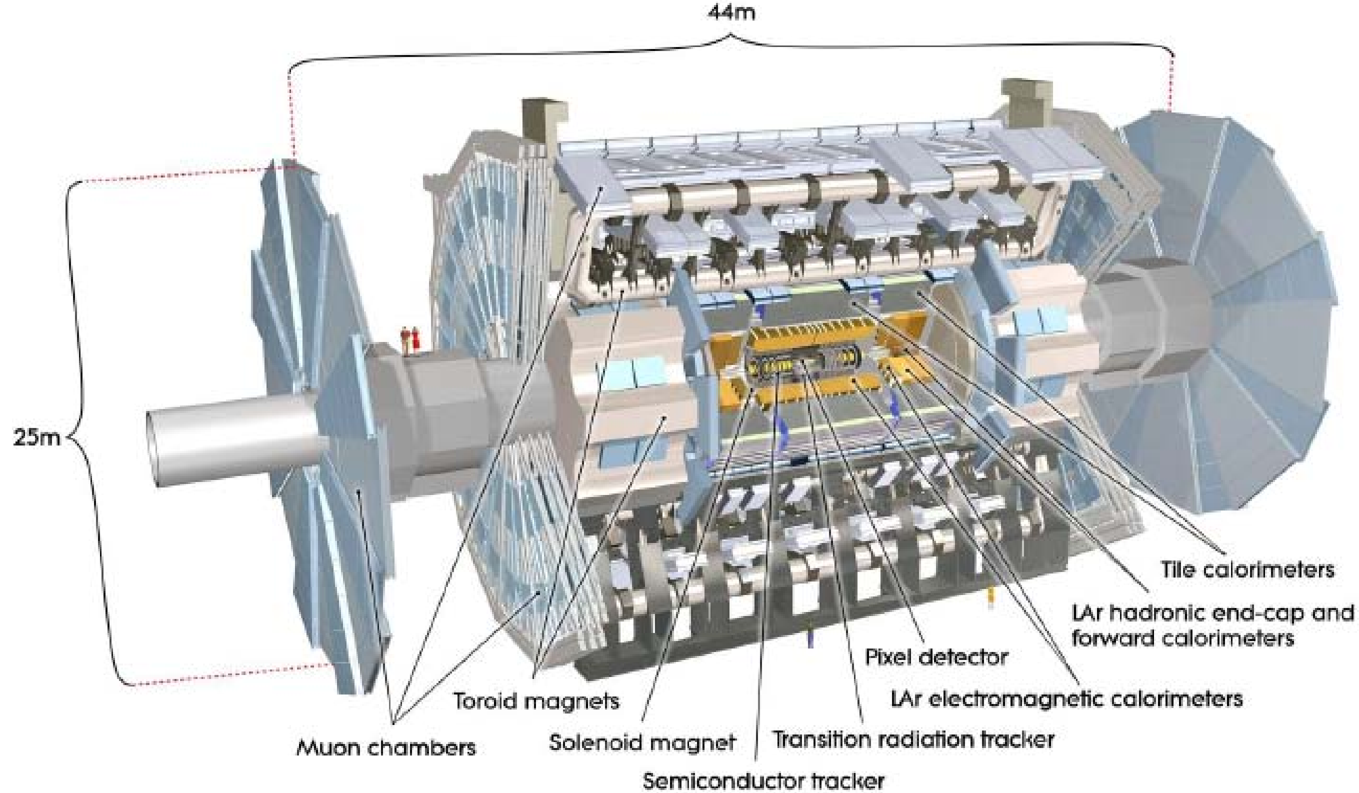
Zbbbar Cross Section Measurement



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Dan Vladoiu
27.07.2010

Preamble

I. Motivation

II. Zbbbar analysis

III. Conclusions & Perspectives

I. Motivation

- **before all -> Zbbbar has an intrinsic importance (QCD calculations).**

- **data favor a light SM Higgs boson: 114.4GeV < M_H < 186GeV, from direct and indirect LEP (ALEPH, DELPHI, OPAL and L3) results. Tevatron - 158GeV-175GeV exclusion region (CDF and DØ) results (95% CL).**

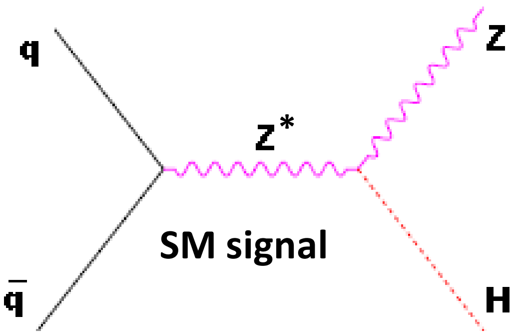
- **a light Higgs would complicate things mainly due to large backgrounds => combination of many signal channels for > 5σ significance.**

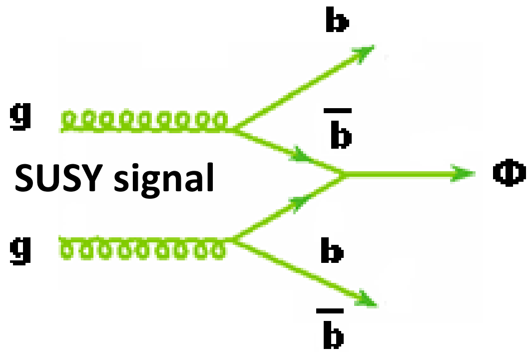
- **light SM Higgs prefers to decay in a pair of bottom – antibottom quarks (< 135GeV).**

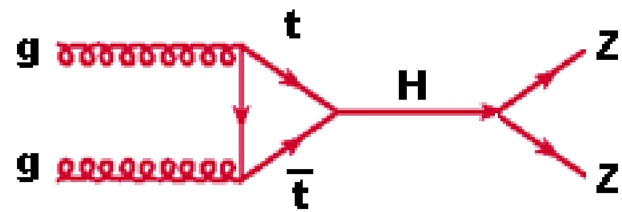
- **Zbbbar is important in a variety of Higgs production channels.**

1. Zbbbar will contribute as the largest background to SM ZH signal (H->bbbar; Z->ll) and SUSY events bbΦ (Φ -> μμ; ττ) where Φ = h,H,A

2. Zbbbar is the largest reducible background to H -> 4l channel

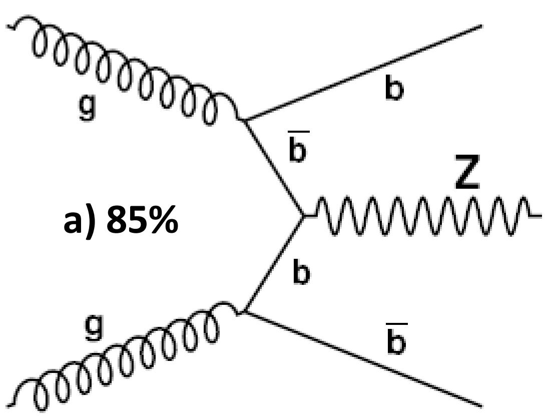


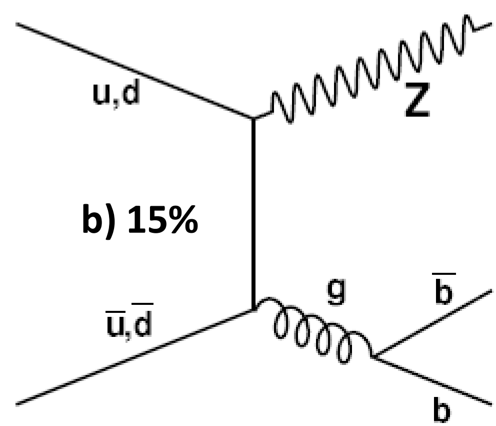


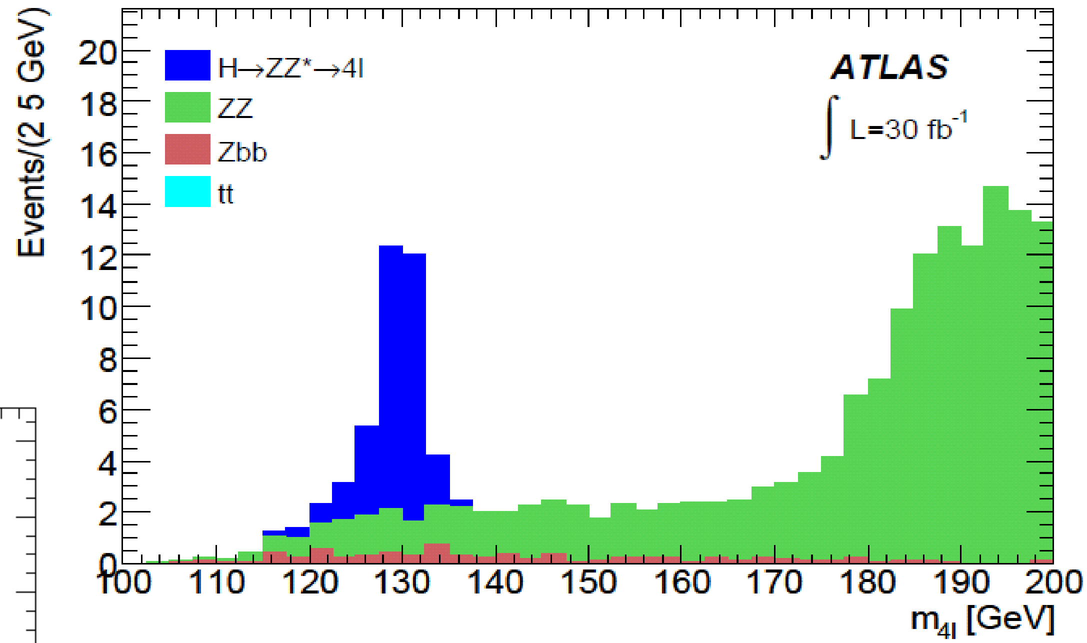


SM “Golden Channel”

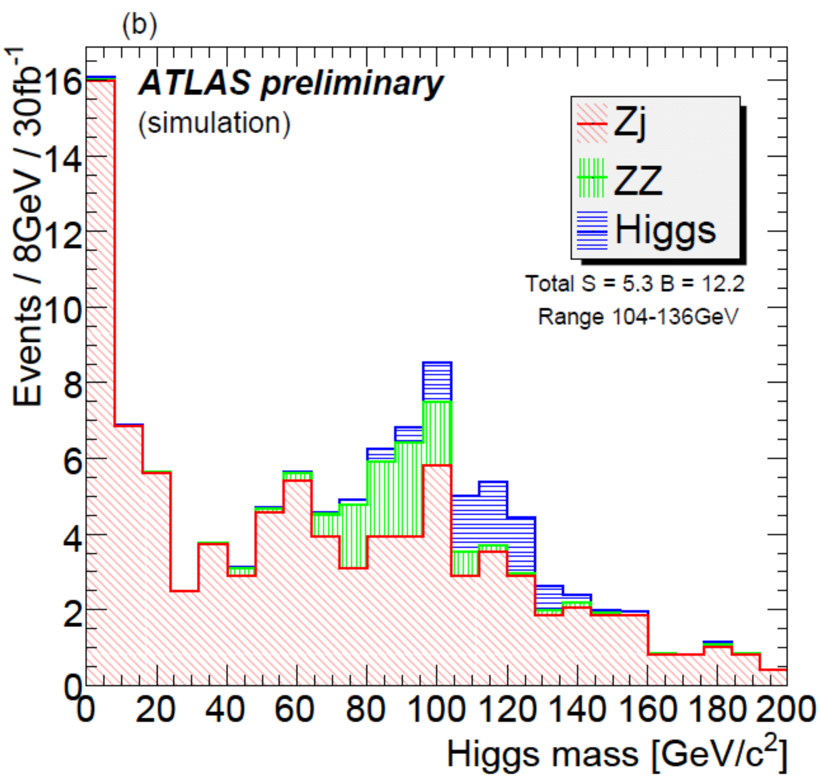
QCD Zbbbar Production (Background)



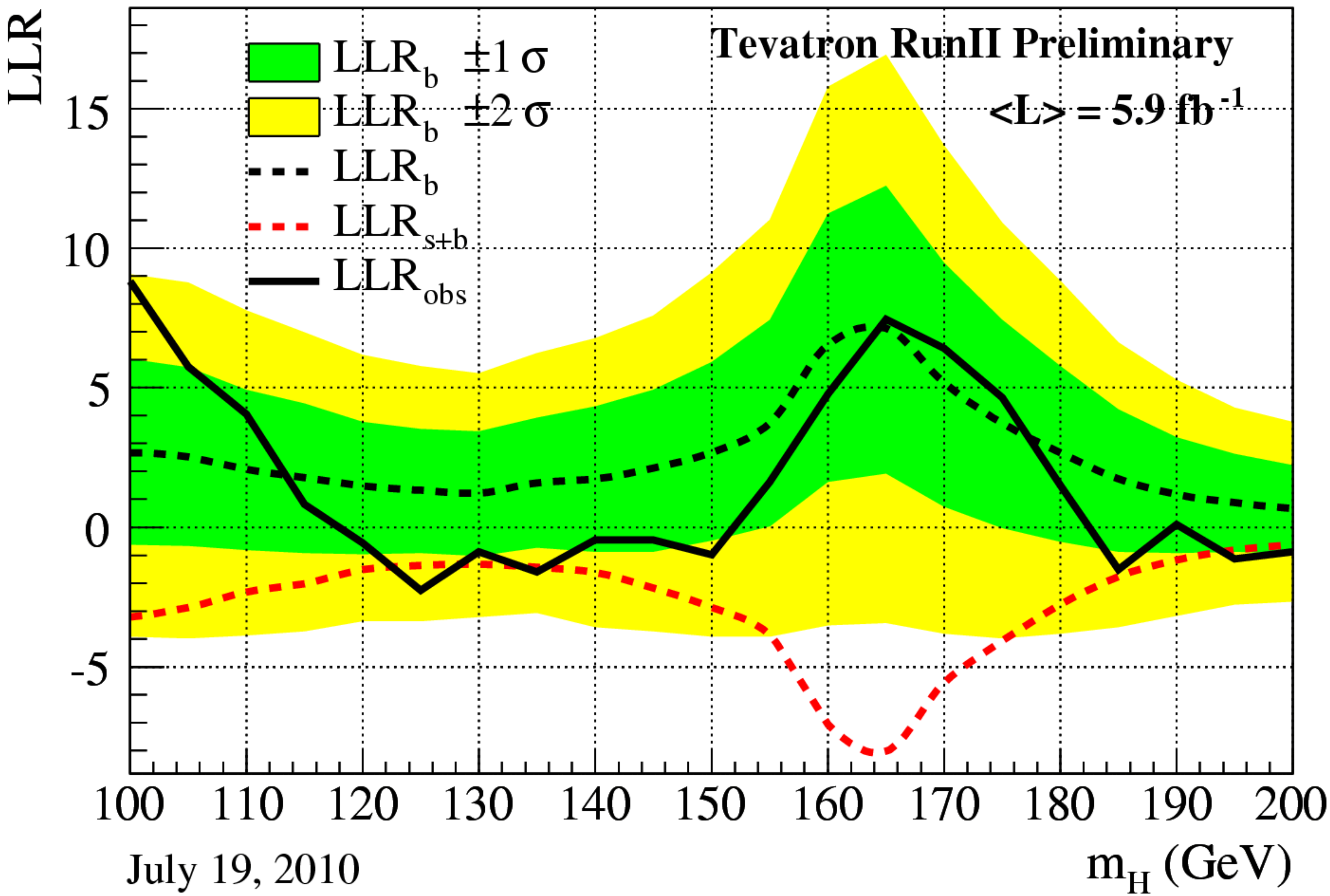




Invariant mass for 4 leptons (M_H =130GeV)



Invariant mass for 2 b-jets (M_H =120GeV)



Combined CDF &D0 exclusion limits (158GeV-175GeV for the SM Higgs Boson)

Zbbbar

Z->ee

Z->mumu

II. Zbbbar analysis

Signal and Backgrounds:

(x-sections at NLO)

1. Signal : Alpgen

- Zbb+0,1,2,3 Partons

2. Main backgrounds: Alpgen

- Z+0,1,2,3,4,5 Jets

- ttbar (no-allhad.) MC@NLO

Reconstruction&Selection

1. Jets

- **“Anti-kT” reconstruction algorithm**
- **No of jets > 1**
- **Jets cleaning (ΔR_Jets&El > 0.2)**
- **Jets b-tagged**
- **Jets pT > 25GeV**
- **|Pseudorapidity| < 2.4**
- **at least two jets in the final selection**

2. Electrons

- **No of electrons > 1**
- **Rejecting electrons for which ΔR_El&El < 0.2 (same el. rec. by 2 different algorithms)**
- **ET deposit Cone ΔR = 0.2 around the electron < 10GeV**
- **Well Isolated Electrons -> all electrons**
- **Rejecting electrons for which ΔR_El&Jets < 0.4**

- **pT > 20GeV**
- **$|\eta| < 2.5$**
- **"crack region" veto (1.37 < |eta| < 1.52)**
- **at least two selected electrons**

- **the first 2 highest energetic electrons are selected to form the Z boson candidate**

$$q1*q2 = -1$$

3. Muons

"Staco" Muons

- **No of muons > 1**
- **Rejecting muons for which ΔR_Mu&Mu < 0.2**
- **ET deposit Cone ΔR = 0.2 around the muon < 10GeV**
- **Rejecting muons for which Dr_Mu&Jets < 0.4**

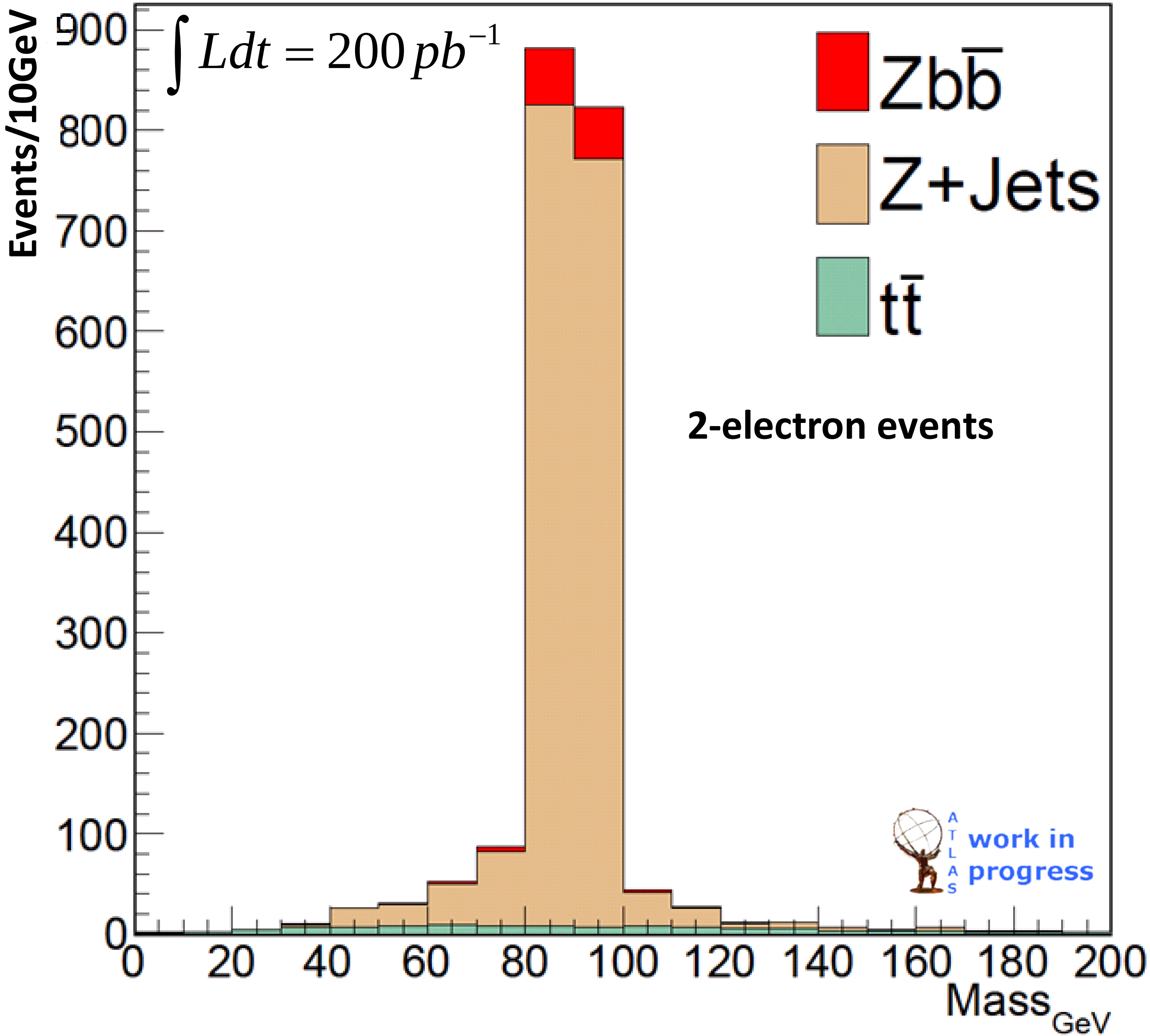
- **pT > 20GeV**
- **|η| < 2.5**
- **at least two selected muons**

- **the first 2 most energetic muons are selected to form the Z boson candidate**

q1*q2 = -1

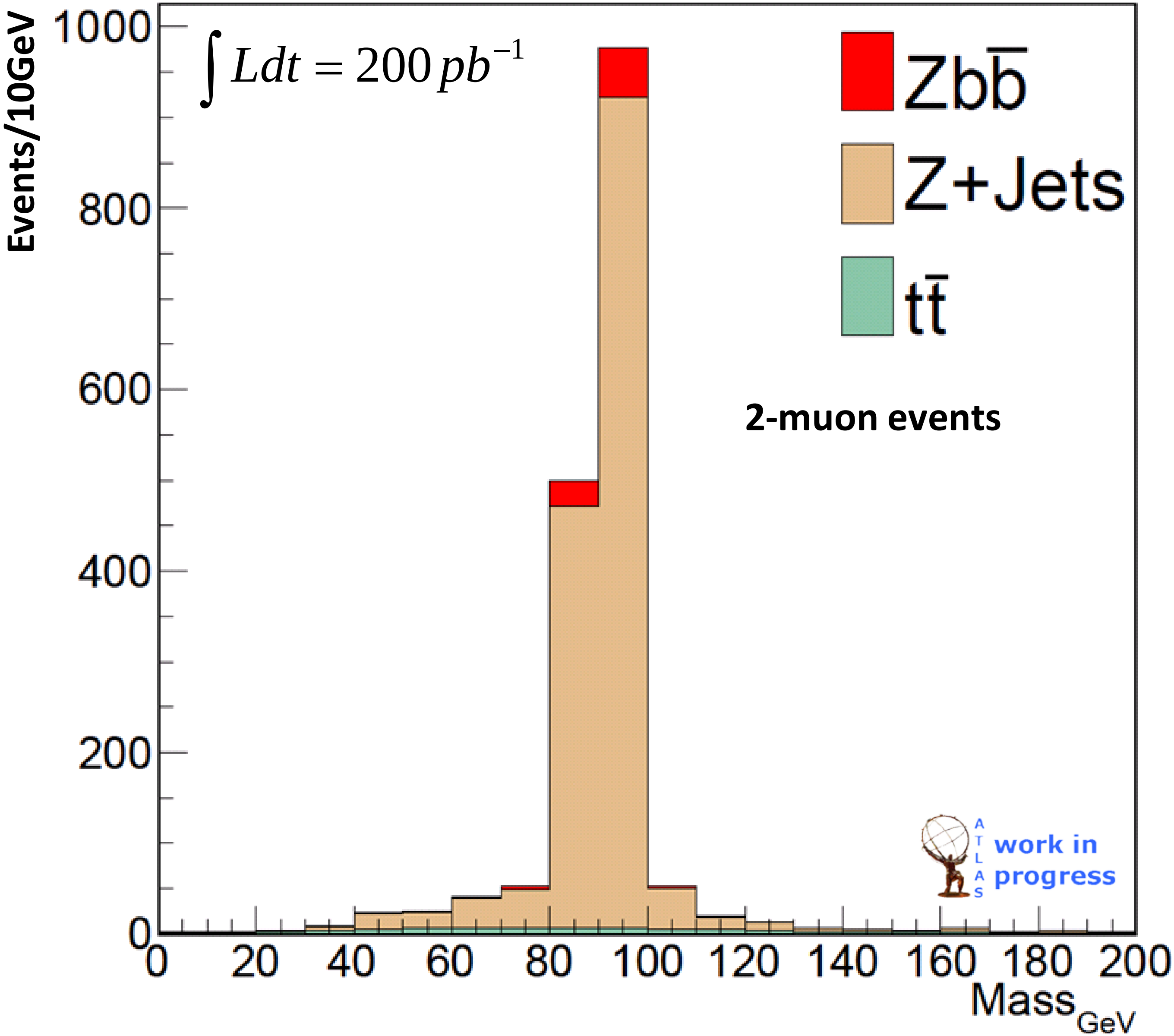
4. MET – no cut yet; would reject ttbar

BEFORE B-TAGGING



$\int Ldt = 200\,pb^{-1}$
Events/10GeV
900
800
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120
140
160
180
200
Mass$_{GeV}$
$Zb\bar{b}$
Z+Jets
$t\bar{t}$
2-electron events
ATLAS
work in progress

E L E C T R O N S



Events/10GeV
1000
800
600
400
200
0
0 20 40 60 80 100 120 140 160 180 200
Mass GeV
$\int Ldt = 200\,pb^{-1}$
Zbb̄
Z+Jets
tt̄
2-muon events
work in progress

M U O N S

Event	Region (80GeV-100GeV)	Outside region
Zbb	108	16
Z+Jets	1581	234
ttbar	16	87

E
L
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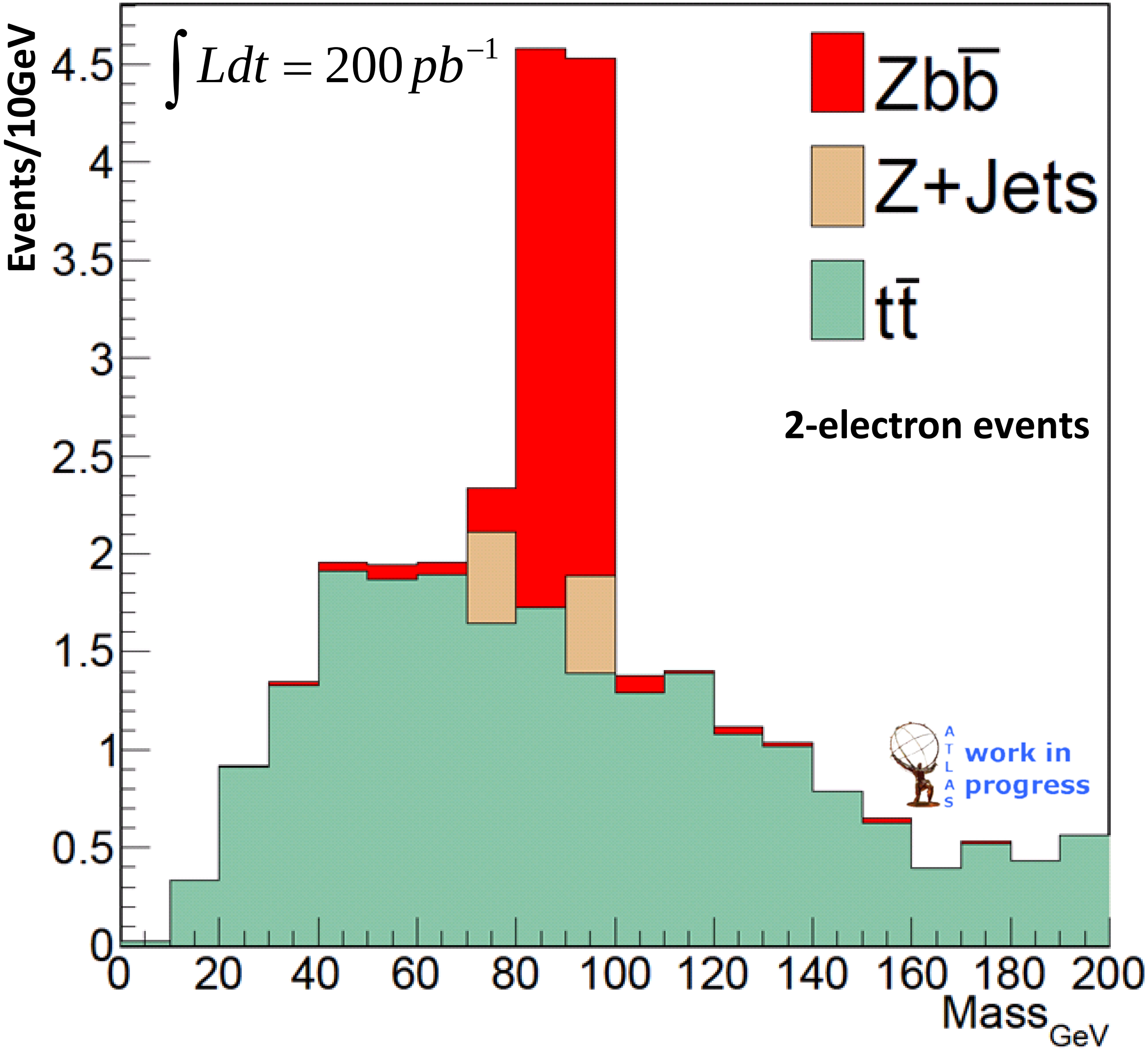
N
S

Event	Region (80GeV-100GeV)	Outside region
Zbb	83	12
Z+Jets	1381	201
ttbar	12	57

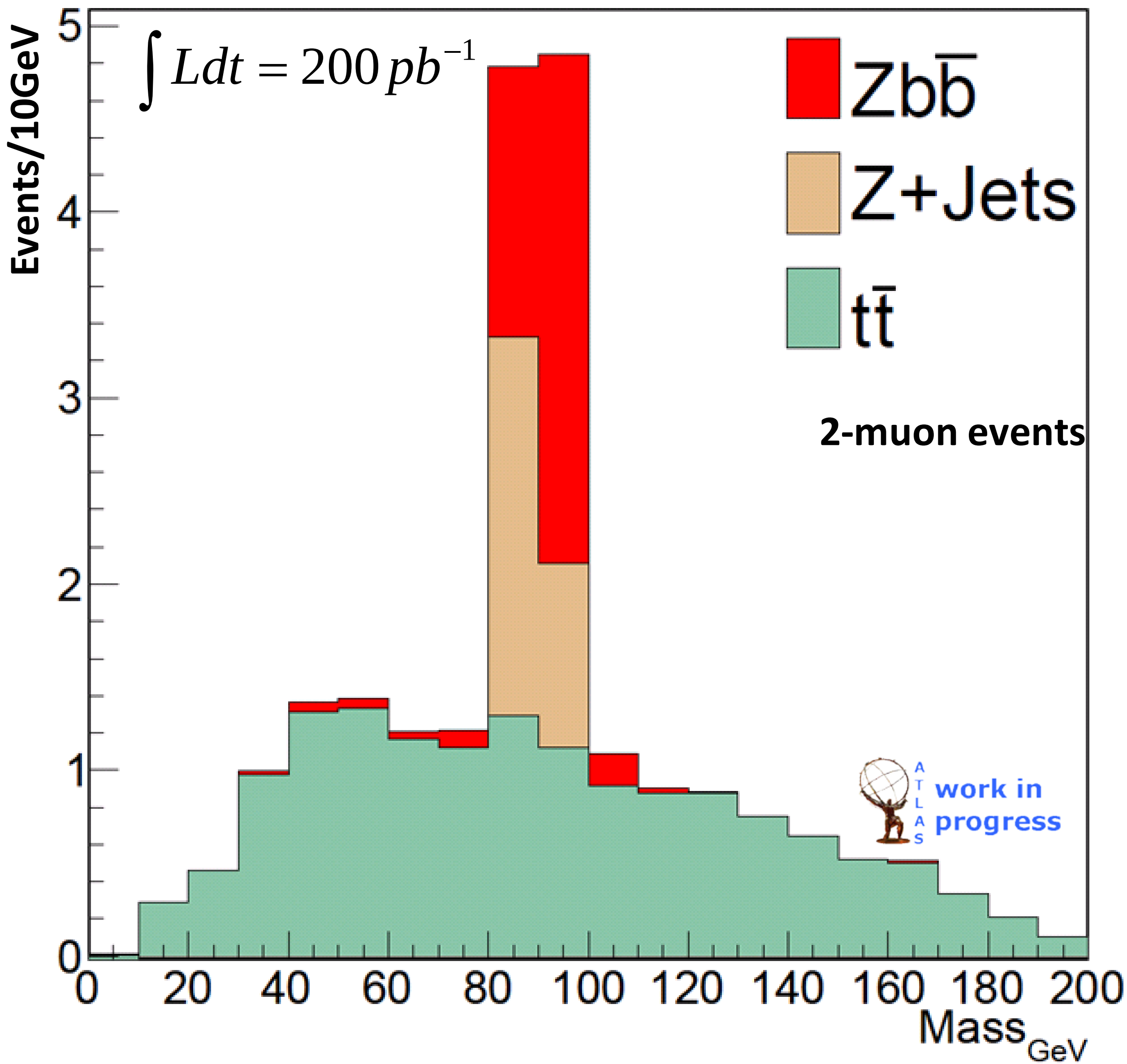
M
U
O
N
S

AFTER B-TAGGING

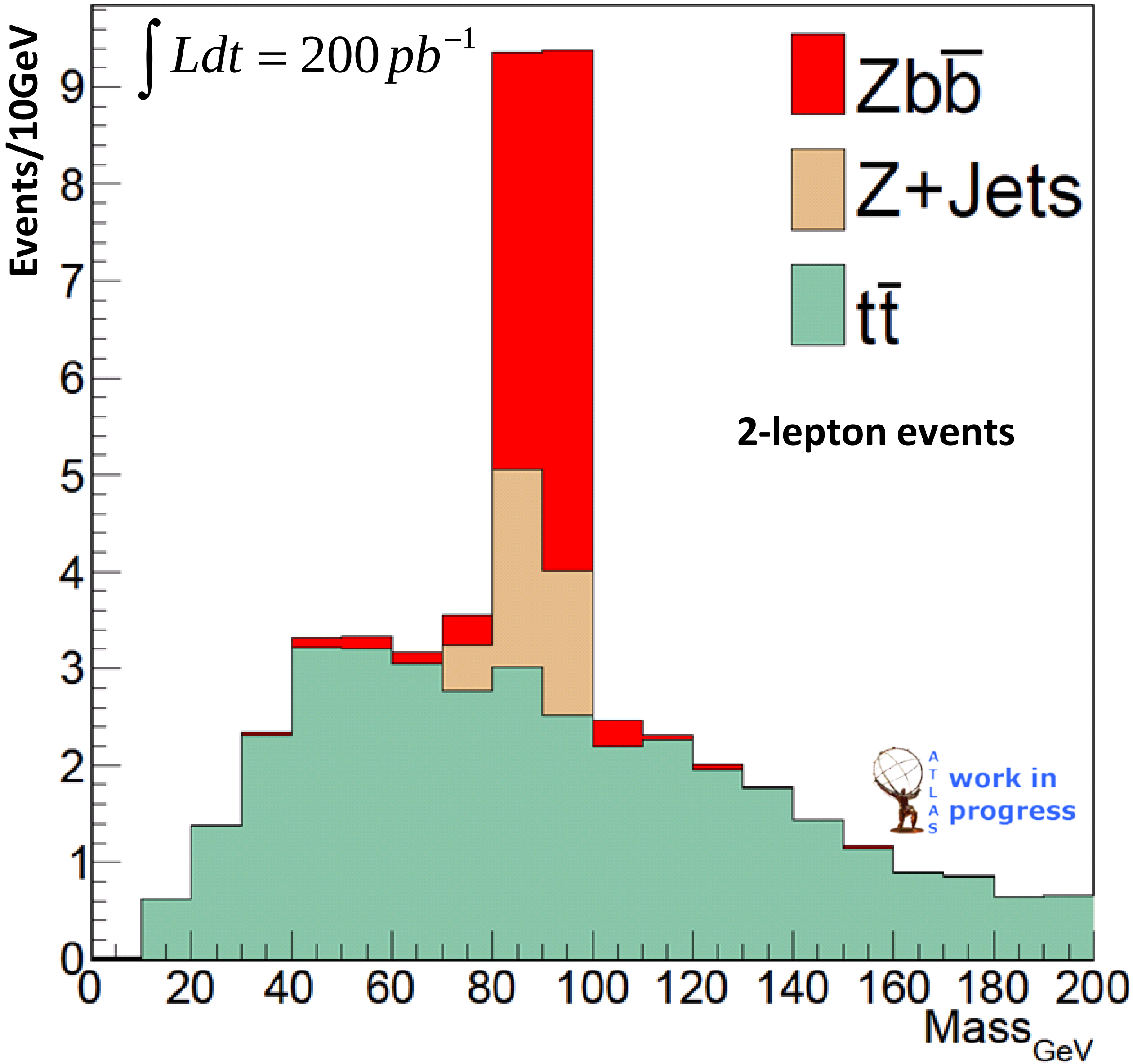


Events/10GeV
$\int Ldt = 200\,pb^{-1}$
$Zb\bar{b}$
Z+Jets
$t\bar{t}$
2-electron events
ATLAS
work in progress
Mass$_{GeV}$
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
20
40
60
80
100
120
140
160
180
200

E L E C T R O N S


Events/10GeV
$\int L dt = 200\, pb^{-1}$
$Zb\bar{b}$
Z+Jets
$t\bar{t}$
2-muon events
ATLAS
work in progress
0
1
2
3
4
5
0
20
40
60
80
100
120
140
160
180
200
Mass$_{GeV}$

M U O N S



Events/10GeV
$\int Ldt = 200\,pb^{-1}$
$Zb\bar{b}$
Z+Jets
$t\bar{t}$
2-lepton events
ATLAS
work in progress
0
1
2
3
4
5
6
7
8
9
0
20
40
60
80
100
120
140
160
180
200
Mass$_{GeV}$

D I L E P T O N I C

$$\int L dt = 200\, pb^{-1}$$

ELECTRONS

Event	Region (80GeV-100GeV)	Outside region
Zbb	6	0.6
Z+Jets	0.5	0.5
ttbar	3	18

MUONS

Event	Region (80GeV-100GeV)	Outside region
Zbb	4	0.5
Z+Jets	3	0
ttbar	2	12

$$\frac{S}{\sqrt{B}} = 3.5$$

DILEPTONIC

Event	Region (80GeV-100GeV)	Outside region
Zbb	10	1
Z+Jets	3.5	0.5
ttbar	5	30

III. Conclusions & Perspectives

-**Zbbbar cross section can be measured with 200pb-1**

- **b-tagging in data**

- **include all backgrounds**

- **consider trigger in Zbbbar analysis**