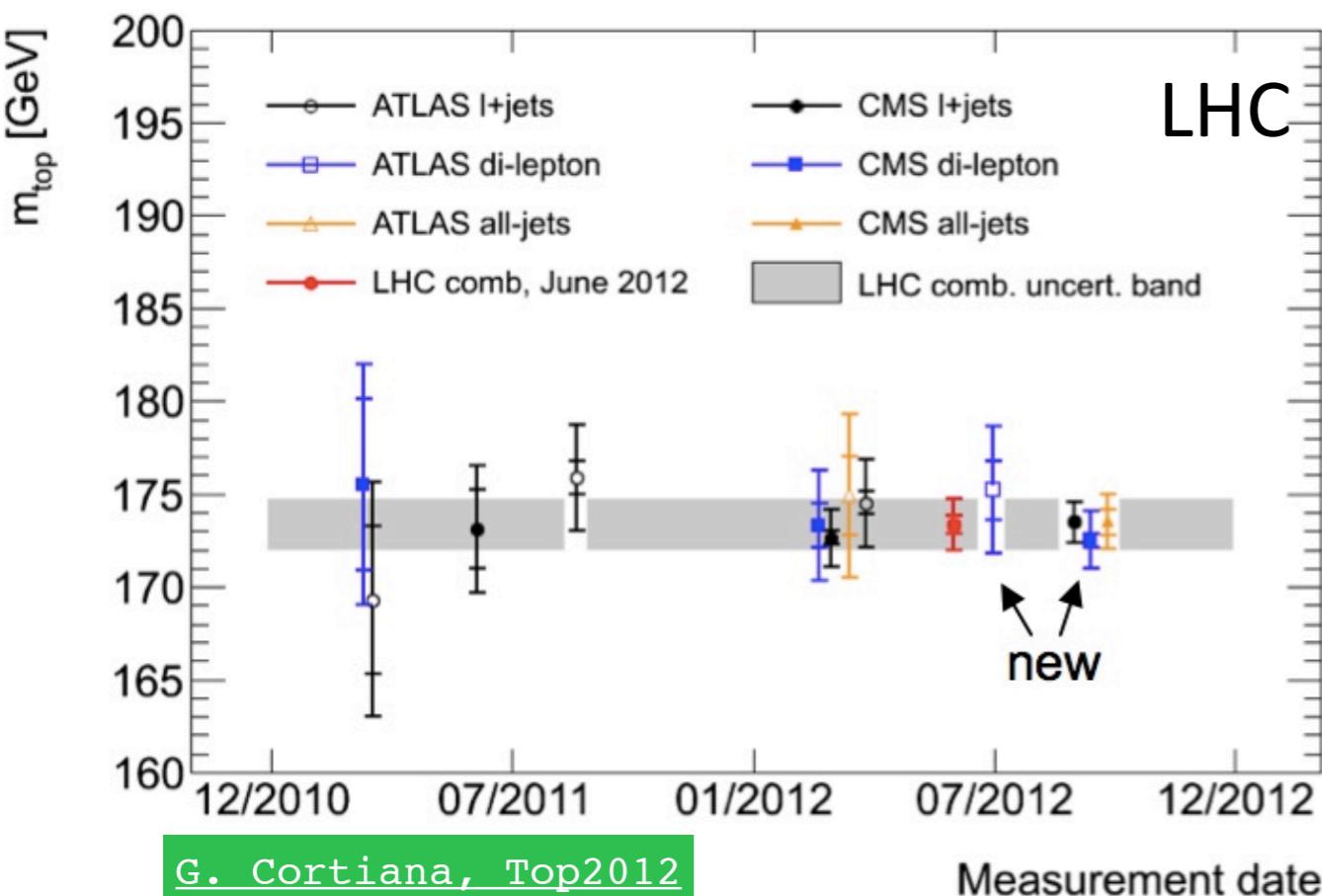
- $h \rightarrow \gamma\gamma$  in eccesso (ATLAS)?
  - top loop + fermioni BSM?
- top yukawa coupling: misure difficili a LHC [fb]:
  - ttbar:  $pp \rightarrow tth, h \rightarrow bb$  (sinergia: boosted!)
  - single top:  $pp \rightarrow h t q$

	$tjh$	$\bar{t}jh$	$tW^-h$	$\bar{t}W^+h$	$tbh$	$\bar{t}bh$	$t\bar{t}h$	
$m_h = 120$ GeV	45	23	9.0	9.0	1.6	0.8	440	fb
$m_h = 150$ GeV	33	19	5.0	5.0	1.0	0.5	240	
$m_h = 180$ GeV	31	16	3.0	3.0	0.6	0.3	140	
$m_h = 200$ GeV	29	15	2.4	2.4	0.5	0.2	100	

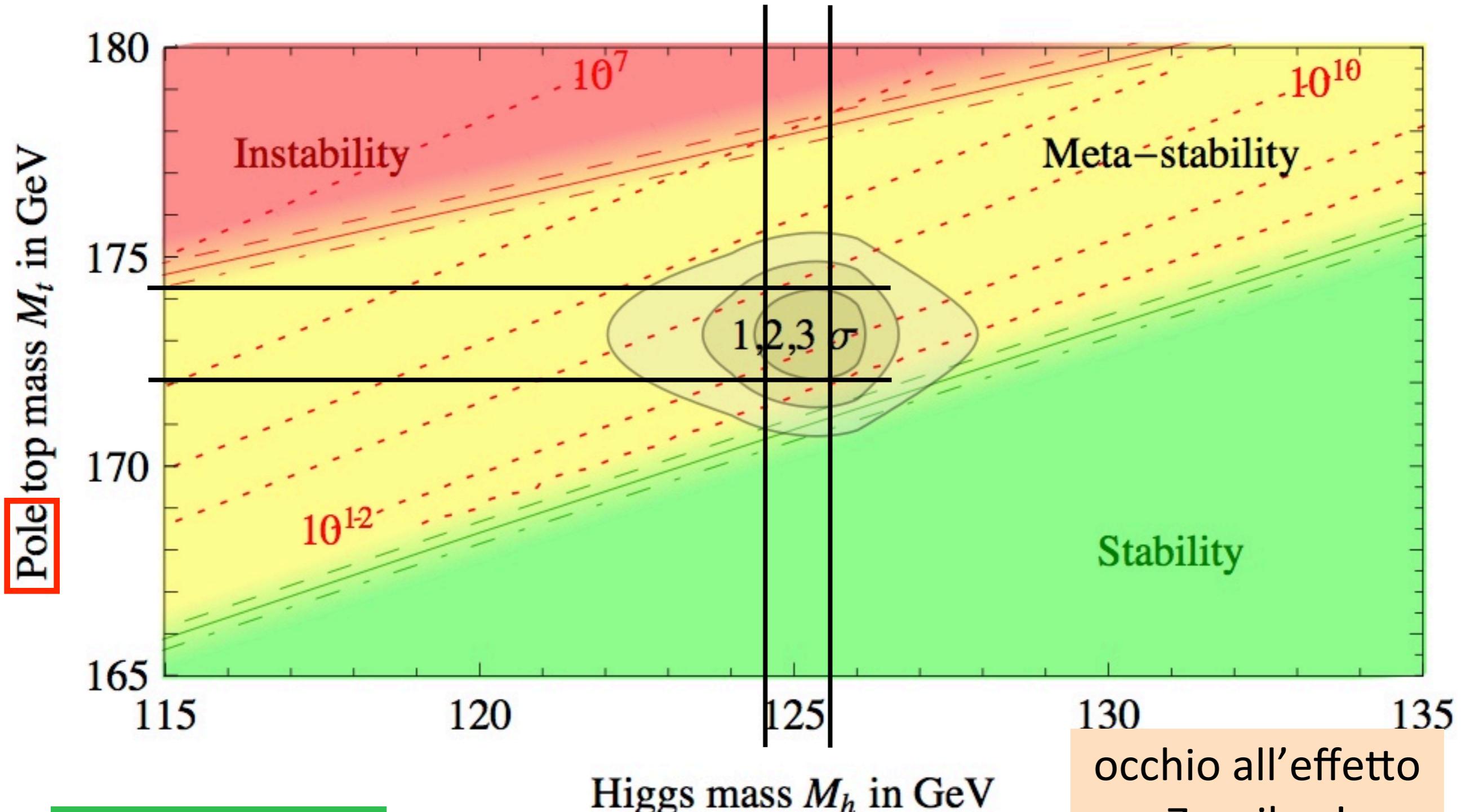


Barger et al. 0911.1556  
Maltoni et al. hep-ph/016293

- Incertezza  $\sim 0.9$  GeV su  $m_t$  si traduce in
  - sezione d'urto: <1%
  - charge asymmetry: 25% total syst
  - spin correlation: 4% total syst
  - W helicity: 20-30% total syst
  - Higgs mass (ora nota con  $\delta \sim 0.5$  GeV)

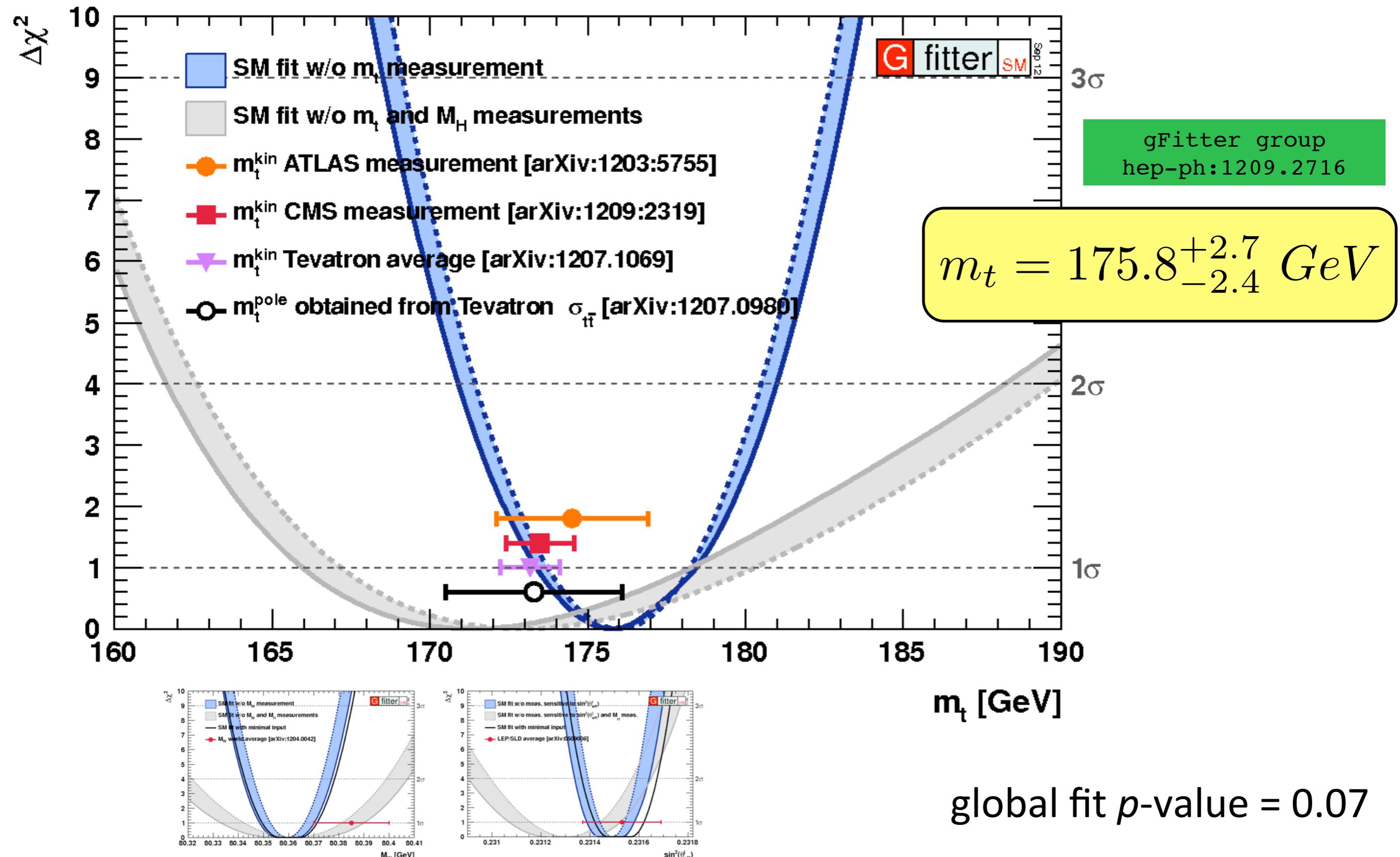


- $m_H \rightarrow m_t$  ?  $\Delta m_H \sim 0.5 \text{ GeV} \Rightarrow \Delta m_t \gtrsim 1 \text{ GeV}$



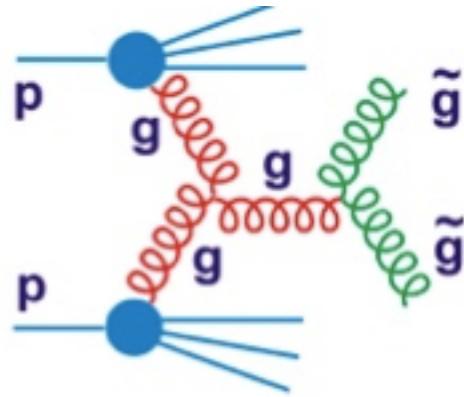
occhio all'effetto  
Zanzibar!  
 $m_H \rightarrow m_t \rightarrow m_H$

# Overconstraining the SM



top come  
luminometro per  
gluoni

# Parton Density Functions



standard model: higgs

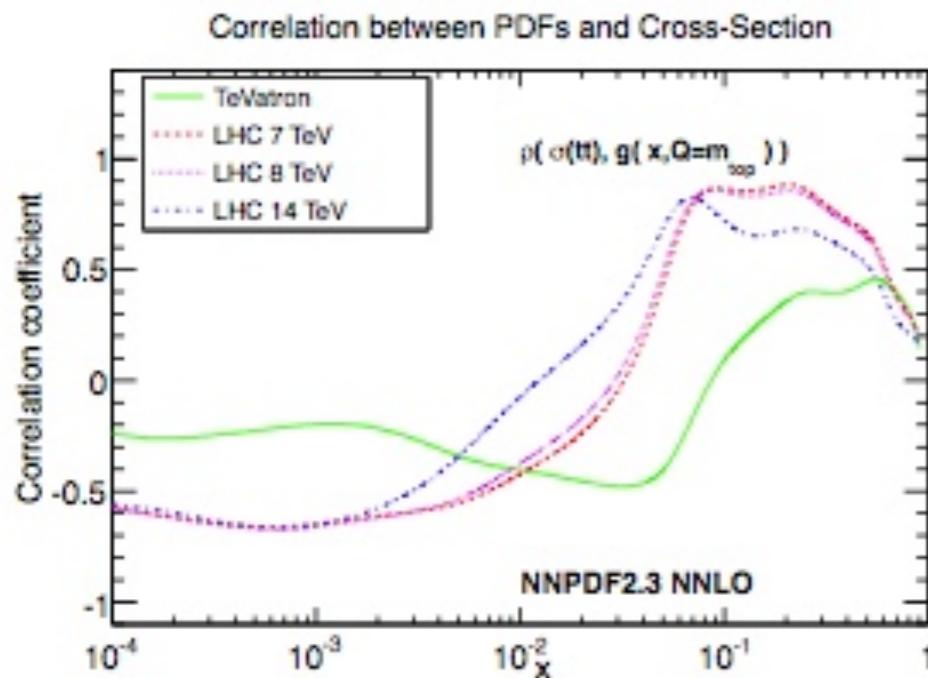
nuova fisica: produzione gluini

$g(x)$  poco vincolata  $s^{\hat{h}at} > 1 \text{ TeV}$

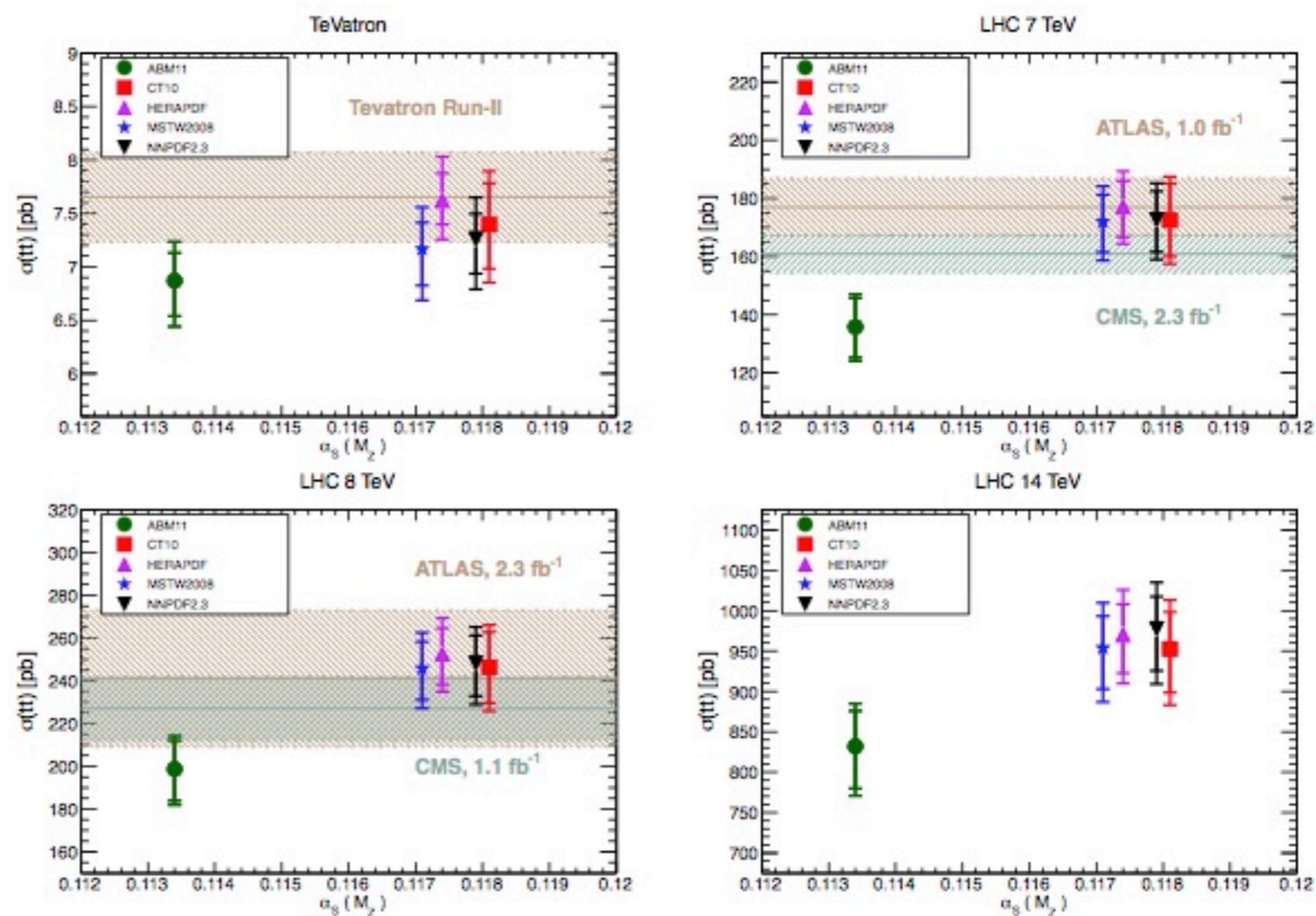
- PDF4LHC: confronto tra MSTW08, NNPDF2.3, CT10
- Si traduce in una incertezza di...
  - sezione d'urto  $t\bar{t}$  incl: 1-3%
  - sezione d'urto  $t\bar{t}+j$ : < 1%
  - massa: 0.1 GeV
  - charge asymm: < 1%  $\Delta(\text{syst})$
  - spin correlation: 28%  $\Delta(\text{syst})$
  - W helicity 15-20%  $\Delta(\text{syst})$

# Sezione d'urto incl.

correlazione  $g(x)$  vs  $\sigma_{\text{incl}}$

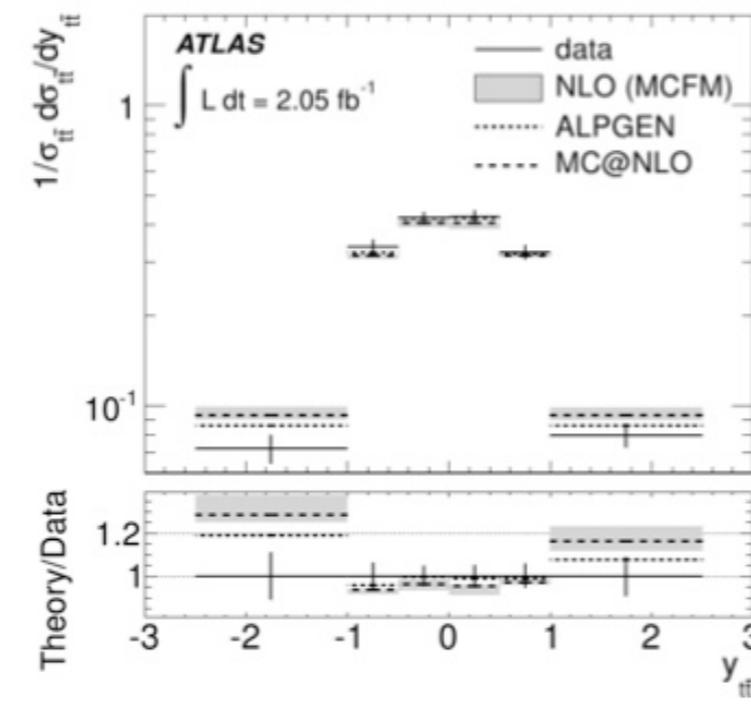
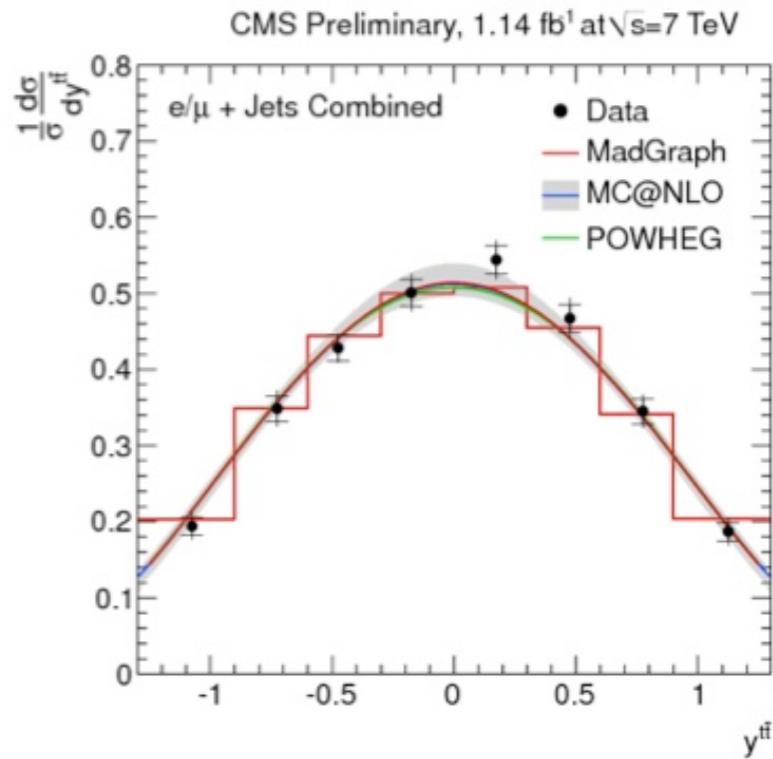
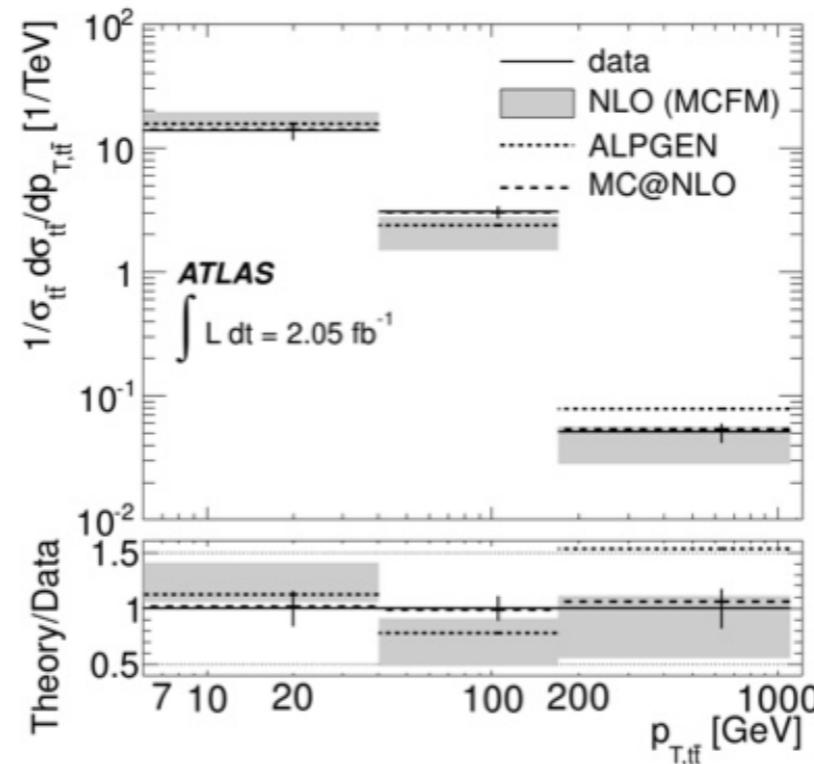
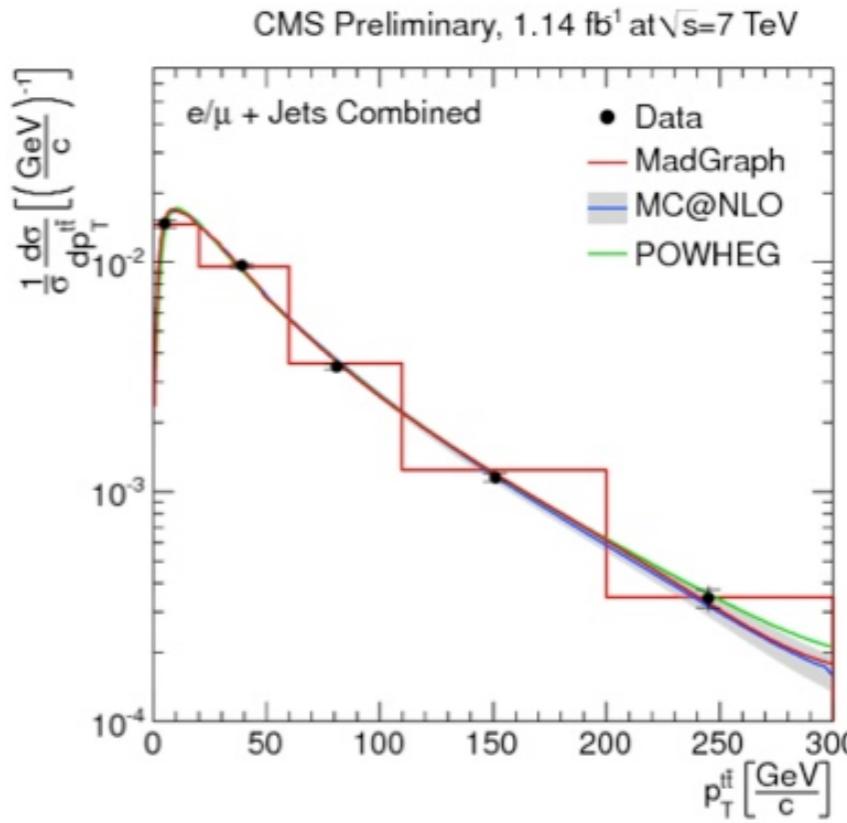


Czakon, Mangano, Mitov, Rojo  
arXiv:1303.7215v2



$\sigma_{\text{incl}}$  VS  $\alpha_s$

# Sezione d'urto diff.



sensibile a  
soft gluon

sensibile a  
 $g(x)$  ad alto  $x$

meccanismi di  
produzione

# Separazione gg/qq?

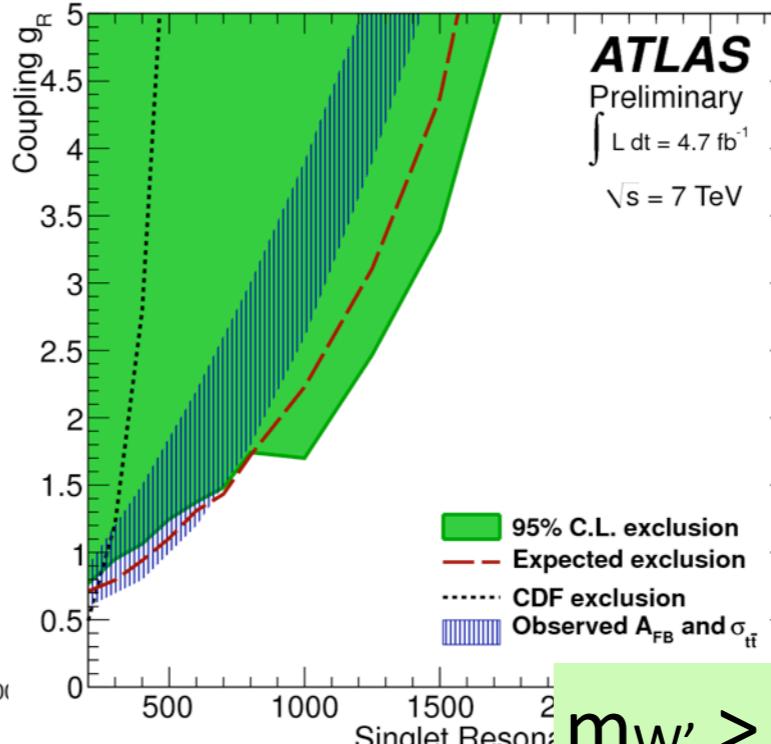
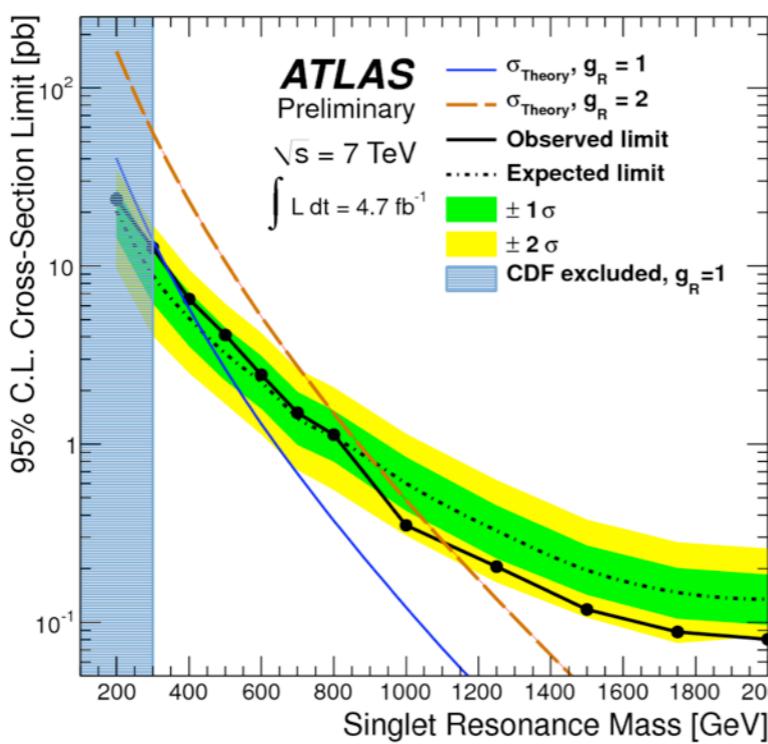
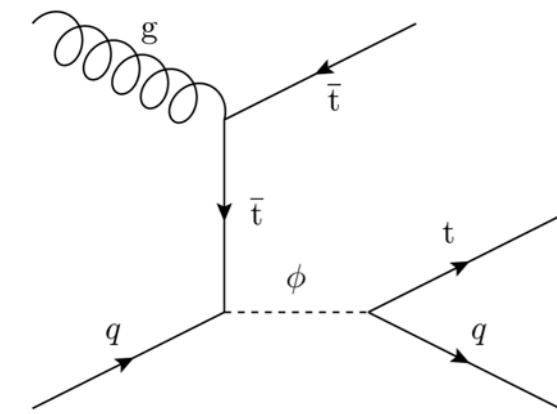
- Possibile? Non ben definita al NLO
- $A_{FB}$  @ Tevatron /  $A_C$  @ LHC
- $\sqrt{s} \nearrow$  S/B  $\nearrow$
- MVA:  $N_{jet}$ ,  $y_{jet}$ ,  $\eta_{lep}$ , event shape, ...



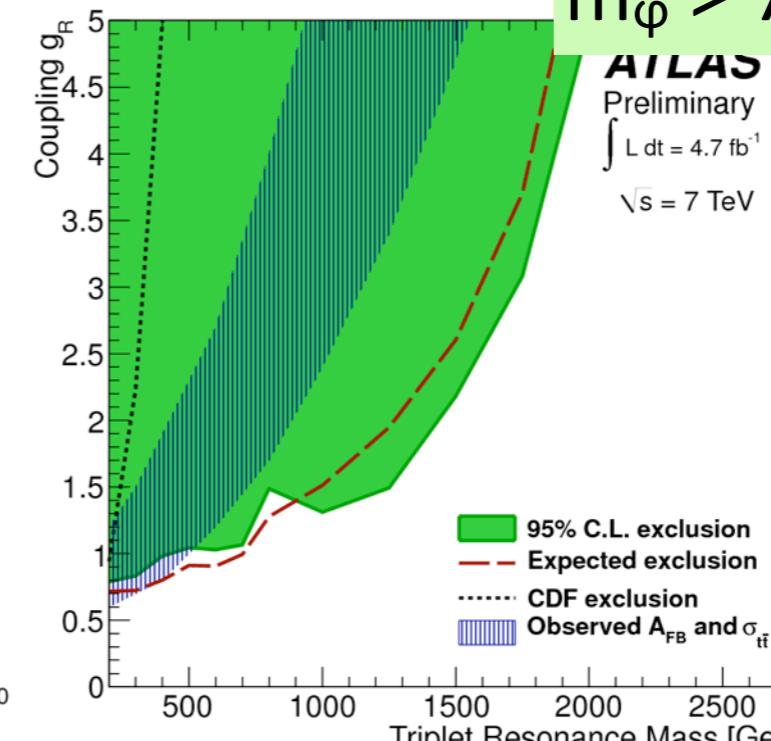
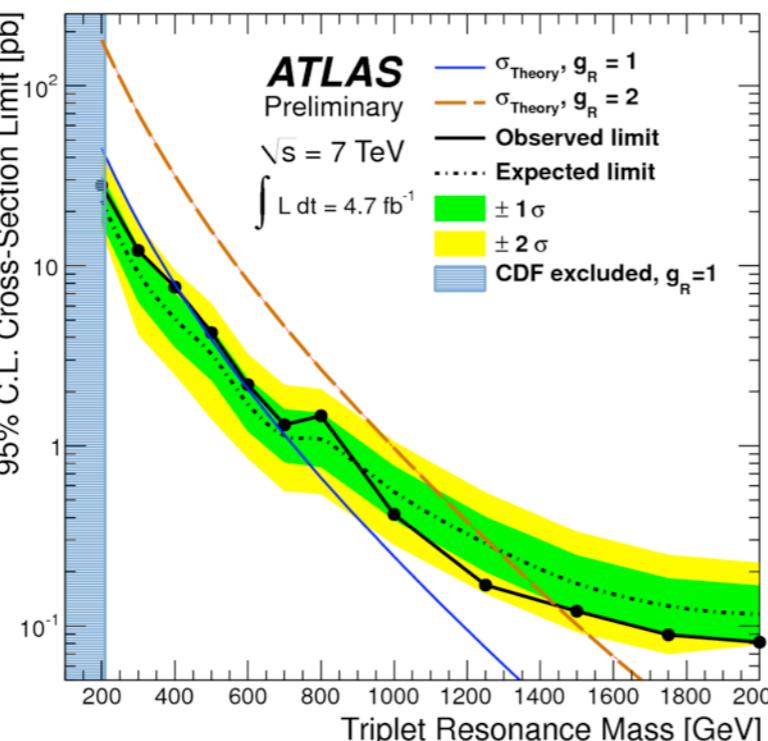
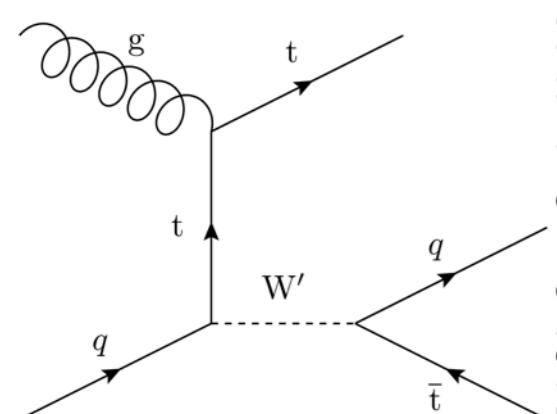
Even more  
material

# Risonanze tj

causa top quark  
charge asymmetry  
anomala?



$m_{W'} > 450 \text{ GeV } 95\% \text{ CL}$   
 $m_\phi > 700 \text{ GeV } 95\% \text{ CL}$

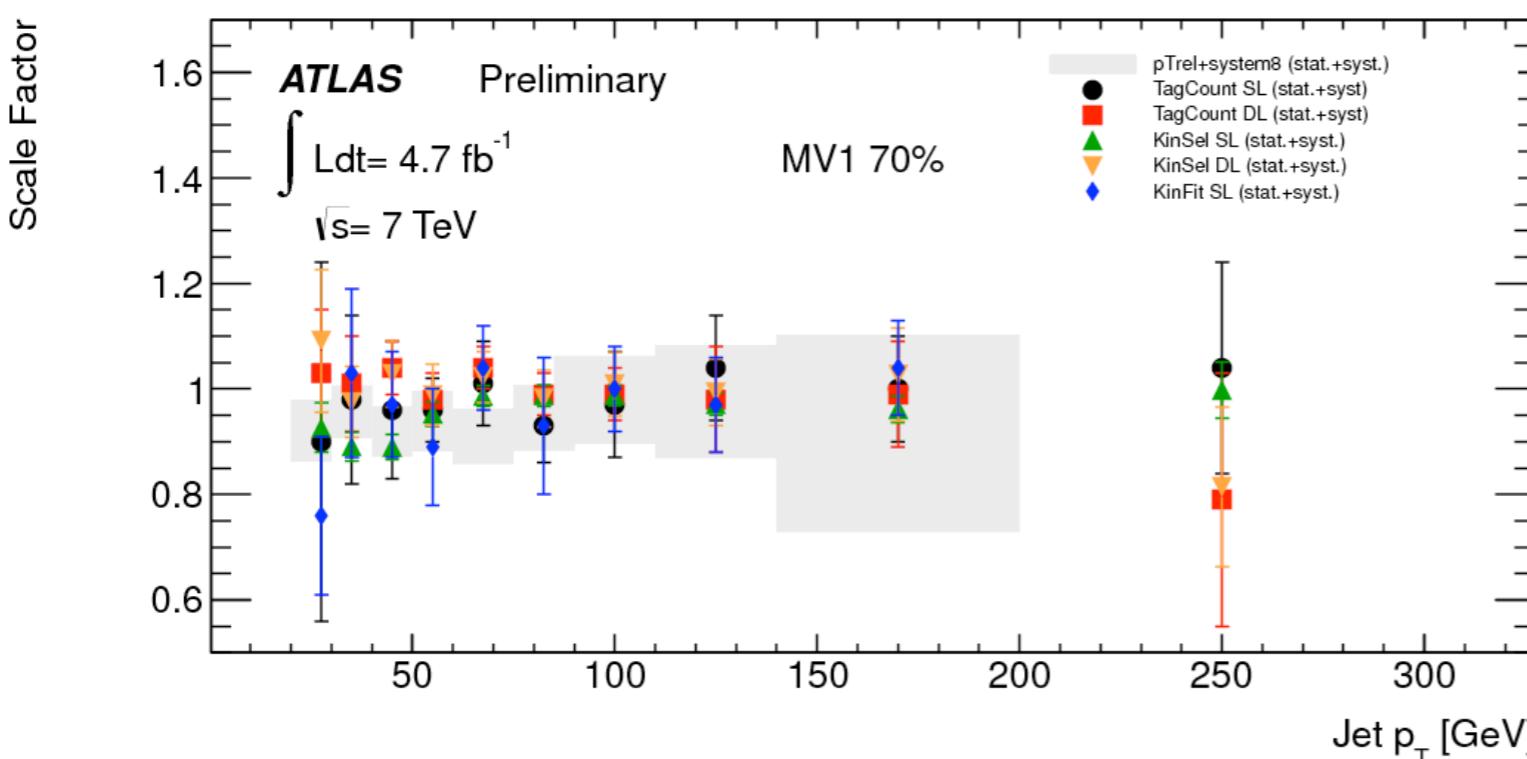


# b-Tagging

- fattori di correzione tra dati e MC
- ATLAS: 3 taggers + combinazione con NN

$$\kappa_{\varepsilon_b}^{\text{data/sim}}(p_T) = \frac{\varepsilon_b^{\text{data}}(p_T)}{\varepsilon_b^{\text{sim}}(p_T)},$$

<b>tag countin</b>	fit molteplicità b-jet	I+jets	IIbb
<b>kin selection</b>	b-tag rate dal jet più duro	I+jets	IIbb
<b>kin fit</b>	fit completo topologia tt		IIbb



# Backgrounds

Channel	Topology	Backgrounds
Di-leptonic	$2 b\text{-jets} + 2l^\pm + \mathcal{E}_T^{\text{miss}}$	$WW + \text{jets}, Z + \text{jets}$
Semi-leptonic	$2 \text{jets} + 2 b\text{-jets} + l^\pm + \mathcal{E}_T^{\text{miss}}$	$W + \text{jets}$
Full-hadronic	$4 \text{jets} + 2 b\text{-jets}$	QCD Multi-jet

