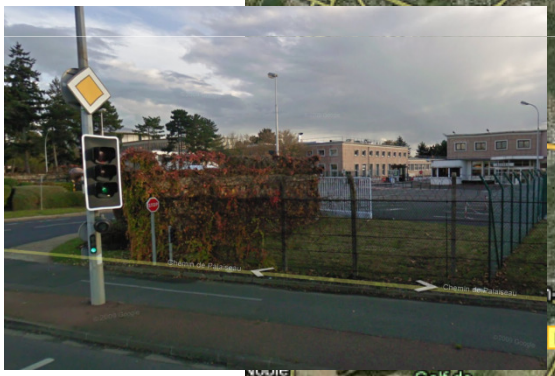
French – Chinese activities in the ATLAS group at CEA Saclay

J. Schwindling

(Presented by B.Mansoulié)

IRFU / SPP



Paris
20 km
CEA Saclay
Palaiseau
7 km
Boulogne-Billancourt
Issy-les-Moulineaux
Montrouge
Malakoff
Gentilly
Le Kremlin-Bicêtre
Ivry-sur-Seine
Arcueil
Cachan
Bagneux
Châtillon
Clamart
Meudon
Bellevue
Sèvres
Chaville
Versailles
Viroflay
Le Chesnay
Vélizy-Villacoublay
Fontenay-Aux-Roses
Le Plessis-Robinson
Sceaux
L'Haÿ-les-Roses
Châtenay-Malabry
Bièvres
Le Val-d'Albian
Verrières-le-Buisson
Villejuif
Chevilly-Larue
Vitry-sur-Seine
Saclay
Vauhallan
Villiers-le-Bâcle
Saint-Aubin
Le Mesnil Blondel
La Petite Barrerie
Ctre d'Etudes Nucléaires de Saclay
Forêt Domaniale de Meudon
Forêt Domaniale de Verrières
Forêt Domaniale de Palaiseau
Bois de Clamart
Bois de l'Homme Mort
Bois du Loup Pendu
Parc de Sceaux
Cimetière Parisien de Bagneux
Route Nationale
Périphérique de l'Ile-de-France
Boulevard Périphérique
L'Autoroute de Normandie
L'Autoroute du Soleil
Av. d'Italie
Quai de Bercy
Bd Lefebvre
Bd Brune
R de Rivoli
Paris
Bougival
La Celle-Saint-Cloud
Golf de Saint-Cloud
Garches
Saint-Cloud
Vaucresson
Marnes-la-Coquette
Ville-d'Avray
Bois des Fonds Maréchaux
Forêt Domaniale de Fausses Reposes
Etang de Saclay
Golf de Saclay
A86
A13
E05
E50
E15
A6a
A6b
N321
N118
N186
N7
D910
D446
D36
D938
A10

The ATLAS group at IRFU / SPP

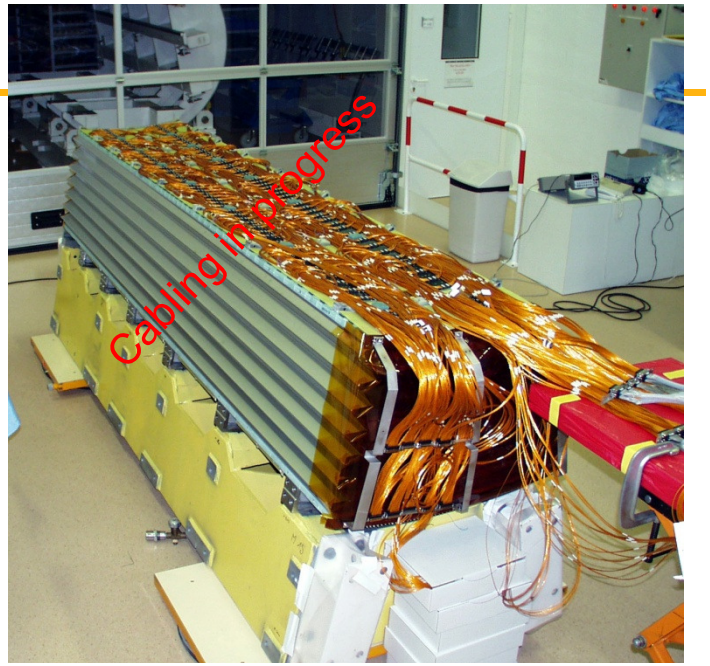
- 39 members:
  - 24 permanent physicists
  - 11 phD students
  - 4 postdocs, visitors

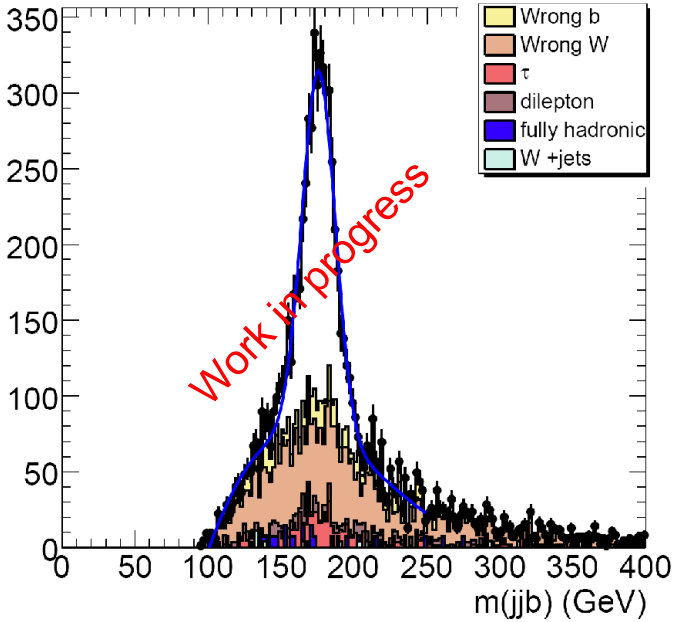
Activities

- Hardware involvement:
  - Barrel EM calorimeter (design, assembly, testing, performances…)
  - Muon system: design, barrel toroidal magnet, alignment system and magnetic field for barrel
  - ATLAS upgrade / micromegas

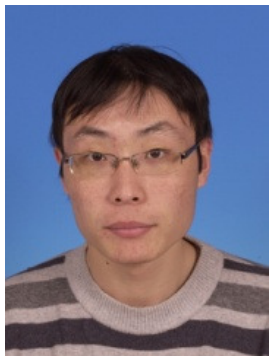
- Muon software: detector description, alignment and B field, muon reconstruction, 3D event display

- Physics:
  - Higgs -> 4 leptons
    - Di-bosons
    - Z b-bbar
    - *H-> W W*
  - Z' searches
  - W & Z
    - Wmass measurement
    - Z differential Xsection
    - Z + jets
  - Top physics
    - Top mass, Xsection
    - Exotics with top

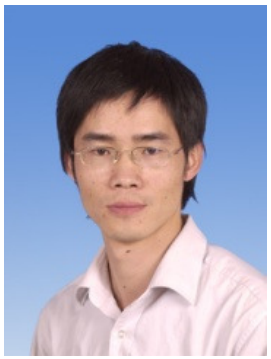




Activities involving Chinese colleagues



Shuoxing Wu:
Micromegas for ATLAS
→ see Paul Colas' talk



Hongbo Liao:
Jet calibration for
top mass measurement

Chao Xu:
Measurement of the
Z+jets cross-section

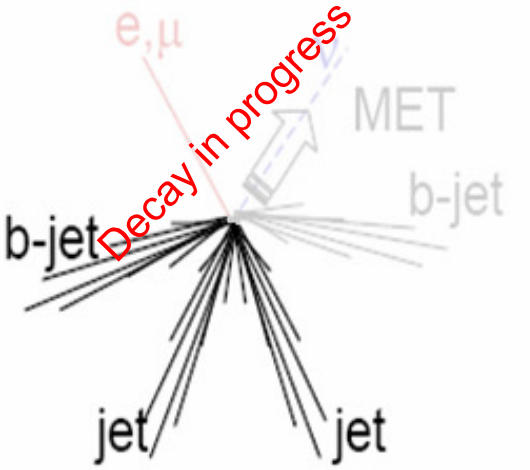
Jie Yu:
ttbar cross-section
measurement
→ see his talk for details

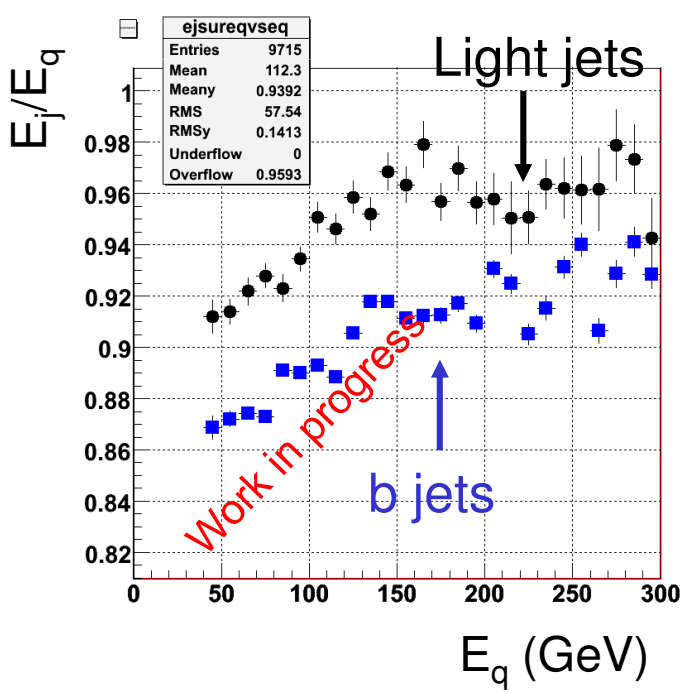
Jet calibration for top mass measurement

- Postdoctoral position: **Hongbo Liao**
  - from October 2007 to December 2009 in Saclay, work with **Jérôme Schwindling**
  - now working at Clermont-Ferrand

- Study with Monte Carlo simulation:
  - Top quark mass measured in tt → lνb jjb by reconstructing the jjb invariant mass
  - Systematic dominated by knowledge of jet calibration:
    - 1% error on light jets → 0.2 GeV
    - 1% error on b jets → 0.7 GeV
  - Light jets can be calibrated in situ to better than 1% by using the W mass peak
  - b jet calibration different from light jets (~ 5%)

→ Try to measure b / light ratio using the P_T balance in γ/Z + jet events





Issues in using P_T balance in γ/Z+jet events

- P_T(jet) / P_T(γ/Z) 2% lower than P_T(jet) / P_T(quark) because of gluon radiation → would cancel when comparing b and light jets

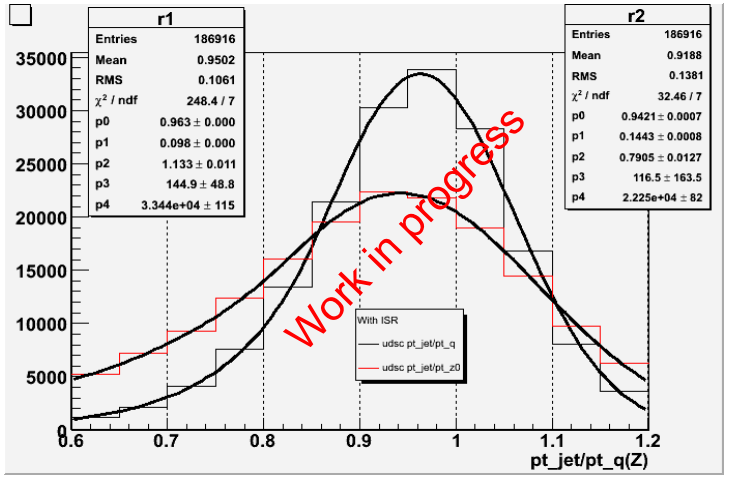
- Light jets not the same in ttbar events and in γ/Z + jets
  - For example the 20% of gluon jets in Z events shift the P_T(jet) / P_T(quark) ratio by -1.5%

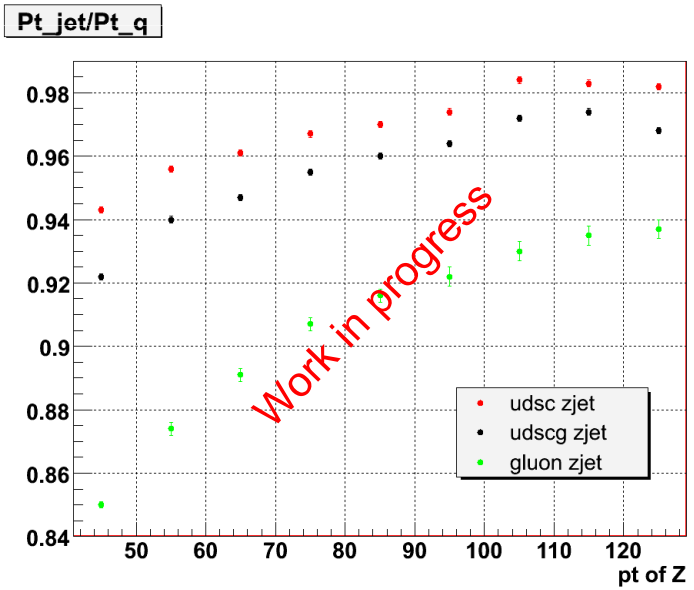
- Only a few % of b jets in γ/Z +jet events → contamination of light jets shifts the PT ratio by +1%

- P_T spectrum of b jets softer in γ/Z +jet → average P_T ratio shifted by -1%

⇒ ***Question shifted to gluon/light/b ratio in γ/Z +jet evts***

Work presented / documented in ATLAS Jet Calibration Task Force





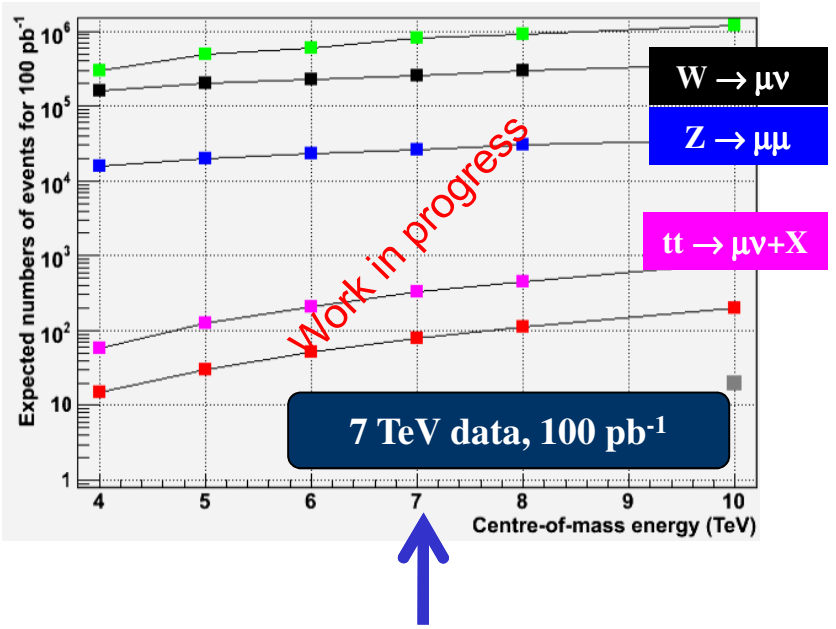
Measurement of the Z+jets cross-section

- PhD thesis by **Chao Xu**
  - From February 2009 to Feb. 2012
  - Co-directed by Zhengguo Zhao (USTC Hefei) and **Eric Lançon**

- Prepare with simulations, then data

- Looked at the σ(W + jets) / σ(Z+jets) ratio
  (W, Z → muons)

  - Can be performed with early data
  - Probe NLO calculation for boosted W/Z bosons
  - Test leptons efficiencies and fake rate estimates
  - Data-driven backgrounds estimates (W+jets background to ttbar, EWK background to jets+Etmiss)

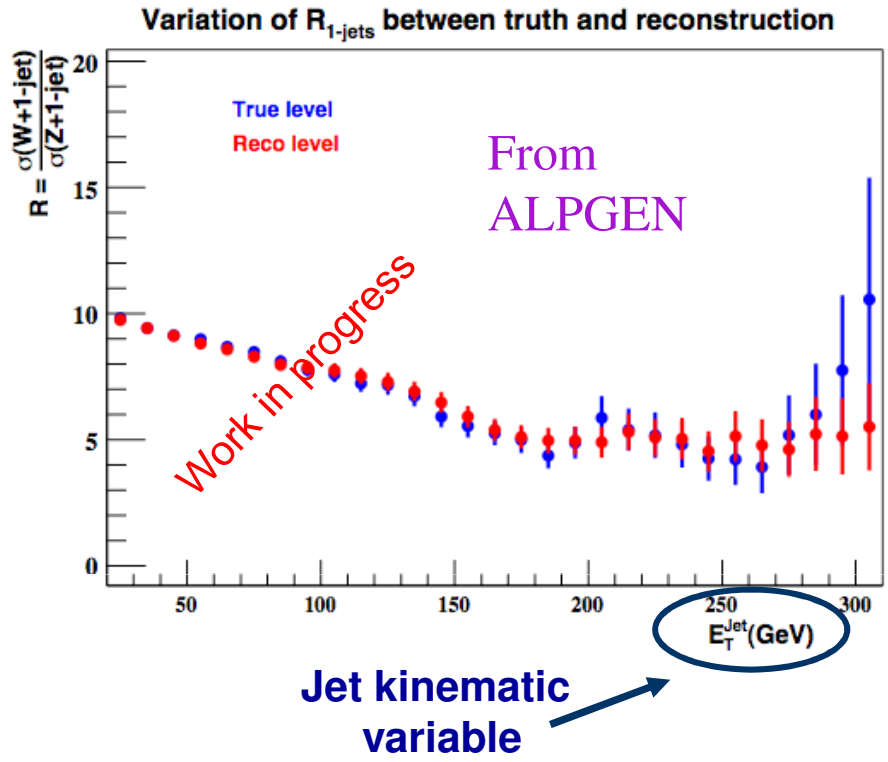


Expect: ~20k Z→ll events, ~200k W→l events

- **ΔR Stat ~ 6-7% for 1 Jet**

The σ(W + jets) / σ(Z+jets) ratio

- Advantages:
  - Jets effects cancel in the ratio
    - Resolution
    - Energy calibration and correction
    - Efficiency of selections
    - migration (unfolding not needed)
  - Non-perturbative QCD effects cancel
  - Luminosity cancel in the ratio



Measure this ratio in many kinematic regions for different jet multiplicities

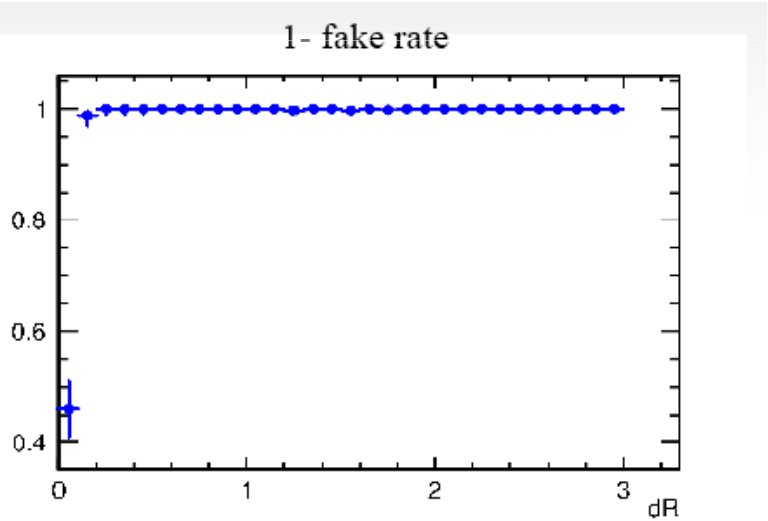
Work within the ATLAS W/Z+jets group

- Event selection
  - Try to improve on default selection

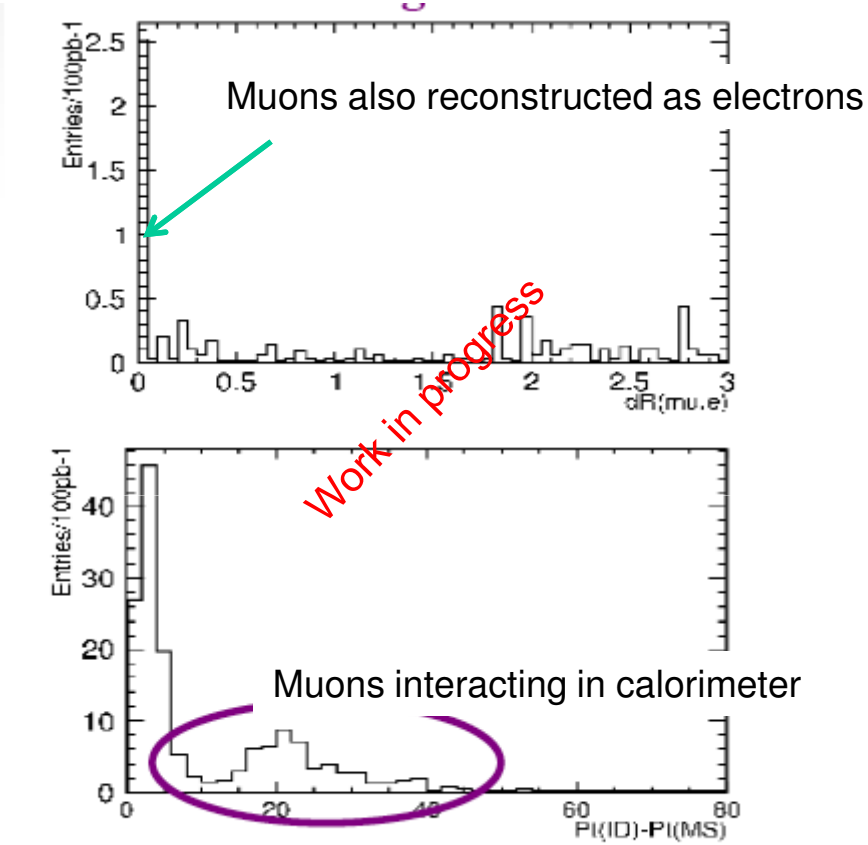
- Muon-jet overlap removal:

Catastrophic losses generate fake jets…

Probability that jet comes from real parton



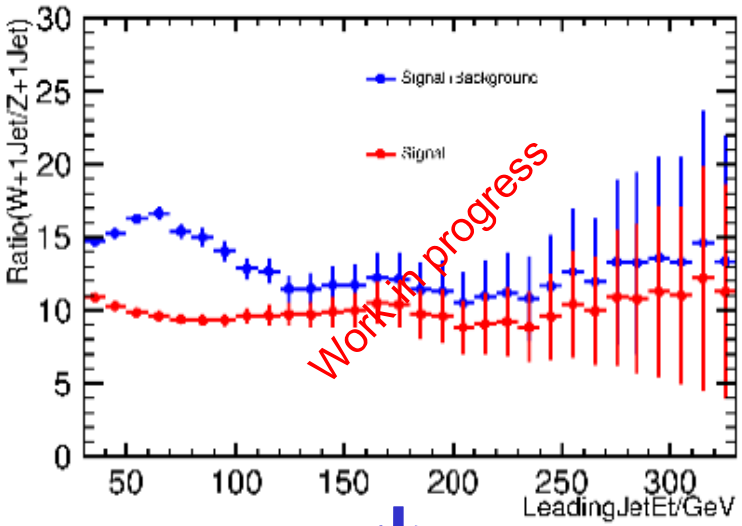
The jet fake rate rises obviously when ΔR(μ,Jet)<0.1



Muon which has ΔR<0.1with the Jet

Background reduction

- Main background is bbar events
  - Can affect the measurement
  - Can be removed by muon isolation cut

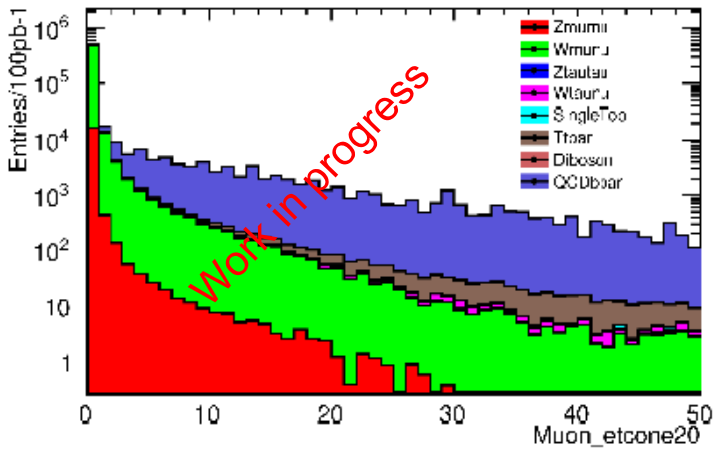


- **Muon/jet Overlap**

+ Background reduction

+ keeping control of efficiencies

=> Need tuning of muon isolation and selection.



Energy deposited within ΔR<0.2 Around the muon after W->μν selection

ttbar cross-section measurement

- PhD thesis by **Jie Yu**
  - From October 2008 to June 2011
  - Co-directed by Shenjian Chen (Nanjing University) and Bruno Mansoulié,

  work with **Jérôme Schwindling**

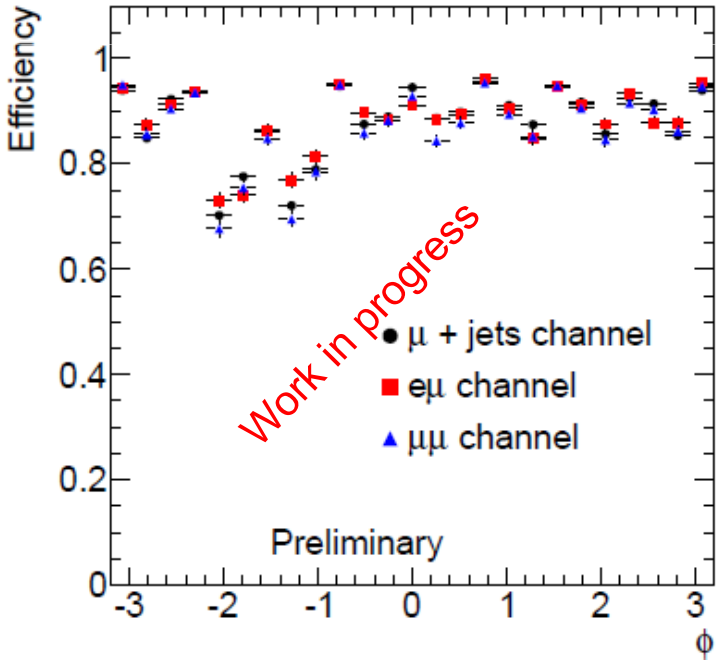
- Worked on trigger efficiency measurement for tt → lνb lνb (l = e or μ) events using a tag and probe method
  - ATL-COM-PHYS-2010-044

- Now working on b-tagging efficiency measurement using ttbar events
  - Work presented at several meetings at CERN
  - First study with 7 TeV simulation

  - See more in his talk

Channel	# Evt (100 pb^{-1})	TrigEff_mu10
$t\bar{t} \to e\nu b\ \mu\nu b$	277.2±1.9	88.2±0.2%
$t\bar{t} \to e\nu b\ \tau\nu b$	19.1±0.5	89.1±0.8%
$t\bar{t} \to \mu\nu b\ \tau\nu b$	17.8±0.5	87.9±0.9%
$t\bar{t}$ other NoHad	4.0±0.2	88.5±1.8%
$t\bar{t}$ FullHad	≤0.1 @95%cl	
single top	11.2±0.9	93.6±2.0%
$Z \to \mu^+\mu^-$	0.3±0.1	≥66.7% @68%cl
$Z \to \tau^+\tau^-$	12.6±1.1	89.1±1.8%
$W \to \mu\nu$	1.3±0.4	≥72.7% @68%cl
Wbb	≤0.5 @95%cl	
diboson	9.7±0.3	89.1±1.1%
total bkg	75.8±2.5	89.7±0.5%

Table 6: Muon trigger efficiency using $t\bar{t} \to e\nu b\ \mu\nu b$



Future thesis

- Higgs -> WW

- Most sensitive channel for SM Higgs search

Sensitivity in the first run at 7 TeV

- Relies strongly on a precise E_T miss

=> Study contribution of muon losses to E_T miss

Administrative work in progress

Candidate PhD student from Nanjing University
Thesis directed by Shenjian Chen and Claude Guyot

Work with **Samira Hassani** (Saclay)

Conclusion

- China CEA-Saclay collaboration is going on smoothly

- For physics: mainly on common theses of PhD students
  - Quite productive work
  - Co-directed thesis is a very good principle but the sharing of time between China and France is not always optimal for the students.

- Atlas upgrade
  - Very good work on R&D (Micromegas et al.)
  - Implementation in Atlas : needs reconsidering in view of the recent LHC schedule.