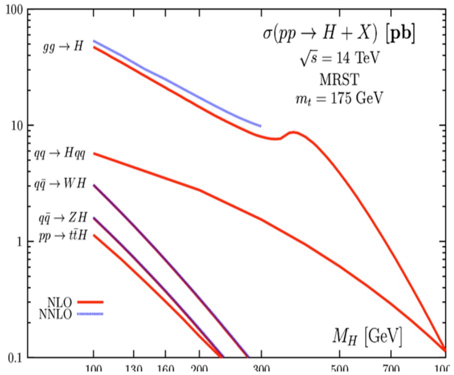
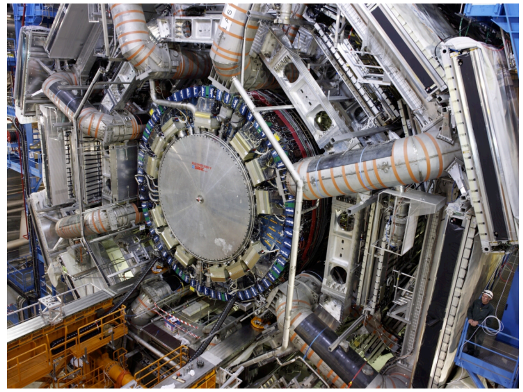
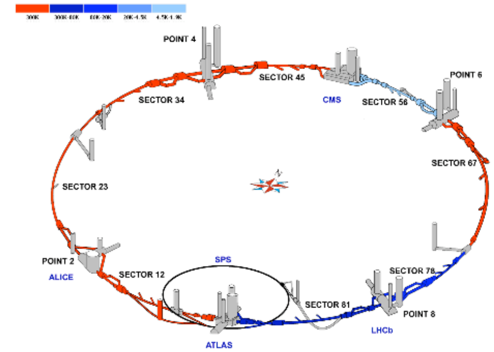


Search for a light SM Higgs with ATLAS

Lorenzo Feligioni

LPC Clermont-Ferrand 21/03/2008

Outline

- Introduction
- Higgs Phenomenology at the LHC
- Experimental Setting
- Light Higgs Searches
  - *Benchmark Analyses:*
    - VBF ($H \rightarrow \tau\tau$)
    - $H \rightarrow \gamma\gamma$
    - ttH($H \rightarrow bb$)
- b-tagging calibration using first data
- Conclusions

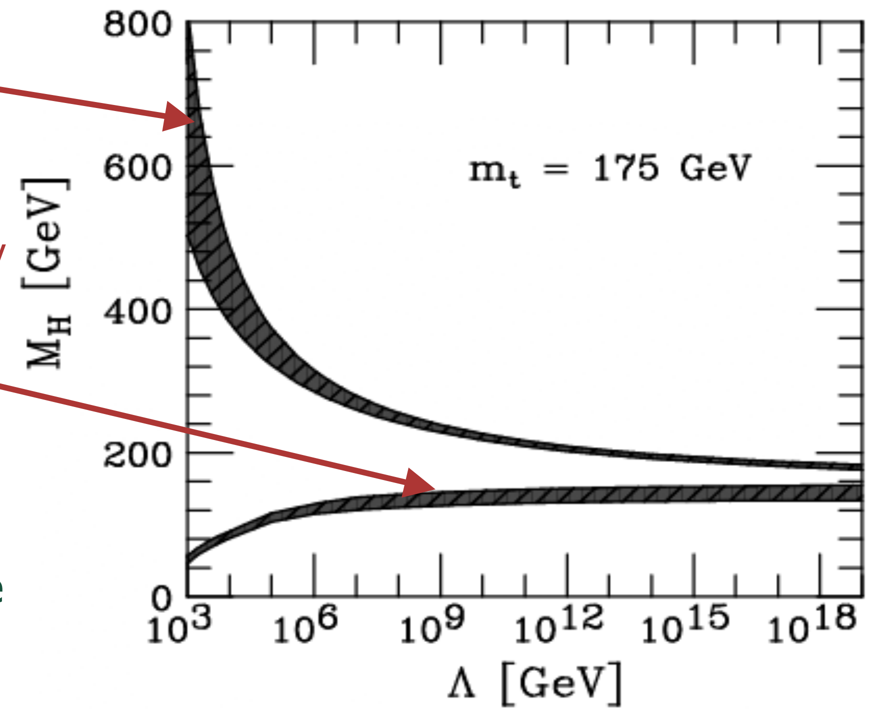
most presented results come from a recent effort on on re-evaluating ATLAS discovery potential (a.k.a. CSC) soon to be published

SM Higgs at the TeV scale

- Many theoretical arguments predict a Higgs mass at the TeV scale:
- WW scattering violates unitarity if only Z/γ are exchanged
  - For Higgs to be able to restore it at any s: $G_F m^2_H \sim< O(1)$
- Triviality bound:
  - Scalar sector is a ϕ^4 theory
    - Energy cut off Λ_C where SM is not trivial

    $\Rightarrow$ $\Lambda_C \sim 10^{16(3)}$GeV $\Rightarrow$ $m_H < 200(1000)$ GeV
- Vacuum stability bound:
  - Fermionic contributions could led to negative self coupling for too small λ
    - Vacuum not a minimum anymore

    $\Rightarrow$ $\Lambda_C \sim 10^{3(16)}$GeV $\Rightarrow$ m_H > 70 (130) GeV

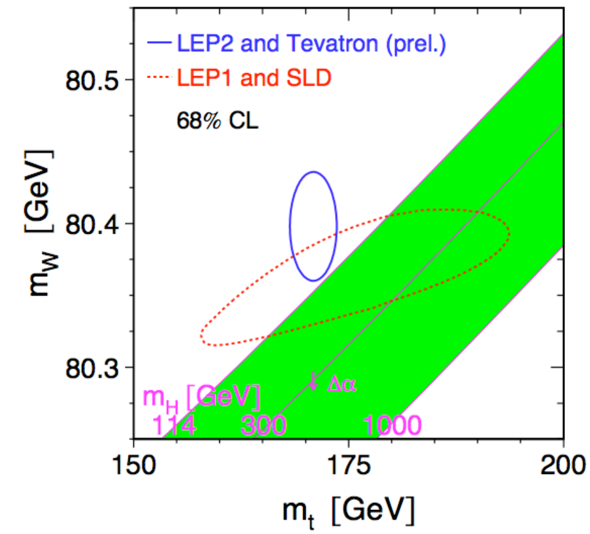


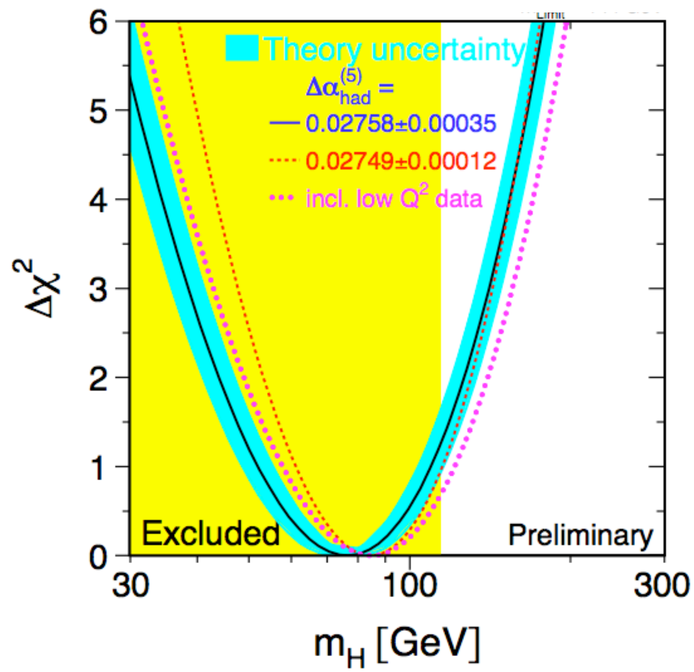
Why a SM Light Higgs

M. Gruenewald et. al

- Electroweak precision measurements
  - SM Higgs field contributes to radiative corrections for many EW observables
  - Fits of SLC, LEP and Tevatron EW measurements constrain m_H
- Latest results Winter 2007
  - $m_H = 76^{+36}_{-24}$ GeV
  - From EW fits only:
    $m_H < 144$ GeV @ 95% C.L.
  - Including LEP-2 direct searches
    $m_H < 182$ GeV @ 95% C.L.

⇒ *Light Higgs favorite scenario*





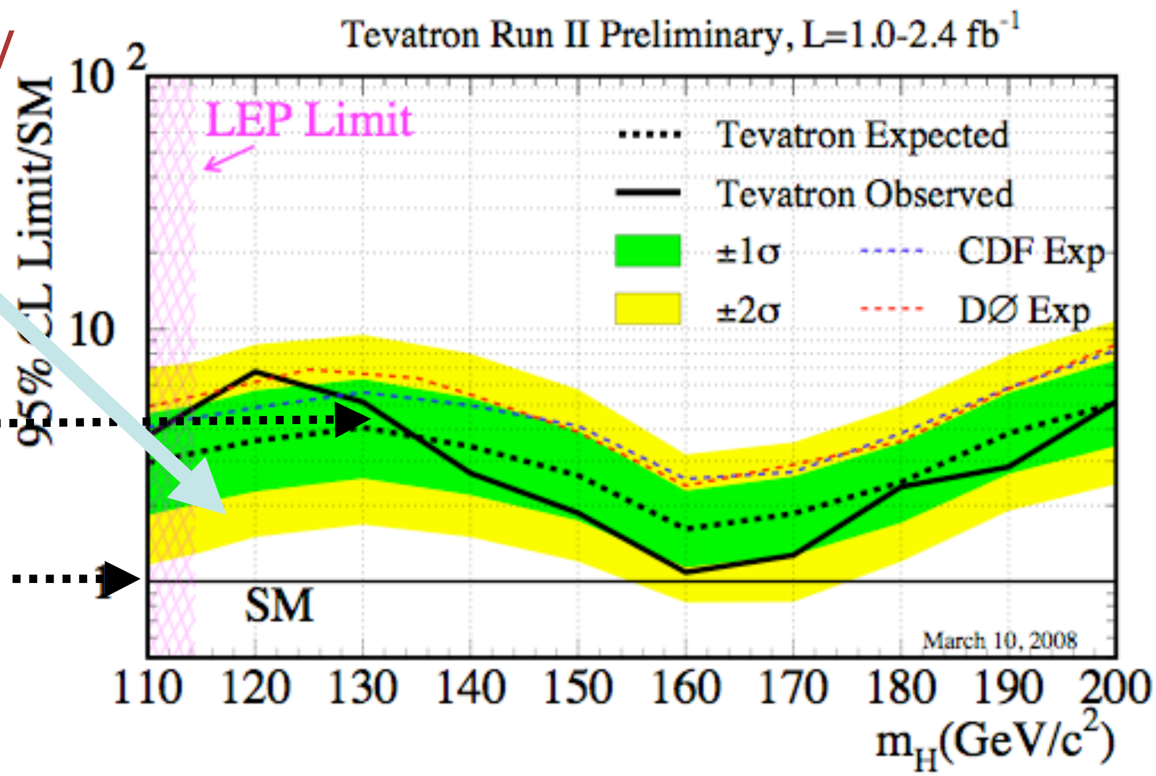
Current Experimental Limits

- LEP $m_H > 114.4$ GeV @95% CL
- Tevatron RunII combined results:
  - W(→lν)H(→bb,WW), Z(→ll,νν)H(→bb), H→WW
  - Update includes more final states
    - H→γγ, H→ττ
  - Best limit at 160 GeV

Light Higgs challenging even at the Tevatron

Tevatron limits

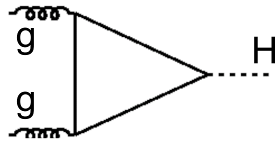
SM Higgs cross section

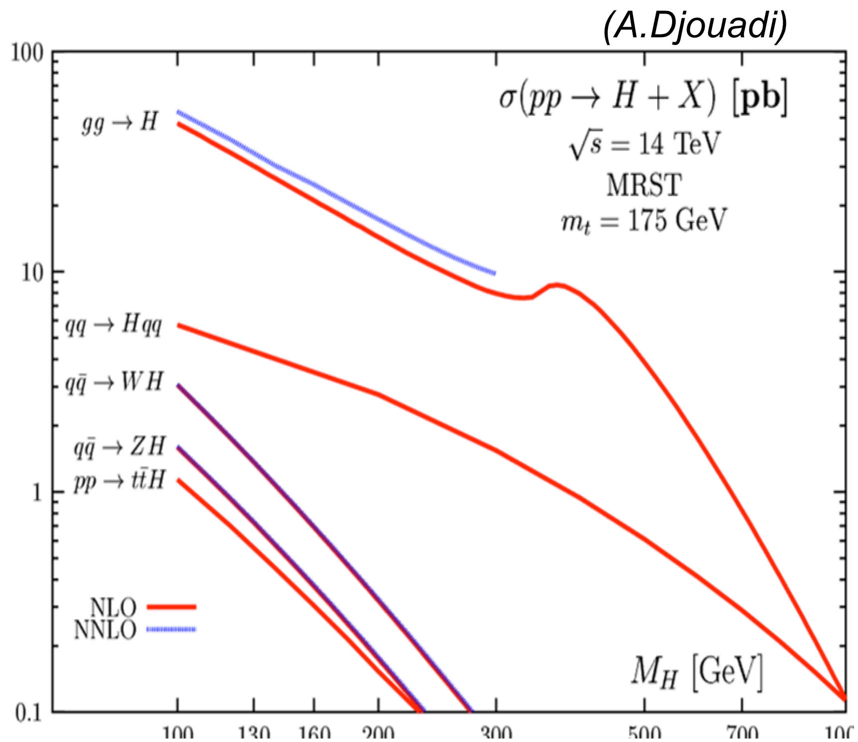



Higgs at the LHC
ATLAS

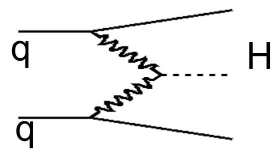
Higgs @ LHC: production

- Gluon Gluon fusion:
  - Dominant production mode
  - NLO correction important
    - K = 1.7
    - Main contribution is gluon radiation
      - many events with at least one jet
  - NNLO cross section known
    - Sig(NNLO)/Sig(NLO) = 1.3

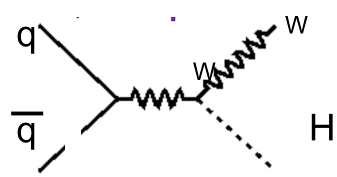


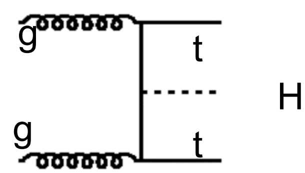


- Vector Boson Fusion:
  - small K factor ~ 1.1
    - Small jet multiplicity in final state
  - No color exchange between quarks
    - large energetic jets at small p_T
    - Low hadronic activity in central region from hard event
      - *a part from Higgs decay*



- Production with Gauge boson:
  - Known NNLO for QCD and EW corrections
- Production with heavy quarks:
  - More complicated final state
  - More than 10 diagrams, known at NLO



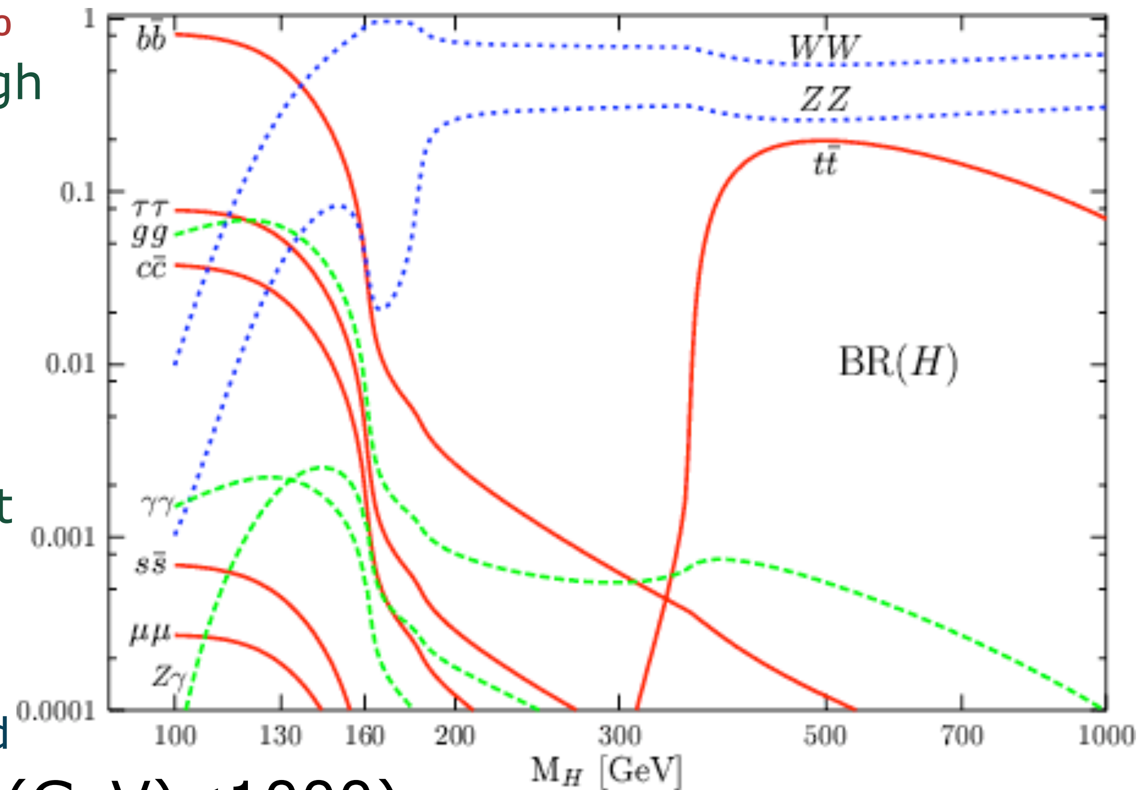


Typical uncertainties on cross-sections

- gg 10-20 % (NNLO)
- VBF ~ 5% (NLO)
- WH,ZH ~< 5% (NNLO)
- ttH 10-20 % (NLO)

Higgs Decay

- Light Higgs ($110<m_H$(GeV)<130)
  - Dominant mode is H→bb (75-50%)
  - H→ττ and cc with 3--7%
  - Higgs decay to γγ through loop of massive particle ~ few permil
  - H→VV$^{(*)}$ rises close to 130 GeV
- Intermediate Higgs ($130<m_H$(GeV)<180)
  - H→VV$^{(*)}$ most important decay mode
    - H→ZZ$^{(*)}$ decreases when 2 on shell W bosons can be produced



- Heavy Higgs ($180<m_H$(GeV)<1000)
  - H→VV
  - For m_H~400 GeV the decay in two top quarks also plays a role
- *All BR calculated at NLO, error within few %*

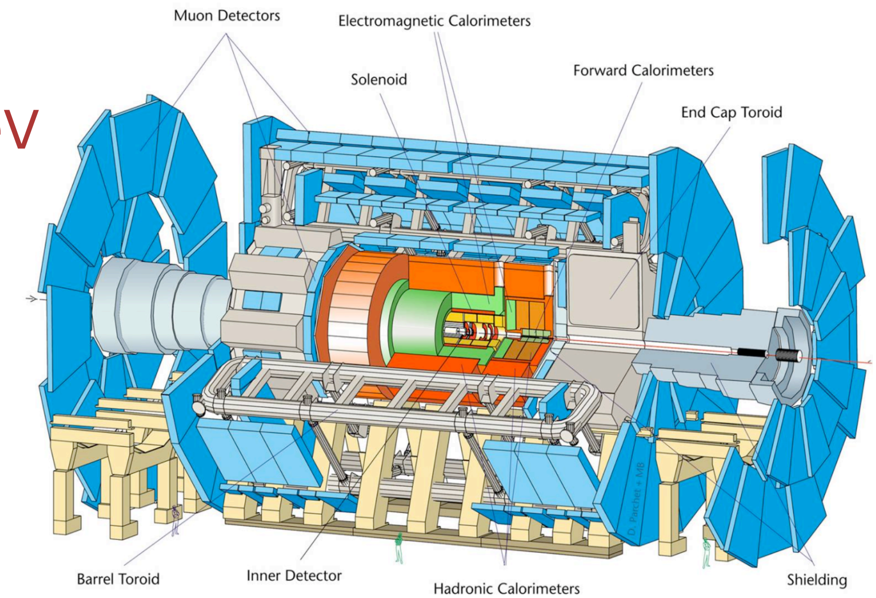
Experimental Setting

LHC:

- Proton-Proton collisions @ 14 TeV
- First run in 2008 (10 TeV?)
- Luminosity:
  - Low luminosity ~10^{33}cm^{-2}s^{-1}

  ⇒ *~ 30 fb^{-1} between 2008 and 2010/2011*
  - High Luminosity ~10^{34}cm^{-2}s^{-1}

  ⇒ *~300 fb^{-1} by 2014/2015*
- Pile-up:
  - ~ 2 (low luminosity) to 20 (high luminosity) pp interactions ("minimum bias") per bunch crossing (every 25 ns)
- Trigger to go from 40 MHz interaction rate to ~200Hz to disk for offline analysis



ATLAS:

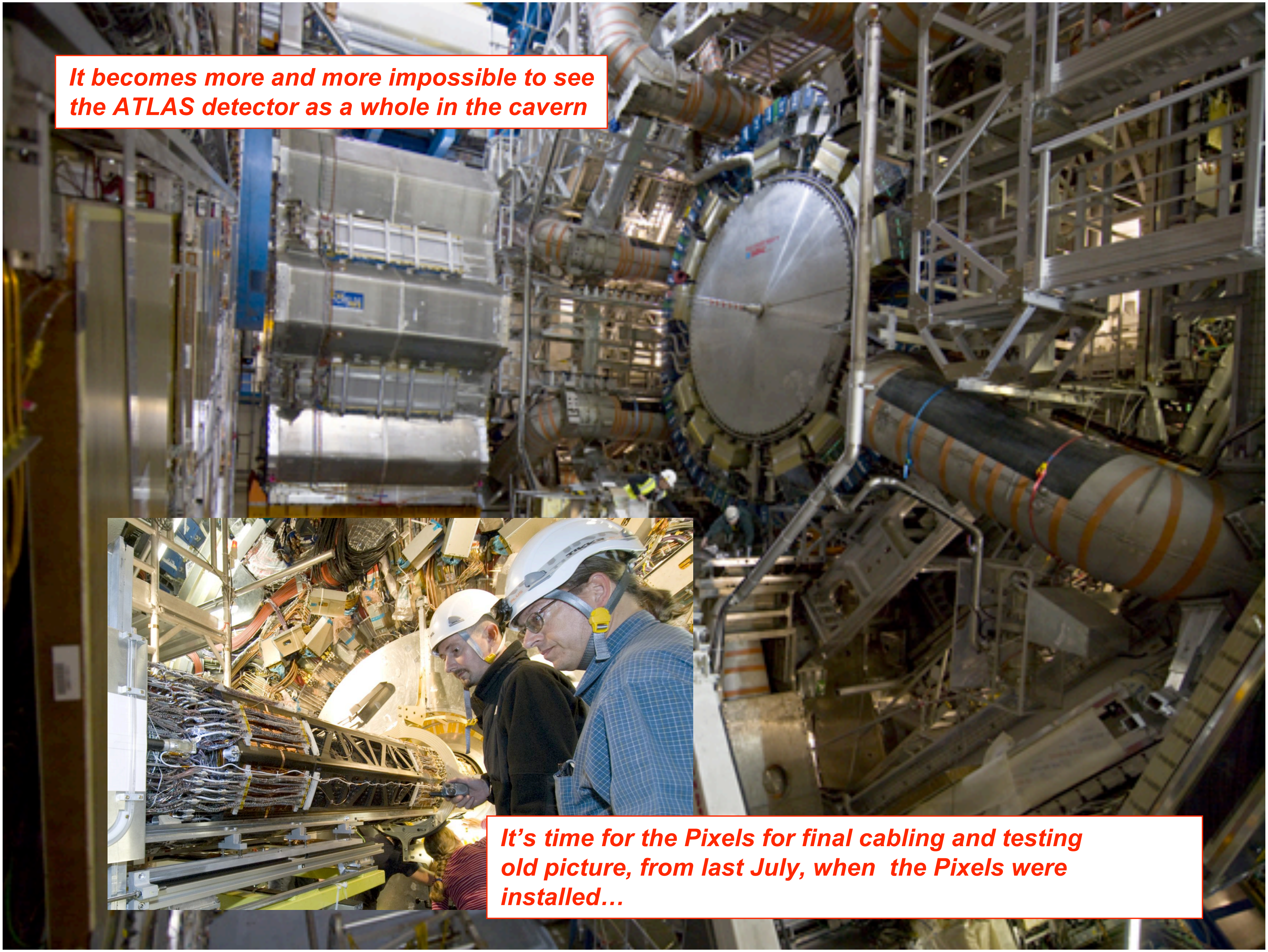
Powerful e/γ/μ/τ/b identification

- Photon ID: eff~80%, R(jet)~10^3
- Electron ID: eff~80%, R(jet)~10^5
- b ID: eff~60%, R(light jet)~100
- τ→hadrons: eff~50% R(jet)~100

Good energy measurement of e/γ,μ,jets

- ~1-2% for $p_T(e)$~25-50 GeV
- 5% initial JES scale uncert (aimed at 1% after in situ calibration)

It becomes more and more impossible to see the ATLAS detector as a whole in the cavern



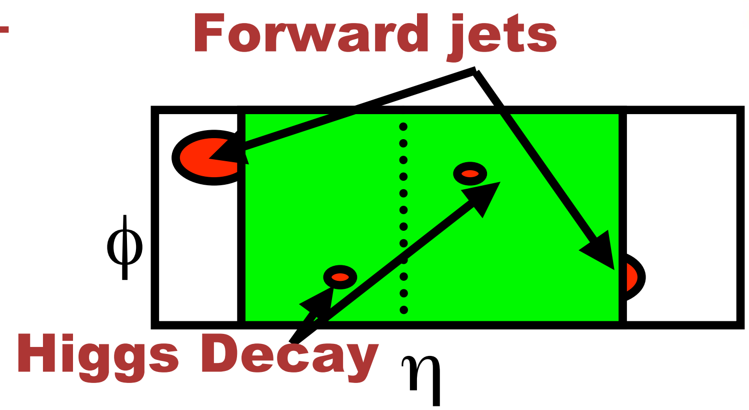
It's time for the Pixels for final cabling and testing
old picture, from last July, when the Pixels were installed…

Benchmark Analyses

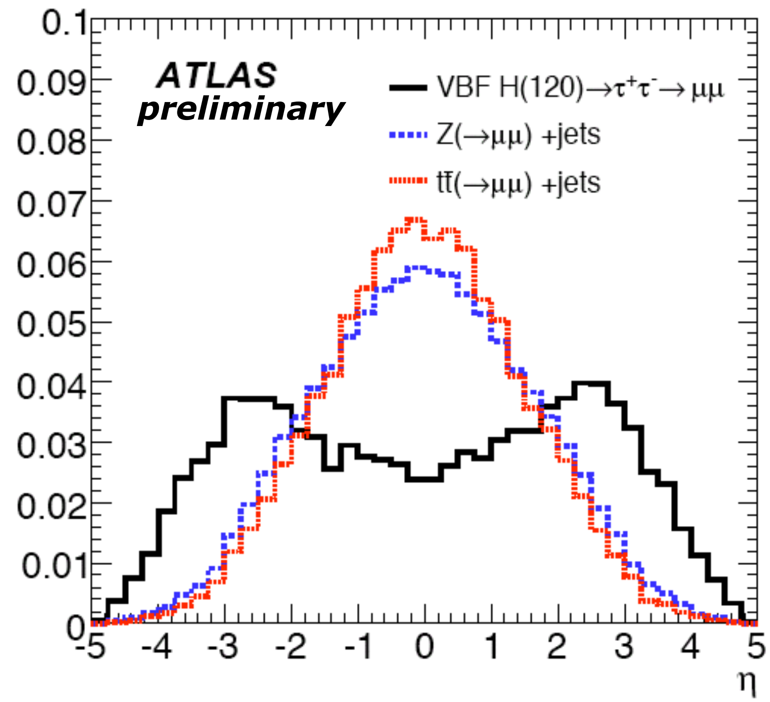
- VBF ($H \rightarrow \tau\tau$)
- $H \rightarrow \gamma\gamma$
- ttH($H \rightarrow bb$)

VBF

- Signal:
  - $qqH \rightarrow qq\tau\tau$
  - Forward tagging jets:
    - energetic jets at high η
  - No color flow between initial partons
    - No jet radiation
    - Central Jet Veto
- Backgrounds:
  - QCD Z/γ + jet
    - Big cross section at LHC
    - Central jet veto reduce this background by 70%
      - Veto can be checked in $Z \rightarrow ee(\mu\mu)$ events (no signal)
  - top quark:
    - Presence of b-quark can mimic signal even at LO
    - In tracker fiducial region b-tag veto

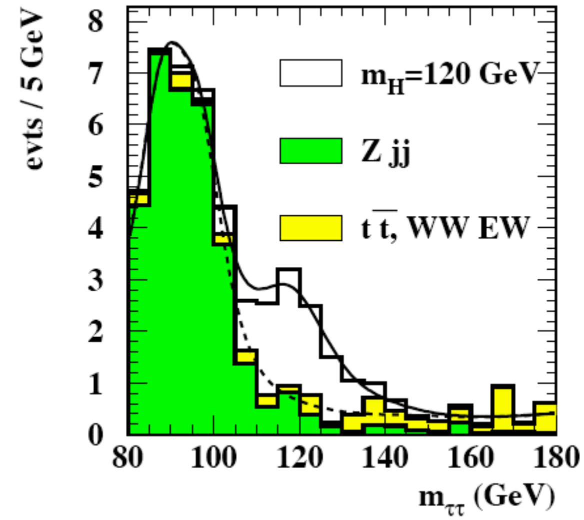


Pseudorapidity of leading jet

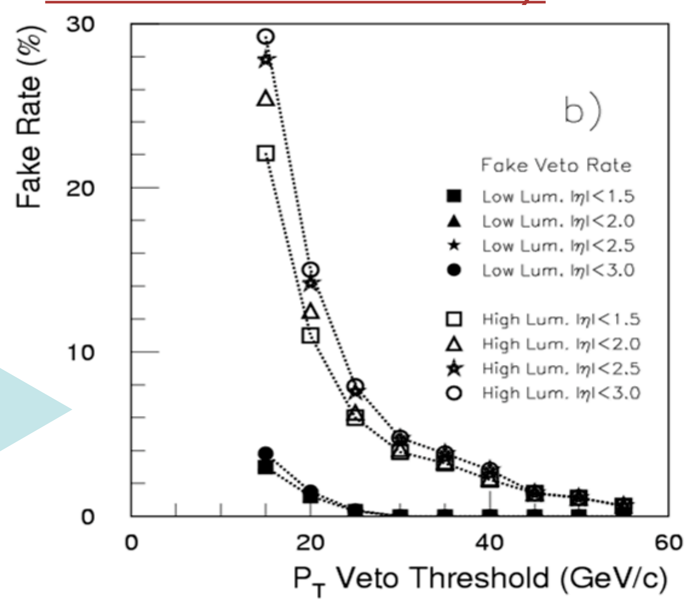


VBF: H→ττ

- Analysis:
  - 2 tagging jets
  - Higgs decay products in central region between tagging jets
    - Jet veto
  - Final states with two central τ's
    1. Dilepton decay
    2. lepton-hadron decay
    3. Hadron-hadron decay
  - M(ττ) reconstruction:
    - Use missing transverse momentum + collinear approximation of τ decays
    - Resolution limited by missing E_T
- Low Luminosity Analysis
  - Jet veto sensitive to pile-up effects

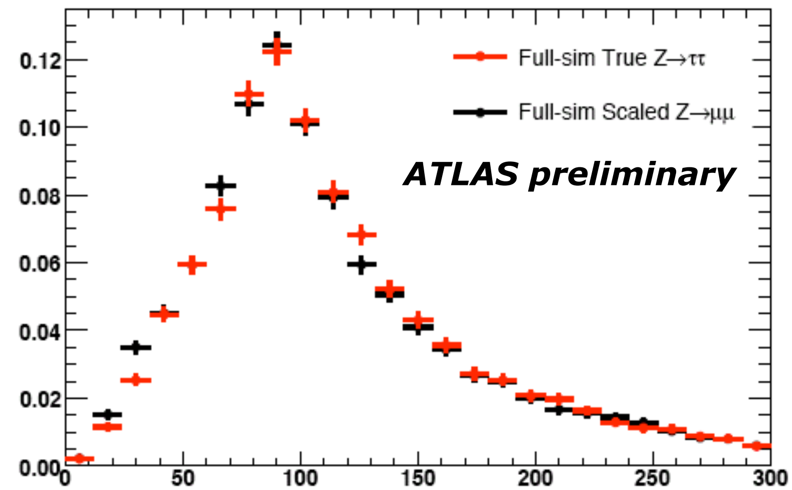


Probability of finding a central Jet as a function of p_T treshold For different luminosity

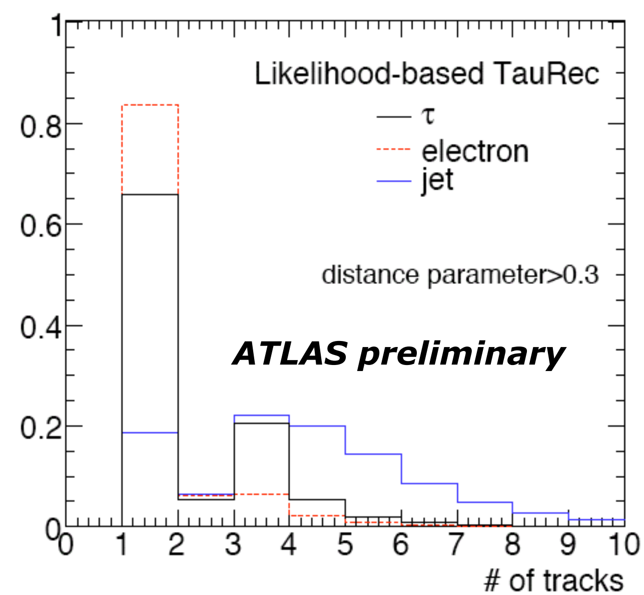


VBF: background estimation

- Progress have been made on data driven background estimation
- $Z\rightarrow\tau\tau$ mass shape is fundamental in order to extract signal in the high-side tail
  - Mis-measurement of missing transverse energy
    - Correlated to effects due to presence of high eta tagging jets
  - Extracted from $Z\rightarrow\mu\mu$+jets events
- QCD background in lep-hadron channel
  - QCD contribution for τ-candidates extracted from track multiplicity
- Global fit of $M(\tau\tau)$ and background contributions
  - *with no pile up indication of discovery with 30 fb^{-1} in m_H 115-130 GeV*



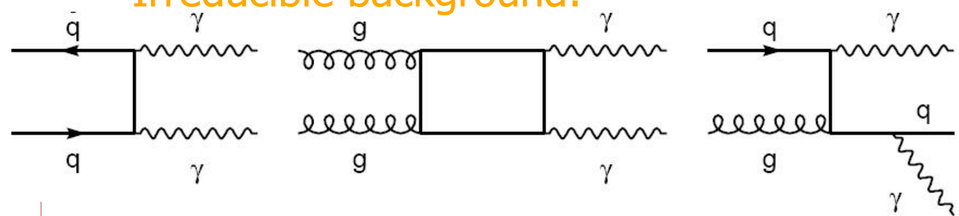
Track density around τ-candidates



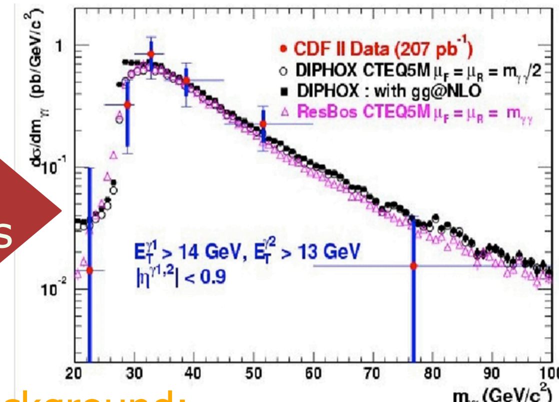
H→γγ

- H→γγ:
  - Looking for a mass peak:
    - two high p_T photons
  - $m^2_{\gamma\gamma}=E_1E_2(1-\cos\vartheta_{12})$
    - Low mass: intrinsic width negligible
  - Recovery of conversion
    - ~60% conversion in the tracker:
      - possibly reconstructed
- Irreducible background:
  - Diphoton background:
    - now computed at NLO
    - Computation agrees with Tevatron data
- Reducible Background:
  - Large cross section
    - Isolation criteria:
    - Need good π^0 rejection
    - π^0 tend not to take all parton energy

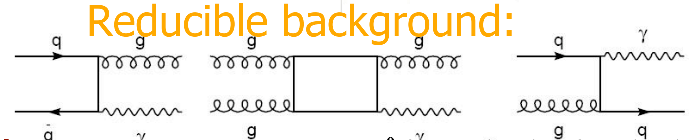
Irreducible background:



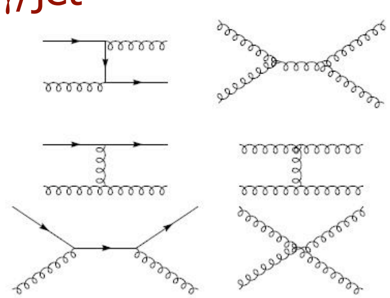
γγ prod
Tevatron results



Reducible background:

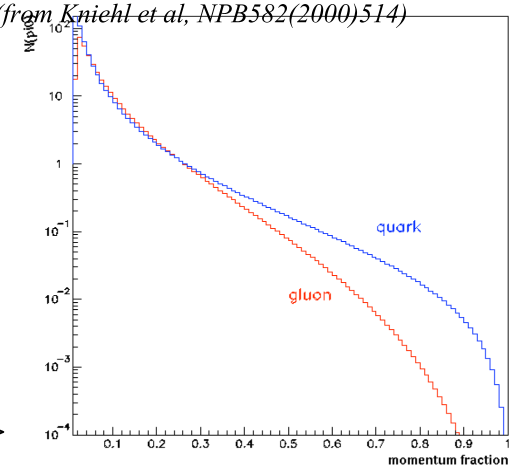


γ/jet



+[…] jet/jet

π^0 fragmentation function in quark and gluon jet
(from Kniehl et al, NPB582(2000)514)

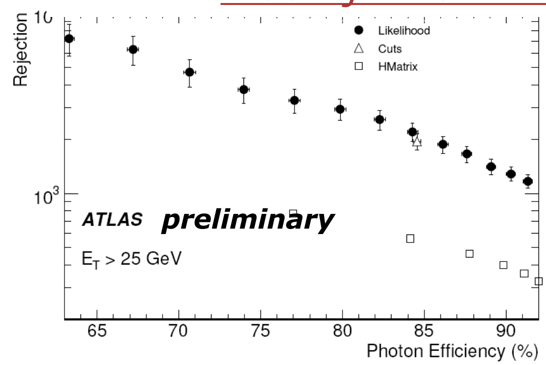


Jets in γ/jet events initiated by quarks ⇒ higher fake rate

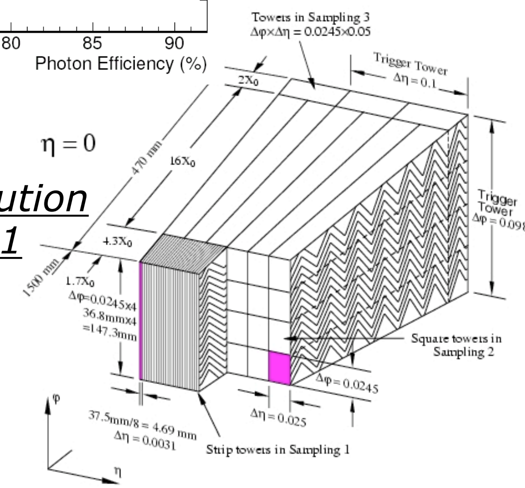
H→γγ: photon ID

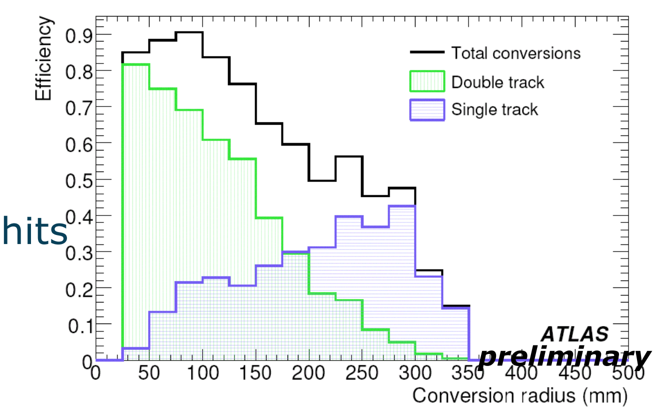
- Photon identification cuts
  - Isolated π^0 main source of background
  - Among shower shapes variables:
    - transverse size in 1st EM layer
    - Search for a second max in η
- Photon reconstruction and calibration
  - Converted photon ⇒ bigger cluster
    - opening of the two electron due to the magnetic field
  - Two categories of converted photons
    - double track conversion
      - reconstructed vertex
    - Single track conversion
      - no innermost pixel layer hits
    - Efficiency for early conversion of about 66%

Quark-jet rejection ~2700 (P_T> 25 GeV)
Gluon-jet 10 times higher



Good angular resolution
Strip Cal $\Delta\eta$=0.0031



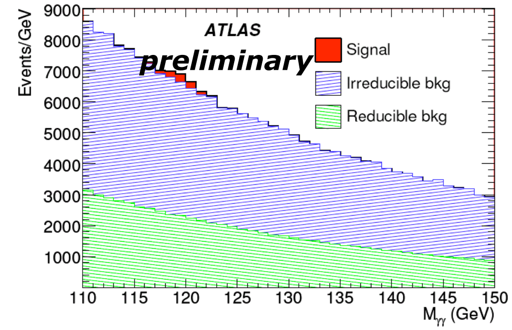


H→γγ analysis categories

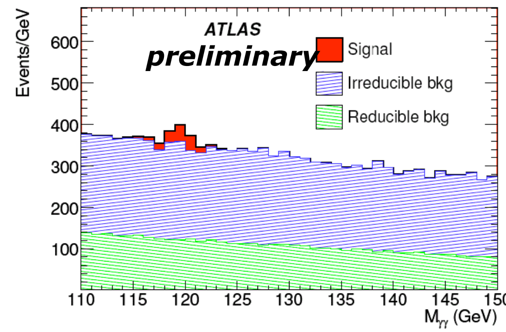
- Different analysis categories
- Inclusive analysis:
  - Selection:
    - $p_T(\gamma)>40(25)$ GeV
    - $|\eta|<2.5$
- Higgs + 1 jet production:
  - radiation mechanism differs for sig and bkgd
  - Selection:
    - $p_T(\gamma)>40(25)$ GeV
    - $|\eta|<2.5$
    - 1 jet $p_T>20$ GeV, $|\eta|<5$
    - $M_{\gamma jj}$ > 350 GeV
- Higgs + 2 jet production:
  - main contribution from VBF
  - Selection:
    - $p_T(\gamma)>50(25)$ GeV
    - $|\eta|<2.5$
    - 2 jets $p_T>20$ GeV, $|\eta|<5$ in opposite emispheres
    - $M_{\gamma\gamma}$ > 500 GeV
    - $\gamma\gamma$ between jets in η

Diphoton invariant mass for 30 fb^-1

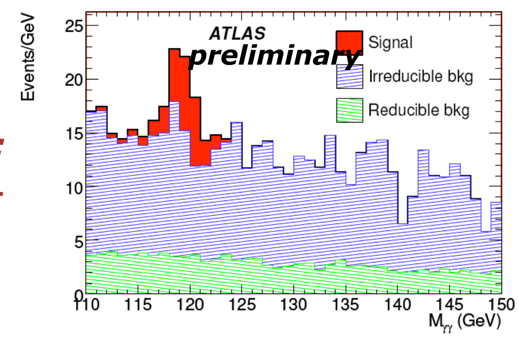
incl



H+1j

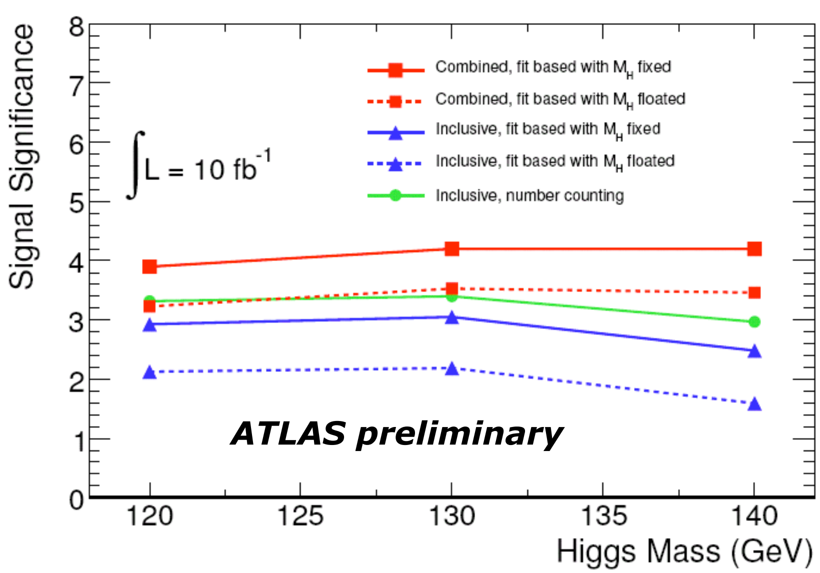


H+2j

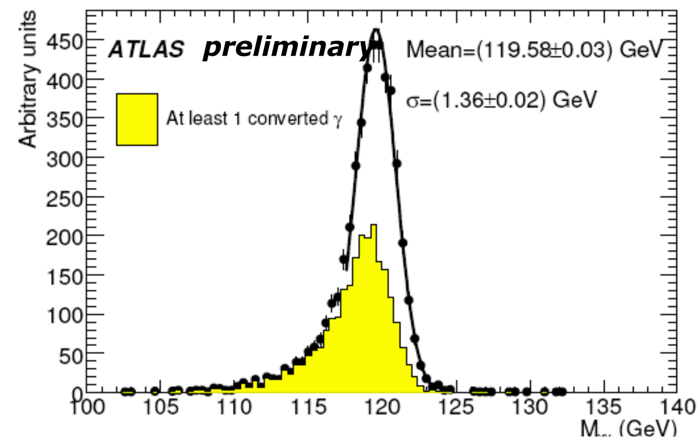


H→γγ with 10 fb-1

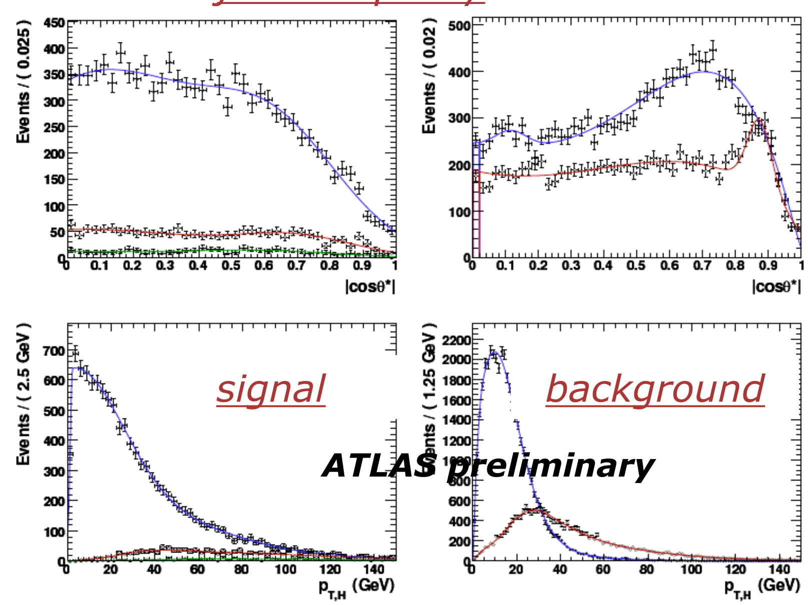
- Unbinned maximum likelihood fit used to extract signal and background
  - 3 photon pseudorapidity regions with different diphoton mass resolution
  - Events with different jet multiplicity
  - Kinematic quantities ($\cos\theta^*$, p_{TH})
  - Floating Higgs mass value



Fitted diphoton resolution



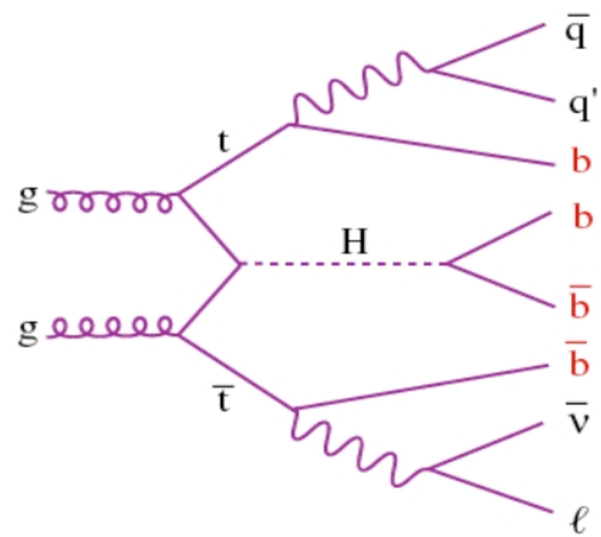
Distribution of $\cos\theta^*$, p_{TH} for different jet multiplicity



ttH(H→bb)

- ttH(→bb): possible discovery and measure of top Yukawa coupling
  - All hadronic final state has higher branching fraction:
    - more difficult trigger
  - Semileptonic final state $\sigma \cdot BR \sim 100$ fb (LO)
    - isolated lepton
    - Missing energy
    - ≥ 6 jets, ≥ 4 jets b-tag
      - need large b-tagging efficiency: signal $\alpha(\varepsilon^4_b)$
  - In general high jet multiplicity:
    - Large contribution of ISR/FSR
      - ⇒ difficult to simulate

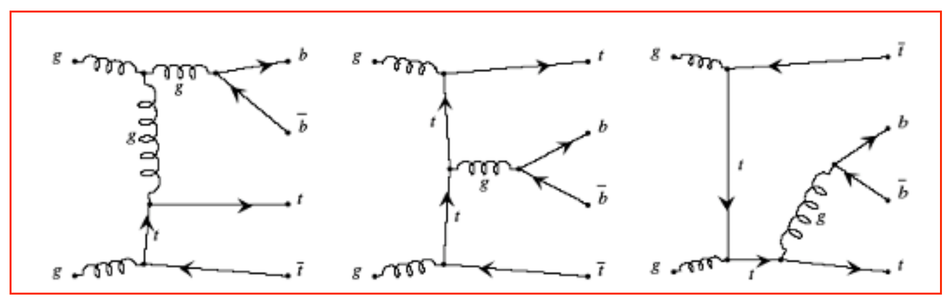
ttH(H→bb) semileptonic



⇒ Reducible Background:

- tt $\sigma \sim 830$ pb (NLO+NLL)
  - Larger background
  - b-tagging must be optimized to have strong light jet rejection
- WWbbjj, Wjjjjjj
  - discriminated by reconstructing tt pairs

ttbb Production diagrams via QCD



⇒ Irreducible background:

- ttbb (EW/QCD) $\sigma \cdot BR \sim 2500$ fb (LO)
  - slight differences in kinematic properties w.r.t ttH
    - could be discriminated using likelihood functions

b-tagging algorithms

Lifetime of B hadrons:

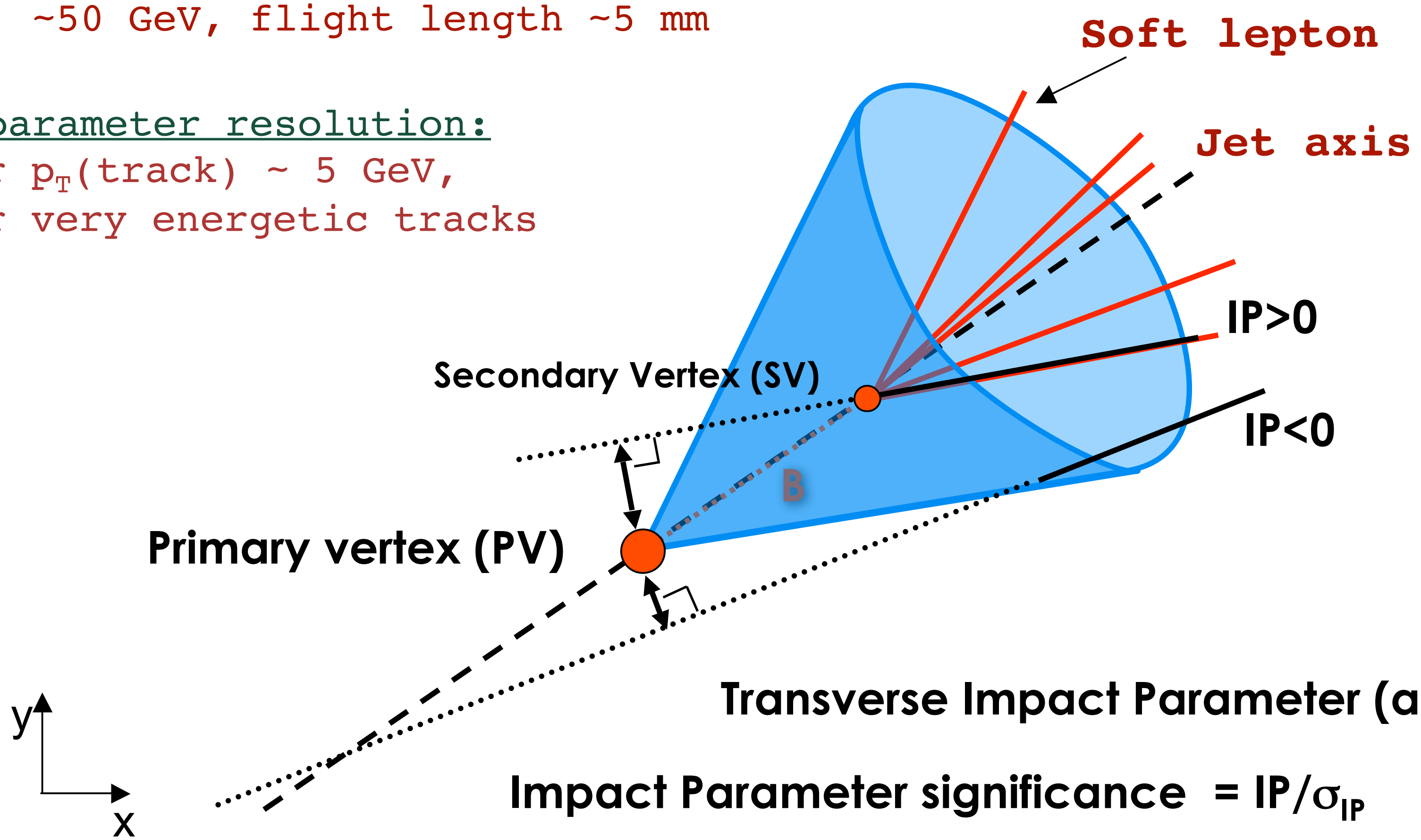
ct ~470 mm (mixture B+/B0/Bs), ~390 mm (Lb)

for E(B) ~50 GeV, flight length ~5 mm

Impact parameter resolution:

35μm for p_T(track) ~ 5 GeV,

10μm for very energetic tracks

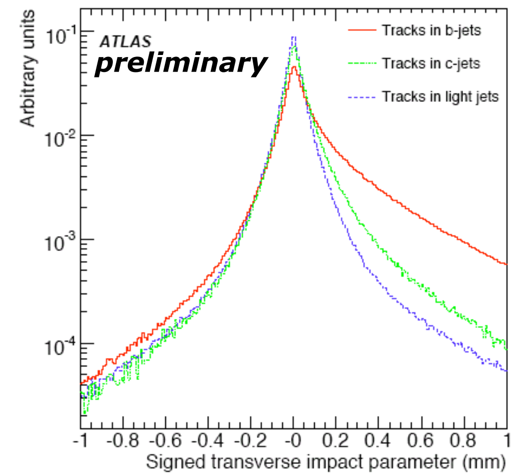


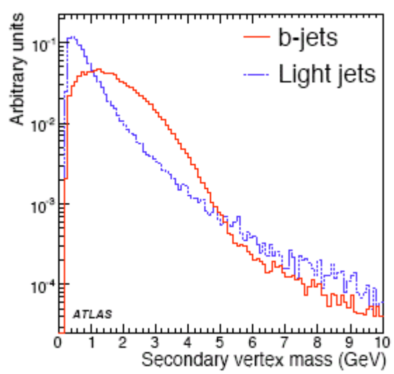
Transverse Impact Parameter (a_0)

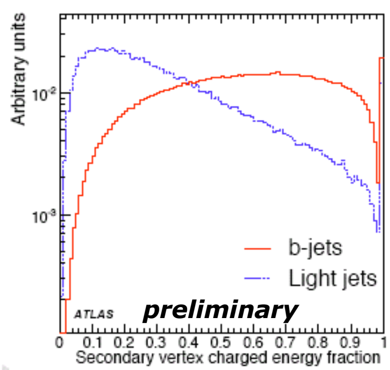
Impact Parameter significance = IP/σ_{IP}

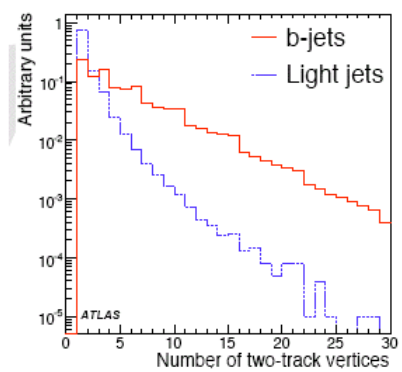
Impact parameter and secondary vertices: IP3D+SV1

- IP3D: combination of transverse and longitudinal normalized track impact parameter
- SV1: secondary vertices quantities used to discriminate light and heavy flavors

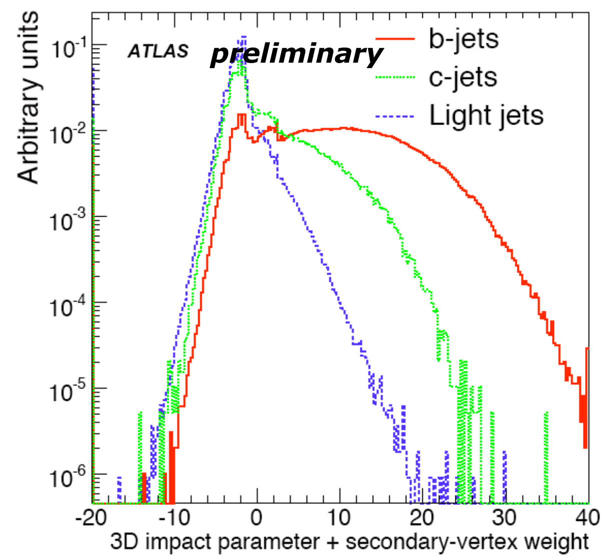








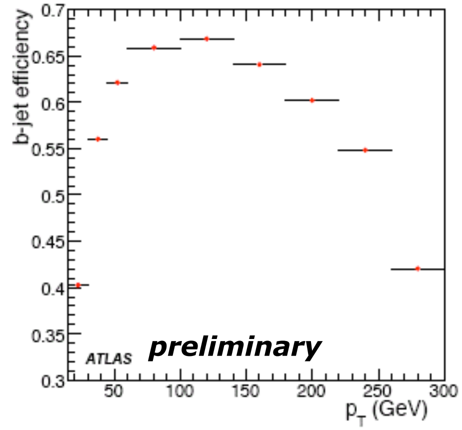
- Combining all track and vertex information a jet weight is obtained
  - Different cuts on the weight allow different working point in terms of b-tagging efficiency vs. light jet rejection

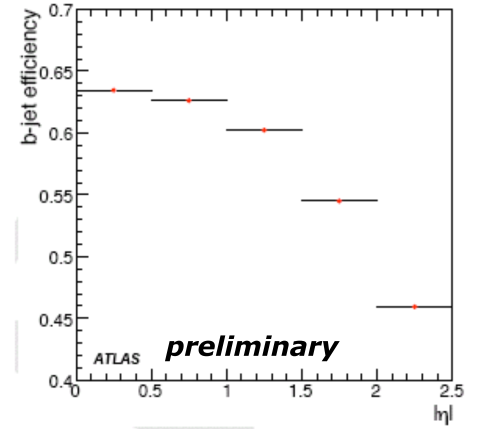


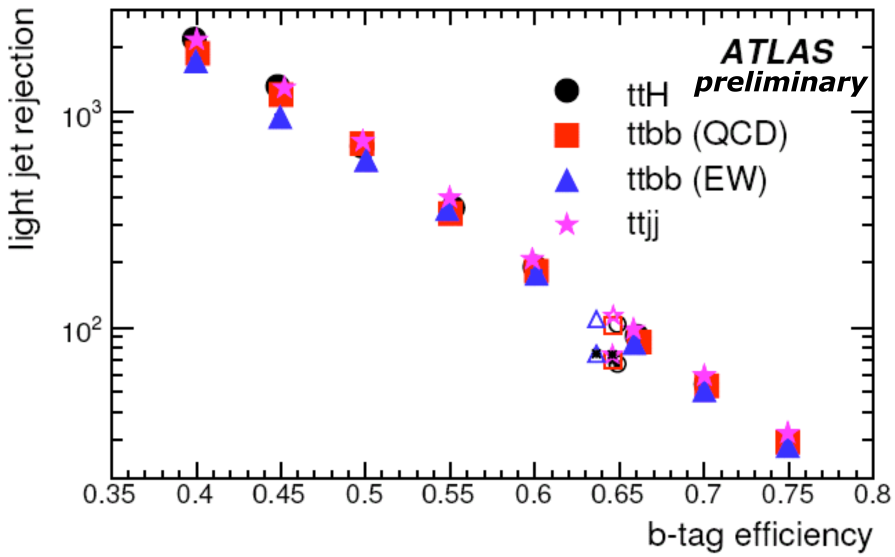
b-tagging SV1+IP3D performance

- Performances heavily dependent on jet p_T and η
  - Need to know the dependency in order to understand the impact on shapes
- For the ttH analysis b-tag weight is rescaled in order to give 30% less light jet rejection
  - take into account effect of residual misalignment
  - *First estimate with real alignment procedure!*

p_T and η dependency for fixed cut

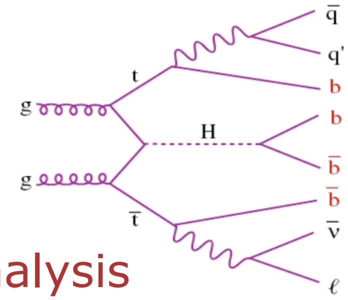






ttH(H→bb) preselection

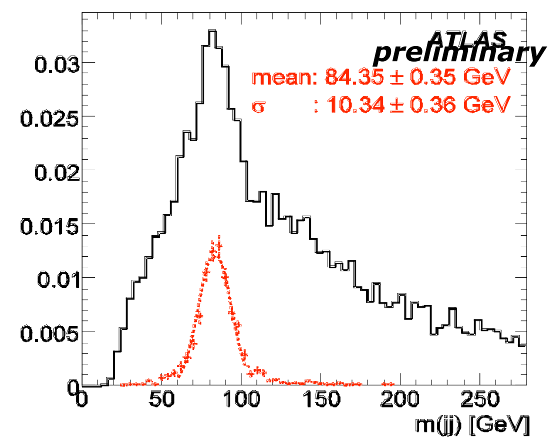
- Three different analysis strategies share the same pre-selection in order to isolate tt+jets events
- Main difficulty of the analysis is to identify b-jets coming from Higgs decay
  - high combinatorial background need for multivariate analysis
    - Normally affected by large systematics



cut	ttH (fb)	ttbb EW (fb)	ttbb QCD (fb)	ttjj (fb)
1 Lepton	56.9	141	1356	63710
+ 6 jets	36.2	76.7	665	26214
+ 4 b-jets loose	16.2	23.4	198	2589
+ 4 b-jets tight	3.76	4.2	29.6	50.7

- First step: W boson reconstruction
  - Hadronic W candidates are formed with non b-tagged jets
    - many extra jets ⇒ large combinatorial bckgd
    - Mass window cut applied
  - Leptonic W reconstruction:
    - force M(lν) to W mass in order to solve for the $p_z(\nu)$

correct combinations shown in red



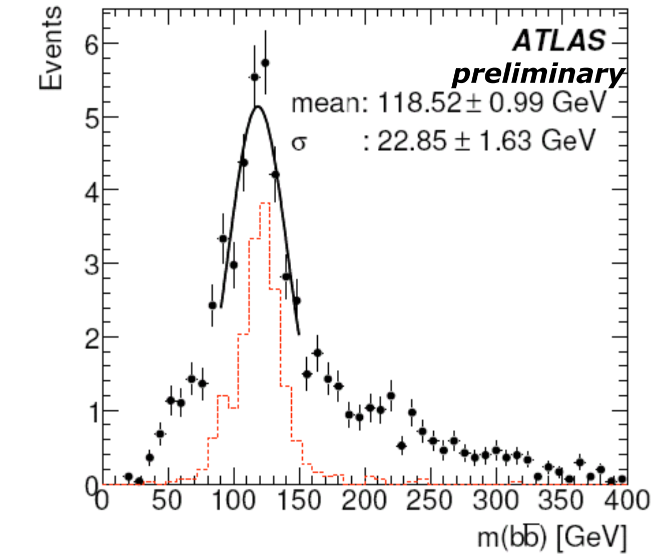
Cut-based analysis

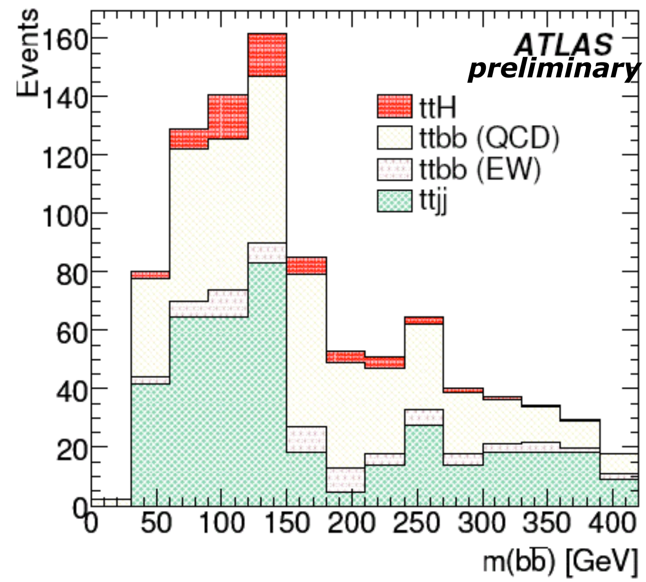
- Starting from W candidates and b-tagged jets in the event top quark candidates are reconstructed
  - cut on $|m_{reco} - m_{true}| < 25$ GeV
- Final combination minimizes χ^2:

$$\chi^2 = \left(\frac{m_{jjb} - m_{top}}{\sigma_{m_{jjb}}}\right)^2 + \left(\frac{m_{l\nu b} - m_{top}}{\sigma_{m_{l\nu b}}}\right)^2$$

- The two remaining b quarks are used to reconstruct the Higgs candidates
- Statistical significance calculated after mass window cut
  - 30 GeV from nominal Higgs mass
- *$S/\sqrt{B}=1.8$*
- Problem of tt+jets statistics
  - generated 1M fully simulated events

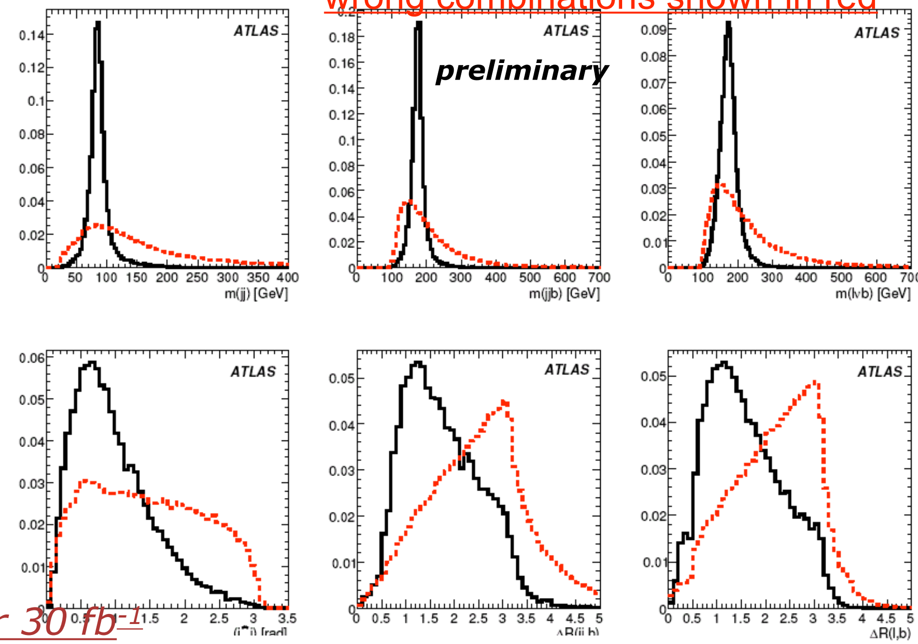
Invariant mass after cut-based analysis
For 30 fb^{-1}





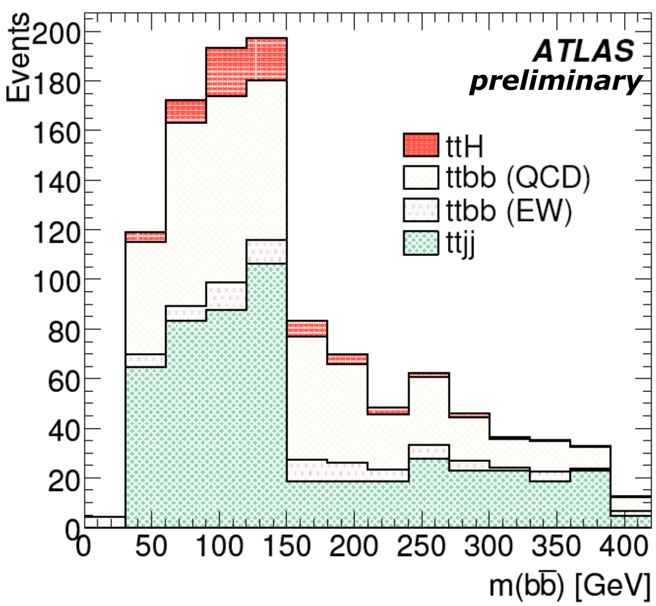
Pairing Likelihood analysis

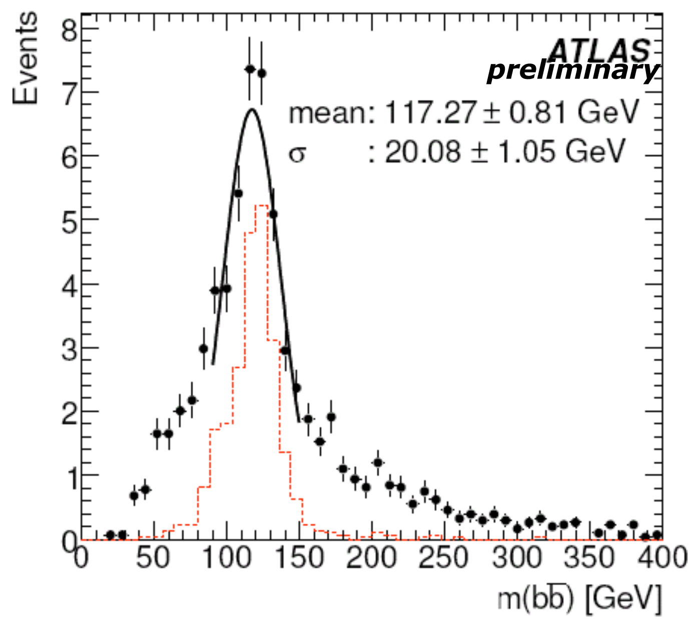
wrong combinations shown in red



- Kinematic properties of tt system are used to isolate top quark decay products
  - Higgs properties not used in order not to bias physics background shape
- 6 mass and angular variables used to form a likelihood discriminant
- *S/√B=1.95*

Invariant mass after likelihood analysis for 30 fb^{-1}





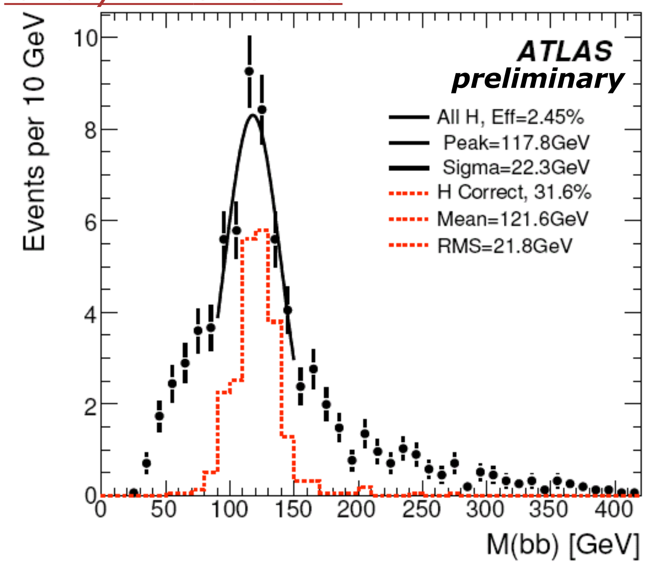
Constrained fit analysis

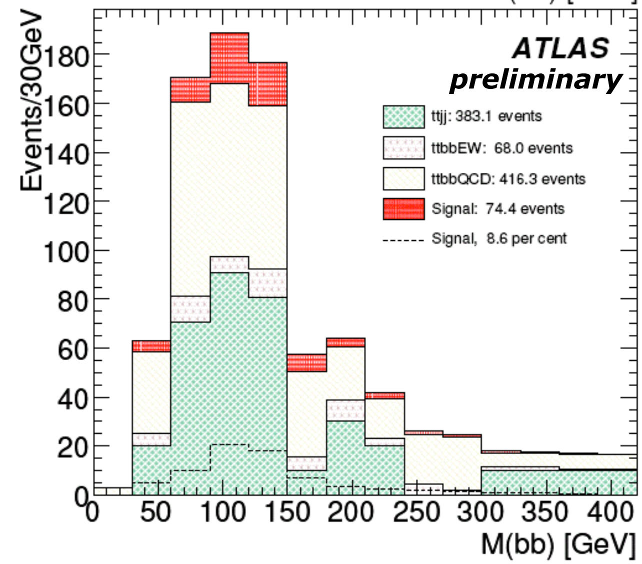
- Fit constrained of the jet momentum and missing transverse energy

$$\chi^2 = \sum_{i=1}^{6} \left(\frac{f^i_{jet} - 1}{\sigma^i_{jet}/P^{i,initial}_{jet}} \right)^2 + \frac{(m_W^{lep} - 80.425)^2}{\sigma_W^2} + \frac{(m_t^{lep} - 175)^2}{\sigma_t^2}$$

- 2 likelihood used
  - 1^{st} pairing likelihood used χ^2 of the fit and other 14 kinematic variables
    - 3D likelihood used in order to take into account the correlations
- Final selection likelihood used to separate signal and physics background
- *S/√B=2.18*

Invariant mass after constrained fit analysis for 30 fb^{-1}

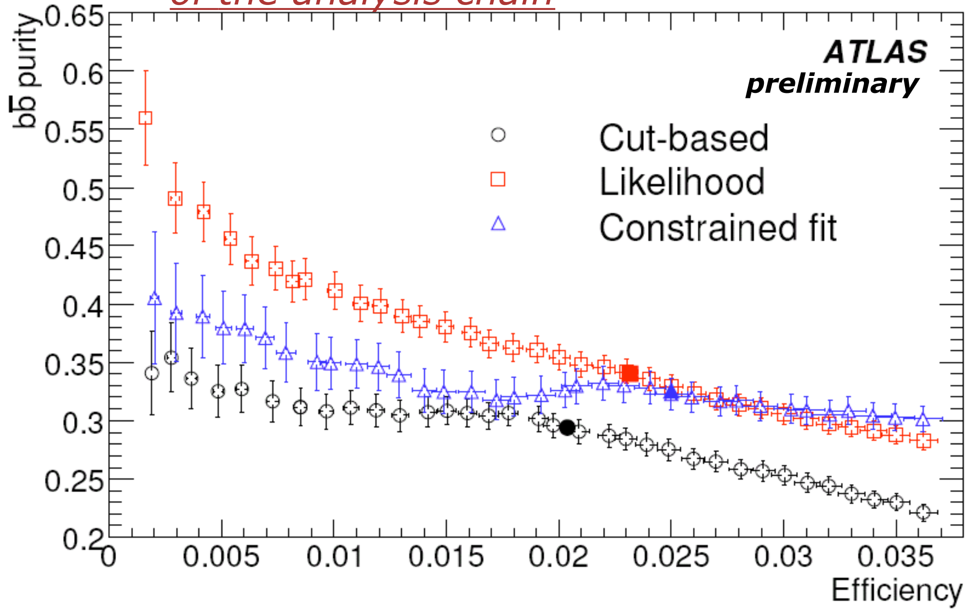




Performance comparison

- Multivariate analysis increase Higgs candidates purity by ~5%:
  - Wide signal mass spectrum
  - No clear signal peak over background
  - Combinatorial background dilute kinematic differences between ttH and ttbb

Comparison performance at the end of the analysis chain



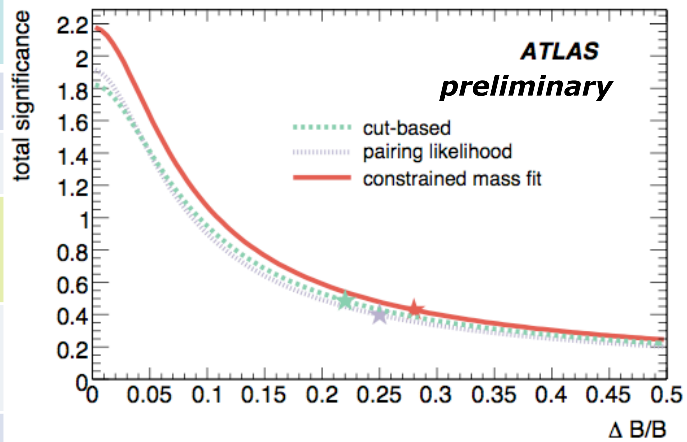
	Cut-based	Likelihood	Constrained fit
Signal efficiency (%)	2.04	2.32	2.49
bb purity (%)	29.4	34.0	32.0
bb mass peak resolution (GeV)	22.8	20.1	22.3
s/b	0.110	0.103	0.123
s/sqrt(b)	1.82	1.95	2.18

Systematic uncertainties

Background summary of major systematic uncertainties

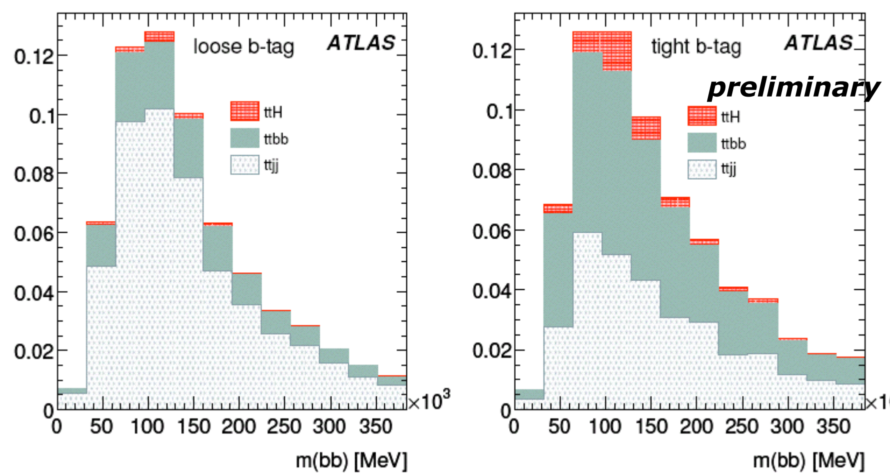
	Cut-based	Likelihood	Constrained fit
JES	5%	14%	8%
Jet resolution	7%	5.5%	14%
b-tagging efficiency	20%	20%	20%
Light jet rejection	5%	3%	10%
All	22%	25%	28%

Significance as a function of background uncertainty



- 5% uncert on JES, 5% on b-tag eff, 10% on light rejection.
- Main effects come from jet related uncertainties
  - Straight propagation gives decrease in significance to ~0.5
- Need for data driven background shape estimation
  - Crucial for the analysis
  - Indication of shape background independent from b-tag cut
  - Loose b-tag analysis depleted of signal to constrain shapes and normalizations

Loose analysis depleted in signal

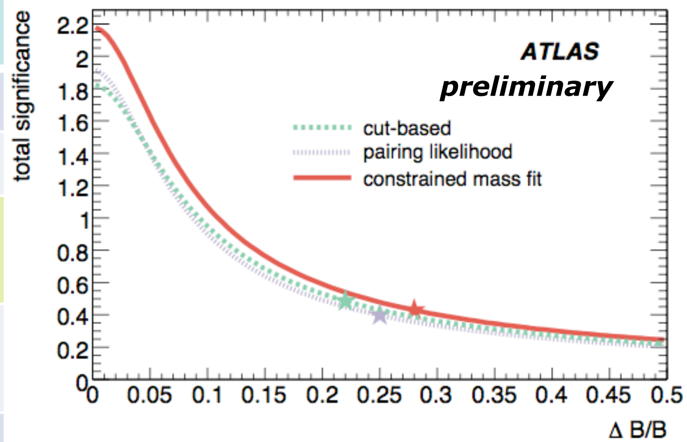


Systematic uncertainties

Background summary of major systematic uncertainties

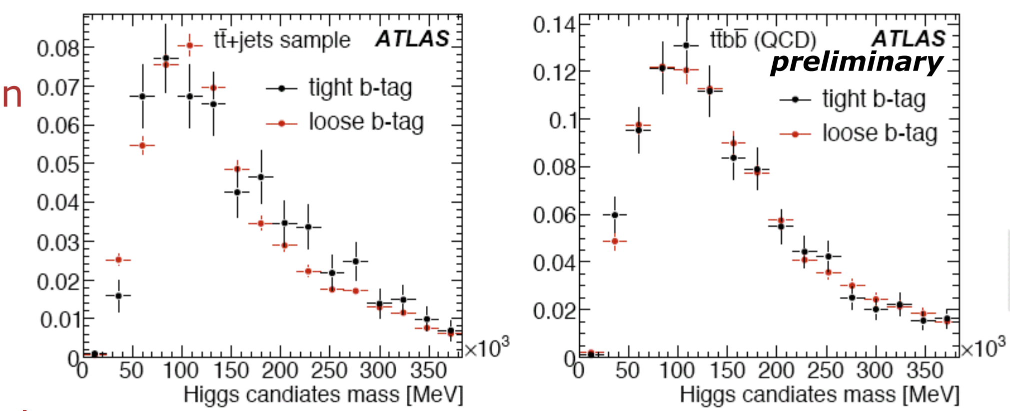
	Cut-based	Likelihood	Constrained fit
JES	5%	14%	8%
Jet resolution	7%	5.5%	14%
b-tagging efficiency	20%	20%	20%
Light jet rejection	5%	3%	10%
All	22%	25%	28%

Significance as a function of background uncertainty



- 5% uncert on JES, 5% on b-tag eff, 10% on light rejection.
- Main effects come from jet related uncertainties
  - Straight propagation gives decrease in significance to ~0.5
- Need for data driven background shape estimation
  - Crucial for the analysis
  - Indication of shape background independent from b-tag cut
  - Loose b-tag analysis depleted of signal to constrain shapes and normalizations

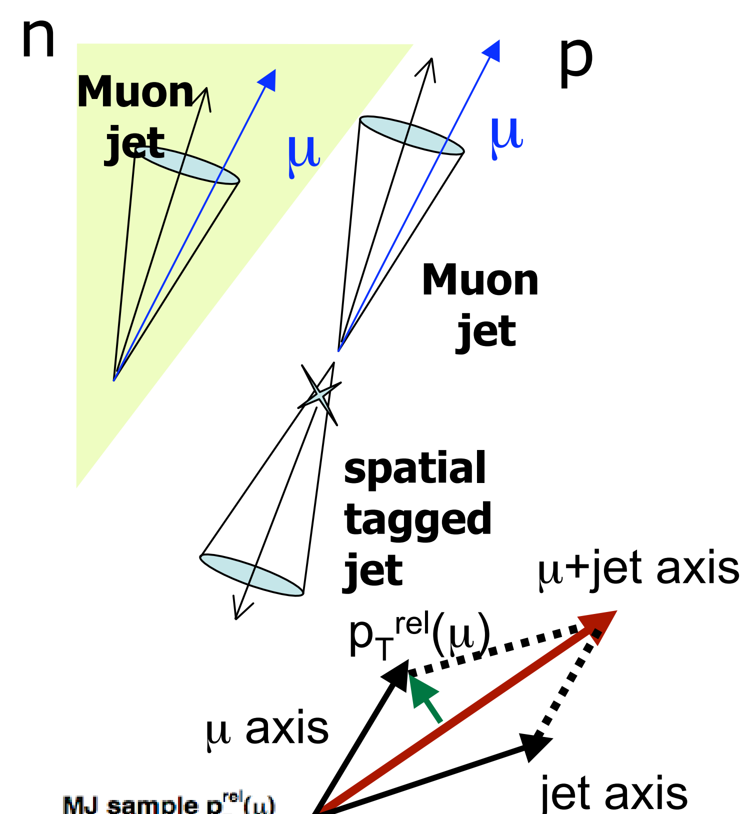
Background shape does not depend upon B-tag cut



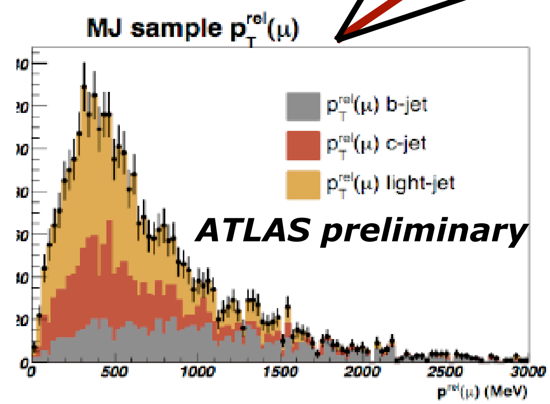
towards first data:
b-tagging calibration

b-tagging calibration: dijet

- Non-linear system (System8 à la D0):
  - 2 samples
    - Muon Jets (n)
    - MJ + other tag opposite jet Jet (p)
  - 2 different b/l fractions: n_b, p_b
  - 2 non-correlated taggers:
    - Tracks (IP3D+SV1) ε^{LT}
    - Soft Muon (pTrel/pT likelihood): ε^{SMT}
  - ➔ system can be solved analytically



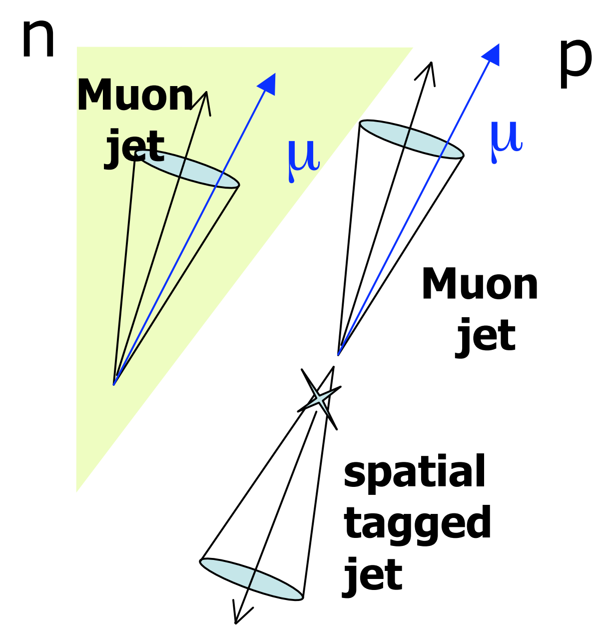
$$
\begin{aligned}
n &= n_b + n_{cl} \\
p &= p_b + p_{cl} \\
n^{LT} &= \alpha_6\, \epsilon_b^{LT}\, n_b + \alpha_4\, \epsilon_{cl}^{LT}\, n_{cl} \\
p^{LT} &= \epsilon_b^{LT}\, p_b + \epsilon_{cl}^{LT}\, p_{cl} \\
n^{SMT} &= \alpha_5\, \epsilon_b^{SMT}\, n_b + \alpha_3\, \epsilon_{cl}^{SMT}\, n_{cl} \\
p^{SMT} &= \epsilon_b^{SMT}\, p_b + \epsilon_{cl}^{SMT}\, p_{cl} \\
n^{both} &= \alpha_1\, \alpha_5\, \alpha_6\, \epsilon_b^{LT}\, \epsilon_b^{SMT}\, n_b + \alpha_2\, \alpha_3\, \alpha_4\, \epsilon_{cl}^{LT}\, \epsilon_{cl}^{SMT}\, n_{cl} \\
p^{both} &= \alpha_1\, \epsilon_b^{LT}\, \epsilon_b^{SMT}\, p_b + \alpha_2\, \epsilon_{cl}^{LT}\, \epsilon_{cl}^{SMT}\, p_{cl}
\end{aligned}
$$



α's correlation parameters evaluated in MC: source of systematic uncertainties

b-tagging calibration: dijet

- Non-linear system (System8 à la D0):
  - 2 samples
    - Muon Jets (n)
    - MJ + other tag opposite jet Jet (p)
  - 2 different b/l fractions: n_b, p_b
  - 2 non-correlated taggers:
    - Tracks (IP3D+SV1) ε^{LT}
    - Soft Muon (pTrel/pT likelihood): ε^{SMT}
  - ➔ system can be solved analytically



$$
\begin{aligned}
n &= n_b + n_{cl} \\
p &= p_b + p_{cl} \\
n^{LT} &= \alpha_6\, \epsilon_b^{LT}\, n_b + \alpha_4\, \epsilon_{cl}^{LT}\, n_{cl} \\
p^{LT} &= \epsilon_b^{LT}\, p_b + \epsilon_{cl}^{LT}\, p_{cl} \\
n^{SMT} &= \alpha_5\, \epsilon_b^{SMT}\, n_b + \alpha_3\, \epsilon_{cl}^{SMT}\, n_{cl} \\
p^{SMT} &= \epsilon_b^{SMT}\, p_b + \epsilon_{cl}^{SMT}\, p_{cl} \\
n^{both} &= \alpha_1\, \alpha_5\, \alpha_6\, \epsilon_b^{LT}\, \epsilon_b^{SMT}\, n_b + \alpha_2\, \alpha_3\, \alpha_4\, \epsilon_{cl}^{LT}\, \epsilon_{cl}^{SMT}\, n_{cl} \\
p^{both} &= \alpha_1\, \epsilon_b^{LT}\, \epsilon_b^{SMT}\, p_b + \alpha_2\, \epsilon_{cl}^{LT}\, \epsilon_{cl}^{SMT}\, p_{cl}
\end{aligned}
$$

Results using simulated moun jets

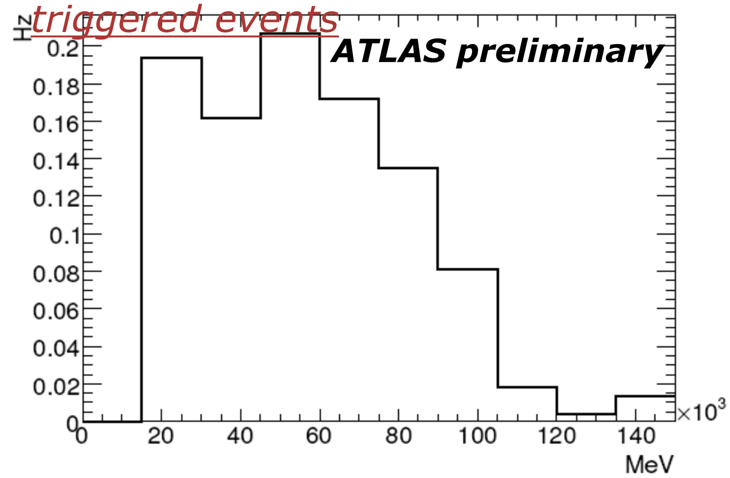
Tagger	Weight cut	Measured ϵ_b	$\lvert\Delta_{meas.,true}\rvert$
IP3D + SV1	w > 4	0.747 ± 0.036	0.002
	w > 7	0.611 ± 0.032	0.012
	w > 10	0.441 ± 0.037	0.043
IP2D	w > 3	0.644 ± 0.033	0.009
	w > 4	0.550 ± 0.029	0.007

α's correlation parameters evaluated in MC: source of systematic uncertainties

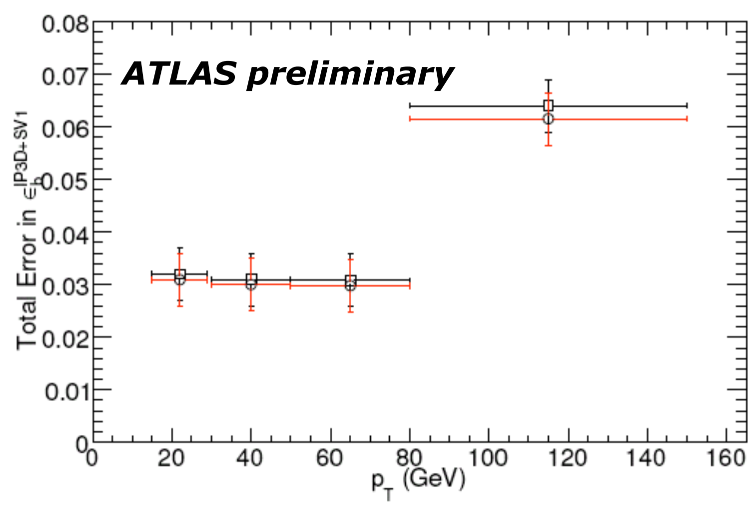
dijet: results for 100 pb^{-1}

- Dedicated trigger are necessary in order to obtain the required number of muon-jets
- L1 muon+jets trigger used although heavily prescaled
  - for 10^{31} a trigger for $p_T(\mu)>6$ GeV and p_T(jet)>10 GeV prescaled by a factor 100
  - Need to go low on p_T for system 8 studies
- Need to achieve high purity
  - matching jet muon can be implemented at L2
  - muon jet purity ~ 80%
- Combination of jet tresholds used in order to have flat jet p_T spectrum
- Folding trigger in system 8 results allows to estimate achievable error with 50 or 100 pb^{-1} data
  - order of 3-5% in bin of p_T and η

pT distributions of mu+jet triggered events



Total efficiency error for (50) 100 pb^{-1}

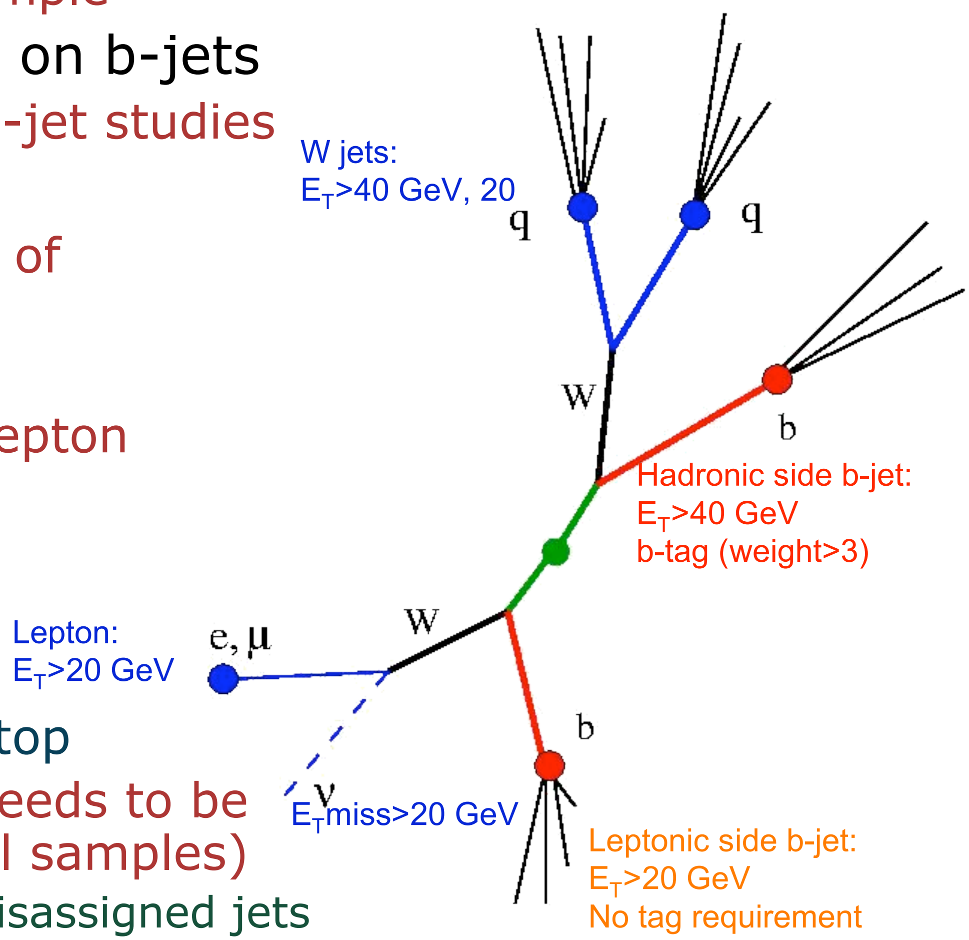


b-tag performances from tt

- tt at LHC ~800 pb
  - Can be used as calibration sample
- tt provides a sample enriched on b-jets
  - Different environment than di-jet studies

1. Event/tag counting method
   - Count events with different # of tagged b-jets
   - likelihood fit for ε_b, ε_c and σ_{tt}
   - Consider semileptonic and dilepton final state
2. Topological selection
   - Very energetic events
   - One b-tagged jets used to reconstruct hadronic top
   - Background on a 20% level needs to be subtracted using data (control samples)
     - combinatorial background: misassigned jets
     - Physics background: W+heavy flavors

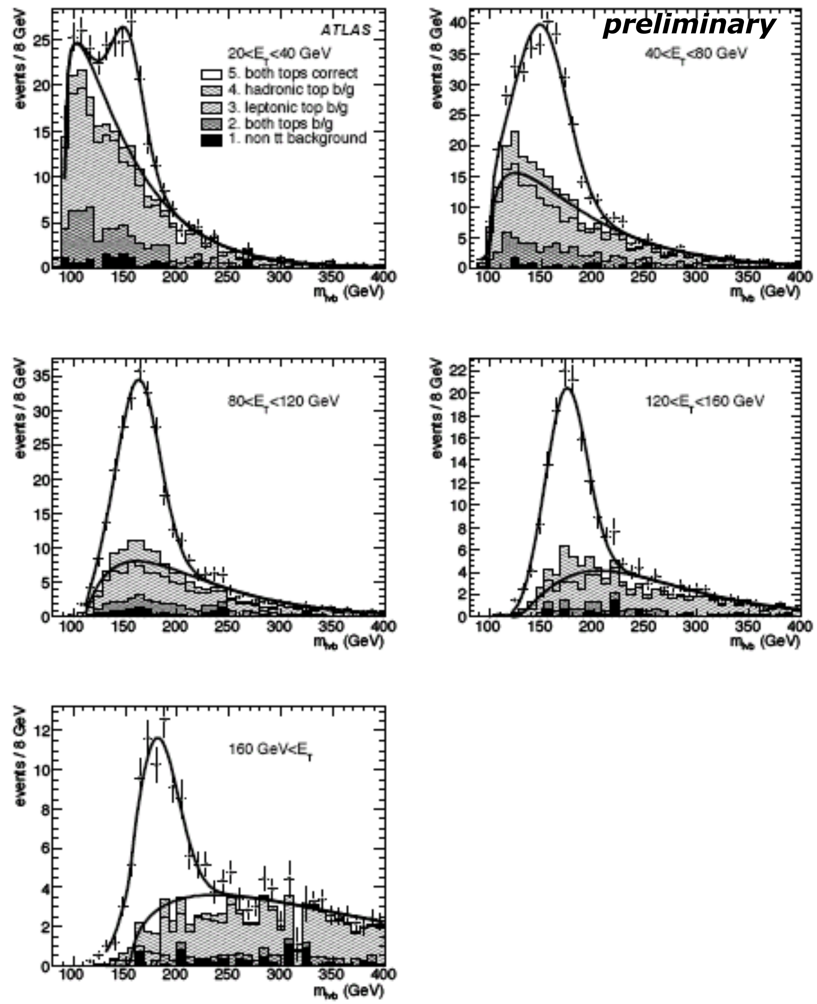
Event selection for topological analysis



Topological approach using $m_{bl\nu}$ distribution

- Select semileptonic ttbar events
  - Reconstruct m_{bjj} on hadronic side from 'raw' jet energies, cuts on m_W and m_{top}
    - Require b-tag on b-jet, anti-b on W jets
- Use recon mass of leptonic top ($m_{bl\nu}$) to find region enhanced in b-jets
  - No requirement on b-tag of this jet
    - Leptonic top ensures jets are b-flavour
- Have to subtract background from mis-reconstructions
  - Estimate shape from a control sample where hadronic side $m_{bjj}>200$ GeV, and leptonic top jet is anti b-tagged
  - Estimate flavour composition from signal sample where $m_{bl\nu}$ outside $m_{top} \pm 2\sigma$ (mass sideband region)

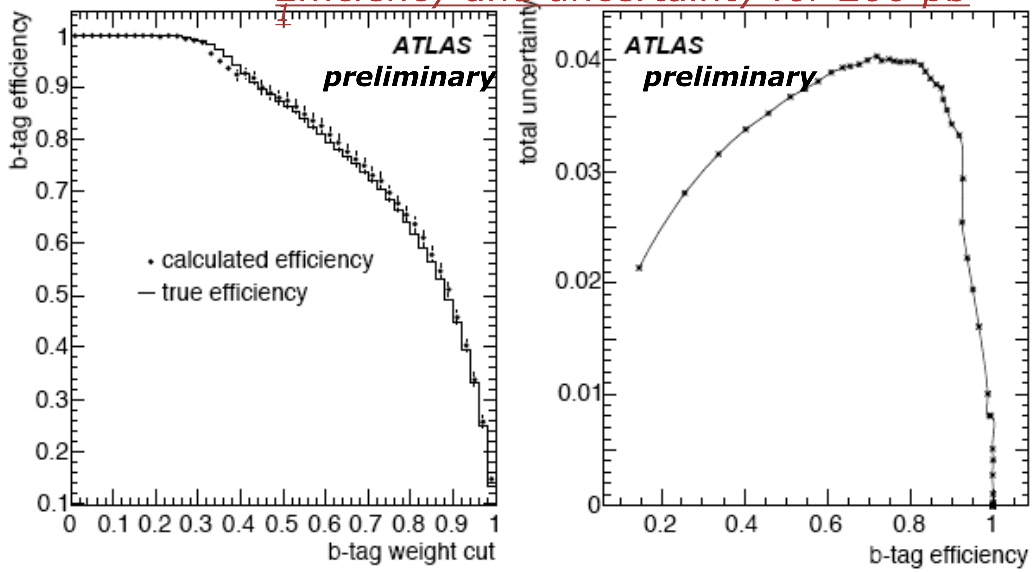
Results of the fit with full statistics 948 pb^{-1}



Topological approach: results

- This method allow to select b-jets with a very high purity
  - compatible with 100% for p_T>40 GeV
- In general good results for relatively energetic jets
  - p_T>40 GeV
- Limited statistics at high energy could also be a problem
- Method tested on several integrated luminosity
  - converge for L>200pb^{-1}
- Relative statistical error of 6.4%.

Efficiency and uncertainty for 200 pb^{-1}



Systematic	Topological
Light jets and τ	0.5
Charm jets	0.7
Jet energy scale	0.5
b-jet labelling	-
MC generators	0.2
ISR/FSR	1
W+jet background	2.8
Single top background	1.2
Top quark mass	-
Total systematic	3.4
Statistical (100 pb^{-1})	-
Statistical (200 pb^{-1})	6.4

Conclusions

- ATLAS work of re-evaluation of Light Higgs sensitivity almost completed
  - New studies used realistic detector simulation
    - more challenging
    - possibility of developing data driven background estimation
- Light Higgs boson remains the most difficult scenario
- Three main channels can be used together to ensure discovery
  - $H \rightarrow \gamma\gamma$: most established analysis
  - VBF: distinct signature
  - ttH: most challenging needs data driven background estimation
- For all this channels will be crucial the work coming in the next months towards the understanding of the detector performance and systematic uncertainties
  - New calibration technique have been tested to be effective from early data
    - b-tagging calibration from di-jets and top quarks
- ATLAS is finally entering a new phase concentrating on looking and understanding the first collisions