

LPNHE - Tristan Beau 20th of june 2014









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Outline

- Local LPNHE ATLAS team, PhD subjects
- Few words about the detector
- Two main fields of studies : Higgs & Top quark
- General common detector tasks
- Few words about R&D

ATLAS team @ LPNHE



- 17 permanent physicists (9 from university, 8 from CNRS)
- 3 Post-docs, 6 PhD students
- 8 tecnicians or engineers
- About 20 undergraduate student trainings
- ~150 days of invited collaborators
- 17 seminars, 47 conferences in 2011-2014



Defended PhD

- **Stefania Bordoni** : Mesure de la section efficace de production des quarks beaux et charmes a partir de leur desintegration semileptonique en electrons avec l'experience ATLAS dans les collisions protons-protons a sqrt(s) = 7 TeV au LHC.
- Li Yuan : Mesure de la section efficace de production de paires de photons et étude de sensibilité de recherche du Higgs dans le canal H->gammagamma avec le détecteur ATLAS
- **Timothée Theveneaux-Pelzer** : Mesure de la section efficace de production de paires de quarks top dans les canaux multileptons dans l'expérience Atlas
- Olivier Davignon : Recherche du Boson de Higgs de basse masse dans le processus de production de Fusion de Bosons Vecteurs avec lexpérience ATLAS au collisionneur LHC
- Nicolas Meric : Etude des corrections électrofaibles aux processus QCD, théorie+expérience
- Camila Rangel : Search for Higgs boson in H->gamma gamma channel in ATLAS experiment
- Heberth Torres : Mesure de la production de photons dans l'expérience ATLAS. Application á la recherche du boson de Higgs se désintégrant en deux photons
- Liwen Yao : research on Higgs to di-photon

2011

2012

2013

PhD to be defended

- Aurelien Demilly : Mesure de la masse du quark top dans le canal dileptonique eµ avec le détecteur ATLAS au LHC
- Guillaume Lefebvre : Mesure de la section efficace de production de paires ttbar avec le détecteur ATLAS au LHC
 - Kun Liu : Photon efficiency measurement and search for Higgs boson from H->γγ and H->Zγ with ATLAS
- Sylvestre Pires : Mesure de la masse du quark top dans les canaux en dileptons avec l'experience ATLAS

• Carlo Pandini : FASTRACK et Higgs dans le canal VH->bb

2014

2015

2016

 Yee Yap : Recherche d'un boson de Higgs supplémentaire dans le cadre de modèles à deux doublets de Higgs, à l'aide des désintégrations A->Zh, h->γγ, avec le détecteur ATLAS.

LPNHE ATLAS scientific studies : two main fields

Top properties and measures :

- Cross section
- Mass

Higgs :

- Search
- Measurements

Few words about the LHC...

The Large Hadron Collider (LHC) :

- 27 km long, circular, close to Geneva
- mainly pp collisions
- nominal centre-of-mass energy 14 TeV
 - 2011 : 7 TeV
 - 2012 : 8 TeV



Overall view of the LHC experiments.





First field of study : the Higgs ?

- Postulated mecanism and existence in 1964 (Brout, Englert, Higgs)
- The quest (till mid 2012) :
 - LEP (1989-2000) : m_H>114.4 GeV
 - @Tevatron : excluded $m_{\rm H}$ between 156 and 177 GeV, indications between 115 and 140 GeV
 - @LHC : excluded m_H between 127 and 600 GeV, indications around 125 GeV
- 4th of july, 2012 : observation ATLAS and CMS observation announcement of a Higgs compatible particle
- 24th of july : "evidence" of the decay of that particle in b-bbar pair by CdF and D0
- 14th of march, 2013 : the discovered particle is A Higgs boson, $m_{H} \simeq 125.5$ GeV
- 8th of octobre, 2013 : Nobel price in physics for François Englert and Peter Higgs

First field of study : the Higgs ?

Postulated m

The Nobel Prize in Physics 2013 François Englert, Peter Higgs

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- The quest (til
 - LEP (1989
 - @Tevatrc and 140 (
 - @LHC : ex
- 4th of july, 201 compatible pa
- 24th of july jui
 D0

14th of march

•

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Photo: A. Mahmoud François Englert Prize share: 1/2

2013

Photo: A Mahmoud

The Nobel Prize in Physics

Photo: A. Mahmoud Peter W. Higgs Prize share: 1/2

The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider"

8th of octobre Photos: Copyright © The Nobel Foundation

Higgs)

ndications between 115

ions around 125 GeV

nouncement of a Higgs

b-bbar pair by CdF and

n, m_H ~ 125.5 GeV

slert and Peter Higgs



Higgs production @ LHC



One of the golden channel : Η -> γγ

This channel allow to evaluate the Higgs boson mass with a very good precision, and with a clear signature.



The H -> yy signal ATLAS



The H -> γγ signal in ATLAS : LPNHE contributions



Searches in the H -> Zγ channel



Higgs seen by ATLAS - summary



Multi channel measurements of the Higgs signal

Recent activity in the group with H->bb :

- Analysis optimisation
- Already running for run1

Higgs seen by ATLAS - summary

Spin statistical tests : -> Spin 2 hypothesis exclusion with confidence level of 99.3 %



Higgs seen by ATLAS - summary



19

Some event displays

 $2e2\mu$ candidate with $m_{2e2\mu}$ = 123.9 GeV

 p_{T} (e,e, μ,μ)= 18.7, 76, 19.6, 7.9 GeV, m (e⁺e⁻)= 87.9 GeV, m($\mu^{+}\mu^{-}$) = 19.6 GeV 12 reconstructed vertices



20

Some event displays

H -> γγ candidate

di-photon reconstructed mass : 126.6 GeV



Higgs in ATLAS : what's next @ LPNHE ?

- Extended study channels : H->γγ, H->Zγ, H->bb
- Continuation of spin studies
- Other Higgs candidates searches
- Towards precision measurements

Second field of study : top quark

Observed @ TeVatron in 1995

- Heaviest known elementary particle
- Extra short life time (4.10⁻²⁵ s), it decays before hadronisation





- Detector understanding, top event calibration
- Precision measurements of cross sections, standard Model coherence tests
- Mass measurement, new physics constraints

Top production @ LHC





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Dileptonic channel (ee, µµ, eµ)

- Real of "fake" objects efficiency estimations
- Standard Model Compatible Modèle
- Precision dominated by systematics and theory



Full hadronic channel :

- JES studies (main systematic)
- JER studies via Z-jets



Top mass in dileptonic channel e μ

Matrix Element Method

Computing the differential cross section is the heart of the method:

 $\frac{\mathrm{d}\sigma}{\mathrm{d}x}(m_{top} \mid P) \propto \int \mathrm{d}g_1 \mathrm{d}g_2 \mathrm{d}\Phi |M_{t\bar{t}}(g_1, g_2, x, m_{top})|^2 f_{pdf}(g_1) f_{pdf}(g_2) W(x \mid P)$

- $|M_{t\bar{t}}(g_1, g_2, x, m_{top})|$: matrix element for $g_1g_2 \rightarrow t\bar{t} \rightarrow b\bar{b}e\mu\nu_e\nu_\mu$
- g_1 and g_2 : incoming partons
- x: observables of the final state at the parton level
- $\mathrm{d}\Phi$: phase space for the $pp o t \overline{t} o b \overline{b} e \mu
 u_e
 u_\mu$ process
- f_{pdf}: parton density function
- P: observables of the final state at the reconstructed leve
- $W(x \mid P)$: transfer function from P to x



- Final point of the study @ 7 TeV
- Application to 8 TeV data



Top mass : combined public results



Beyond the top and the Higgs : the success of the Standard Model



28

Beyond the SM in ATLAS ?

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: Moriond 2014

ATLAS Preliminary $\int \mathcal{L} dt = (4.6 - 22.9) \text{ fb}^{-1}$ $\sqrt{s} = 7, 8 \text{ TeV}$

	Model	e, μ, τ, γ	Jets	$E_{ m T}^{ m miss}$	∫ <i>L dt</i> [fb	Mass limit		Reference
Inclusive Searches	$\begin{array}{l} \mbox{MSUGRA/CMSSM} \\ \mbox{MSUGRA/CMSSM} \\ \mbox{MSUGRA/CMSSM} \\ \mbox{MSUGRA/CMSSM} \\ \mbox{$\tilde{q}\tilde{q}, \bar{q} \rightarrow q \tilde{\chi}_{1}^{0}$} \\ \mbox{$\tilde{g}\tilde{z}, \bar{z} \rightarrow q q \tilde{\chi}_{1}^{1}$} \\ \mbox{$\tilde{g}\tilde{z}, \bar$	$\begin{matrix} 0 \\ 1 e, \mu \\ 0 \\ 0 \\ 1 e, \mu \\ 2 e, \mu \\ 2 e, \mu \\ 2 e, \mu \\ 1 \cdot 2 \tau \\ 2 \gamma \\ 1 e, \mu + \gamma \\ \gamma \\ 2 e, \mu + \gamma \\ \gamma \\ 2 e, \mu (Z) \\ 0 \end{matrix}$	2-6 jets 3-6 jets 7-10 jets 2-6 jets 2-6 jets 3-6 jets 0-3 jets 0-2 jets 1 b 0-3 jets mono-jet	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	20.3 20.3 20.3 20.3 20.3 20.3 20.3 4.7 20.7 20.7 20.3 4.8 4.8 5.8 10.5	1.2 T 1.1 Te ¹ 740 GeV 1.3 1.1 Te ¹ 740 GeV 1.3 1.18 T 1.12 Te 1.24 619 GeV 900 GeV 600 GeV 600 GeV 600 GeV	$\begin{array}{llllllllllllllllllllllllllllllllllll$	ATLAS-CONF-2013-047 ATLAS-CONF-2013-062 1308.1841 ATLAS-CONF-2013-047 ATLAS-CONF-2013-047 ATLAS-CONF-2013-062 ATLAS-CONF-2013-068 ATLAS-CONF-2013-026 ATLAS-CONF-2013-026 ATLAS-CONF-2012-144 1211.1167 ATLAS-CONF-2012-152 ATLAS-CONF-2012-152
3 rd gen. <u>§</u> med.	$\begin{array}{c} \bar{g} \rightarrow b \bar{b} \tilde{\chi}_{1}^{0} \\ \bar{g} \rightarrow t \bar{t} \tilde{\chi}_{1}^{0} \\ \bar{g} \rightarrow t \bar{t} \tilde{\chi}_{1}^{0} \\ \bar{g} \rightarrow b \bar{t} \tilde{\chi}_{1}^{1} \end{array}$	0 0 0-1 <i>e</i> , μ 0-1 <i>e</i> , μ	3 b 7-10 jets 3 b 3 b	Yes Yes Yes Yes	20.1 20.3 20.1 20.1	1.2 1.1 Te 1.3 1.3 1.3		ATLAS-CONF-2013-061 1308.1841 ATLAS-CONF-2013-061 ATLAS-CONF-2013-061
3 rd gen. squarks direct production	$ \begin{array}{c} \bar{b}_{1}\bar{b}_{1}, \bar{b}_{1} \rightarrow b\bar{\chi}_{1}^{0} \\ \bar{b}_{1}\bar{b}_{1}, \bar{b}_{1} \rightarrow \bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}(\text{light}), \bar{r}_{1} \rightarrow b\bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}(\text{light}), \bar{r}_{1} \rightarrow b\bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}(\text{medium}), \bar{r}_{1} \rightarrow b\bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}(\text{medium}), \bar{r}_{1} \rightarrow b\bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}(\text{nedium}), \bar{r}_{1} \rightarrow b\bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}(\text{heavy}), \bar{r}_{1} \rightarrow b\bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}(\text{neaved}), \bar{r}_{1} \rightarrow c\bar{\chi}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}^{*} \\ \bar{r}_{1}\bar{r}_{1}^{*} \\ \bar{r}_{1}^{*} \\ \bar{r}_{1}^$	$\begin{matrix} 0 \\ 2 \ e, \mu \ (\text{SS}) \\ 1-2 \ e, \mu \\ 2 \ e, \mu \\ 2 \ e, \mu \\ 0 \\ 1 \ e, \mu \\ 0 \\ 0 \\ 1 \ e, \mu \\ 0 \\ 3 \ e, \mu \ (Z) \end{matrix}$	2 b 0-3 b 1-2 b 0-2 jets 2 jets 2 b 1 b 2 b ono-jet/c-t 1 b 1 b	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	20.1 20.7 4.7 20.3 20.3 20.1 20.7 20.5 20.3 20.3 20.3	100-620 GeV 275-430 GeV 110 <mark>-167 GeV</mark> 130-210 GeV 215-530 GeV 200-610 GeV 320-660 GeV 90-200 GeV 150-580 GeV 290-600 GeV	$\begin{split} & m(\tilde{\chi}_{1}^{0}) < 90 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) = 27 m(\tilde{\chi}_{1}^{0}) \\ & m(\tilde{\chi}_{1}^{0}) = 55 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) = m(\tilde{r}_{1}) \cdot m(W) \cdot 50 \text{GeV}, m(\tilde{r}_{1}) < < m(\tilde{\chi}_{1}^{0}) = 1 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) = 1 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) = 200 \text{GeV} m(\tilde{\chi}_{1}^{0}) - m(\tilde{\chi}_{1}^{0}) = 5 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) = 0 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) = 0 \text{GeV} \\ & m(\tilde{r}_{1}) \cdot m(\tilde{\chi}_{1}^{0}) < 85 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) > 50 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) > 15 \text{GeV} \\ & m(\tilde{\chi}_{1}^{0}) > 200 \text{GeV} \end{split}$	1306.2631 ATLAS-CONF-2013-007 1208.4305, 1209.2102 1403.4853 1403.4853 1308.2631 ATLAS-CONF-2013-037 ATLAS-CONF-2013-058 1403.5222 1403.5222
EW direct	$ \begin{array}{c} \tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell} \rightarrow \ell \tilde{\chi}_1^0 \\ \tilde{\chi}_1^+ \tilde{\chi}_1^-, \tilde{\chi}_1^+ \rightarrow \tilde{\ell} \nu(\ell \tilde{\nu}) \\ \tilde{\chi}_1^+ \tilde{\chi}_1^-, \tilde{\chi}_1^+ \rightarrow \tilde{\ell} \nu(\ell \tilde{\nu}) \\ \tilde{\chi}_1^+ \tilde{\chi}_2^0 \rightarrow \tilde{\ell}_L \nu \tilde{\ell}_L \ell(\tilde{\nu} \nu), \ell \tilde{\ell} \tilde{\ell}_L \ell(\tilde{\nu} \nu) \\ \tilde{\chi}_1^+ \tilde{\chi}_2^0 \rightarrow W \tilde{\chi}_2^0 \ell Z \xi_2^0 \\ \tilde{\chi}_1^+ \tilde{\chi}_2^0 \rightarrow W \tilde{\chi}_1^0 h \tilde{\chi}_1^0 \end{array} $	2 e, μ 2 e, μ 2 τ 3 e, μ 2-3 e, μ 1 e, μ	0 0 0 0 2 b	Yes Yes Yes Yes Yes Yes	20.3 20.3 20.7 20.3 20.3 20.3	90-325 GeV 140-465 GeV 180-330 GeV 700 GeV 420 GeV 2 285 GeV	$\begin{split} & \mathfrak{m}(\widetilde{r}_{1}^{0}){=}0 \text{GeV} \\ & \mathfrak{m}(\widetilde{k}_{1}^{0}){=}0 \text{GeV}, \mathfrak{m}(\widetilde{\ell}, \widetilde{\nu}){=}0.5(\mathfrak{m}(\widetilde{k}_{1}^{+}){+}\mathfrak{m}(\widetilde{k}_{1}^{0})) \\ & \mathfrak{m}(\widetilde{k}_{1}^{0}){=}0 \text{GeV}, \mathfrak{m}(\widetilde{\ell}, \widetilde{\nu}){=}0.5(\mathfrak{m}(\widetilde{k}_{1}^{+}){+}\mathfrak{m}(\widetilde{k}_{1}^{0})) \\ & \mathfrak{m}(\widetilde{k}_{1}^{+}){=}\mathfrak{m}(\widetilde{k}_{2}^{0}), \mathfrak{m}(\widetilde{k}_{1}^{0}){=}0, \mathfrak{m}(\widetilde{\ell}, \widetilde{\nu}){=}0.5(\mathfrak{m}(\widetilde{k}_{1}^{+}){+}\mathfrak{m}(\widetilde{k}_{1}^{0})) \\ & \mathfrak{m}(\widetilde{k}_{1}^{+}){=}\mathfrak{m}(\widetilde{k}_{2}^{0}), \mathfrak{m}(\widetilde{k}_{1}^{0}){=}0, \mathfrak{sleptons} \mathfrak{decoupled} \\ & \mathfrak{m}(\widetilde{k}_{1}^{+}){=}\mathfrak{m}(\widetilde{k}_{2}^{0}), \mathfrak{m}(\widetilde{k}_{1}^{0}){=}0, \mathfrak{sleptons} \mathfrak{decoupled} \end{split}$	1403.5294 1403.5294 ATLAS-CONF-2013-028 1402.7029 1403.5294, 1402.7029 ATLAS-CONF-2013-093
Long-lived particles	Direct $\tilde{\chi}_1^+ \tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$ Stable, stopped \tilde{g} R-hadron GMSB, stable $\tilde{\tau}, \tilde{\chi}_1^0 \rightarrow \tilde{\tau}(\tilde{e}, \tilde{\mu}) + \tau(e, \mu)$ GMSB, $\tilde{\chi}_1^0 \rightarrow \gamma \tilde{G}$, long-lived $\tilde{\chi}_1^0$ $\tilde{q}\tilde{q}, \tilde{\chi}_1^0 \rightarrow qq\mu$ (RPV)	Disapp. trk 0 μ) 1-2 μ 2 γ 1 μ, displ. vtx	1 jet 1-5 jets - - -	Yes Yes Yes -	20.3 22.9 15.9 4.7 20.3	270 GeV 832 GeV 832 GeV 475 GeV 230 GeV 1.0 TeV	$\begin{split} & m(\tilde{\xi}_1^+) \cdot m(\tilde{\xi}_1^0) \!=\! 160 \; \text{MeV}, \; \tau(\tilde{\chi}_1^+) \!=\! 0.2 \; \text{ns} \\ & m(\tilde{\xi}_1^0) \!=\! 100 \; \text{GeV}, \; 10 \; \mu\text{s} \! \cdot\! \tau(\tilde{\chi}) \!<\! 1000 \; \text{s} \\ & 10 \! \cdot\! \tan\! \beta \! <\! 50 \\ & 0.4 \! \cdot\! \tau(\tilde{\chi}_1^0) \! <\! 2 \; \text{ns} \\ & 1.5 \; <\! cr \! <\! 156 \; \text{mm}, \; \text{BR}(\mu) \!=\! 1, \; m(\tilde{\chi}_1^0) \! =\! 108 \; \text{GeV} \end{split}$	ATLAS-CONF-2013-069 ATLAS-CONF-2013-057 ATLAS-CONF-2013-058 1304.6310 ATLAS-CONF-2013-092
RPV	$ \begin{array}{l} LFV \ pp \rightarrow \tilde{\mathbf{v}}_\tau + X, \tilde{\mathbf{v}}_\tau \rightarrow e + \mu \\ LFV \ pp \rightarrow \tilde{\mathbf{v}}_\tau + X, \tilde{\mathbf{v}}_\tau \rightarrow e(\mu) + \tau \\ Bilinear \ RPV \ CMSSM \\ \tilde{X}_1^{\dagger} \tilde{X}_1^{-}, \tilde{X}_1^{+} \rightarrow W \tilde{X}_1^{\dagger} \tilde{X}_1^{-} \rightarrow e \tilde{v}_\mu, e \mu \tilde{v}_e \\ \tilde{X}_1^{\dagger} \tilde{X}_1^{-}, \tilde{X}_1^{+} \rightarrow W \tilde{X}_1^{\dagger} \tilde{X}_1^{-} \rightarrow \tau \tau \tilde{v}_e, e \tau \tilde{v}_\tau \\ \tilde{g} \rightarrow \bar{q}_i q_i \\ \tilde{g} \rightarrow \tilde{i}_i t, \tilde{i}_i \rightarrow b s \end{array} $	$\begin{array}{c} 2 \ e, \mu \\ 1 \ e, \mu + \tau \\ 1 \ e, \mu \\ 4 \ e, \mu \\ 3 \ e, \mu + \tau \\ 0 \\ 2 \ e, \mu \left(\text{SS} \right) \end{array}$	- 7 jets - - 6-7 jets 0-3 b	- Yes Yes Yes - Yes	4.6 4.6 4.7 20.7 20.7 20.3 20.7	1.1 Te 1.2 T 760 GeV 350 GeV 916 GeV 880 GeV	1.61 TeV $\lambda'_{311} = 0.10, \lambda_{132} = 0.05$ χ' $\lambda'_{311} = 0.10, \lambda_{1(2)33} = 0.05$ reV $m(\hat{q}) = m(\hat{g}), c_{T_{SP}} < 1 \text{ mm}$ $m(\tilde{\ell}_{1}^{0}) > 300 \text{ GeV}, \lambda_{121} > 0$ $m(\tilde{\ell}_{1}^{0}) = 80 \text{ GeV}, \lambda_{132} > 0$ BR(r) = BR(c) = BR(c) = 0%	1212.1272 1212.1272 ATLAS-CONF-2012-140 ATLAS-CONF-2013-036 ATLAS-CONF-2013-036 ATLAS-CONF-2013-091 ATLAS-CONF-2013-007
Other	Scalar gluon pair, sgluon $\rightarrow q\bar{q}$ Scalar gluon pair, sgluon $\rightarrow t\bar{t}$ WIMP interaction (D5, Dirac χ) $\sqrt{s} = 7 \text{ TeV}$ full data	$\frac{0}{2 e, \mu (SS)}$	4 jets 2 b mono-jet $\sqrt{s} = \frac{1}{5}$	Yes Yes 8 TeV data	4.6 14.3 10.5	on 100-287 GeV 350-800 GeV Cale 704 GeV 100-1 10	incl. limit from 1110.2693 m(x)<80 GeV, limit of<687 GeV for D8 Mass scale [TeV]	1210.4826 ATLAS-CONF-2013-051 ATLAS-CONF-2012-147

*Only a selection of the available mass limits on new states or phenomena is shown. All limits quoted are observed minus 1 or theoretical signal cross section uncertainty.

Beyond the SM in ATLAS ?

A St	TLAS S	USY Searches	* - 95% CL	Low	er Lim	nits	ATLAS Preliminary			
	Model	ATLAS Exotics Status: April 2014	s Searches	* - 95	5% CL	Exclusion		$\int \mathcal{L} dt = (4.6)$	$\int (dt - (1.0 - 20.3)) \text{fb}^{-1}$ $\int \int dt = (1.0 - 20.3) \text{fb}^{-1}$	AS Preliminary
	MSUGRA/C MSUGRA/C	Model	<i>ℓ</i> ,γ Je	ets E _T	^{niss} ∫£dt[ft	b ⁻¹]	Mass limit		$\int \mathcal{L} dt = (1.0 - 20.3) \text{ ID}^{-1}$	Reference
Inclusive Searches	$\begin{array}{c} \widetilde{q} \widetilde{q}, \widetilde{q} \rightarrow q \widetilde{k}_{0}^{0} \\ \widetilde{q} \widetilde{q}, \widetilde{q} \rightarrow q \widetilde{k}_{1}^{0} \\ \widetilde{g} \widetilde{s}, \widetilde{s} \rightarrow q \widetilde{q} \widetilde{k}_{1}^{1} \\ \widetilde{g} \widetilde{s}, \widetilde{s} \rightarrow q \widetilde{q} \widetilde{k}_{1}^{1} \\ \widetilde{g} \widetilde{s}, \widetilde{s} \rightarrow q q \widetilde{k}_{1}^{0} \\ \widetilde{g} \widetilde{s}, \widetilde{s} \rightarrow q \widetilde{s} \widetilde{s} \widetilde{s}, \widetilde{s} \rightarrow q \widetilde{s} \widetilde{s} \widetilde{s} \widetilde{s}, \widetilde{s} \rightarrow q \widetilde{s} \widetilde{s} \widetilde{s} \widetilde{s} \widetilde{s} \widetilde{s} \widetilde{s} \widetilde{s}$	ADD $G_{KK} + g/q$ ADD non-resonant $\ell\ell/\gamma\gamma$ ADD QBH $\rightarrow \ell q$ ADD BH high N_{trk} ADD BH high Σ_{PT} RS1 $G_{KK} \rightarrow \ell\ell$ RS1 $G_{KK} \rightarrow WW \rightarrow \ell\gamma\ell\gamma$ BS1 $G_{KK} \rightarrow WW \rightarrow \ell\gamma\ell\gamma$	$- 1$ $2\gamma \text{ or } 2e, \mu$ $1 e, \mu$ $2 \mu (SS)$ $\geq 1 e, \mu \geq$ $2 e, \mu$ $\ell \ell \ell \ell = 2 e, \mu$ $2 e, \mu$ $5 b \overline{b} = - 2 e, \mu$	-2 j Yi : 2 j - or - Yi 1 b -	 4.7 4.7 20.3 20.3 20.3 20.3 1.0 4.7 1.9 	М _D M ₅ M _{th} M _{th} G _{KK} mass G _{KK} mass G _{KK} mass	845 GeV 1.23 590,710 GeV	4.37 TeV 4.18 TeV 5.2 TeV 5.7 TeV 6.2 TeV 2.47 TeV	n = 2 n = 3 HLZ NLO n = 6 $n = 6, M_D = 1.5 \text{ TeV, non-rot BH}$ $n = 6, M_D = 1.5 \text{ TeV, non-rot BH}$ $k/\overline{M}_{Pl} = 0.1$ $k/\overline{M}_{Pl} = 0.1$ $k/\overline{M}_{Pl} = 0.1$	1210.4491 1211.1150 1311.2006 1308.4075 ATLAS-CONF-2014-016 ATLAS-CONF-2013-017 1203.0718 1208.2880 ATL & SCONF-2014-005
3 rd gen. <u>§</u> med.	$\begin{array}{l} \tilde{g} \rightarrow b \bar{b} \tilde{\chi}_{1}^{0} \\ \tilde{g} \rightarrow t \bar{t} \tilde{\chi}_{1}^{0} \\ \tilde{g} \rightarrow t \bar{t} \tilde{\chi}_{1}^{0} \\ \tilde{g} \rightarrow b \bar{t} \tilde{\chi}_{1}^{+} \end{array}$	Bulk RS $g_{KK} \rightarrow t\bar{t}$ S^1/Z_2 ED UED	$1 e, \mu \ge 1 b,$ $2 e, \mu$ 2γ	≥ 1J/2j Yi 	'es 14.3 - 5.0 'es 4.8	g_{KK} mass $g_{KK} \approx R^{-1}$ Compact. scale R^{-1}	1.	0.5-2.0 TeV 4.71 TeV 41 TeV	R/MP = 1.0 BR = 0.925	ATLAS-CONF-2012-003 ATLAS-CONF-2013-052 1209.2535 ATLAS-CONF-2012-072
en. squarks t production	$ \begin{split} \tilde{b}_1 \tilde{b}_1, \tilde{b}_1 \rightarrow b \tilde{k} \\ \tilde{b}_1 \tilde{b}_1, \tilde{b}_1 \rightarrow t \tilde{k} \\ \tilde{r}_1 \tilde{r}_1 (\text{light}), \tilde{r}_1 \rightarrow t \tilde{k} \\ \tilde{r}_1 \tilde{r}_1 (\text{light}), \tilde{r}_1 \\ \tilde{r}_1 \tilde{r}_1 (\text{medium}) \\ \tilde{r}_1 \tilde{r}_1 (\text{medium}) \end{split} $	$\begin{array}{c} \mathrm{SSM}\ Z' \to \ell\ell\\ \mathrm{SSM}\ Z' \to \tau\tau\\ \mathrm{SSM}\ W' \to \ell\nu\\ \mathrm{EGM}\ W' \to WZ \to \ell\nu\ \ell'\ell\\ \mathrm{LRSM}\ W'_R \to t\bar{b}\end{array}$	2 e,μ 2 τ 1 e,μ 3 e,μ 1 e,μ 2 b,	– - Yi – Yi – Yi , 0-1 j Yi	- 20.3 - 19.5 Yes 20.3 Yes 20.3 Yes 14.3	Z' mass Z' mass W' mass W' mass W' mass		2.86 TeV 1.9 TeV 3.28 TeV 1.52 TeV 1.84 TeV		ATLAS-CONF-2013-017 ATLAS-CONF-2013-066 ATLAS-CONF-2014-017 ATLAS-CONF-2014-015 ATLAS-CONF-2013-050
3 rd gi direc	$ \begin{array}{l} \tilde{t}_1 \tilde{t}_1 (\text{heavy}), \tilde{t}_1 \tilde{t}_1 (\text{heavy}), \tilde{t}_1 \tilde{t}_1, \tilde{t}_1 \rightarrow c \tilde{\chi}_1^0 \\ \tilde{t}_1 \tilde{t}_1, \tilde{t}_1 \rightarrow c \tilde{\chi}_1^0 \\ \tilde{t}_1 \tilde{t}_1 (\text{natural C}), \tilde{t}_2 \rightarrow \tilde{t}_1 + \end{array} $	Cl qqqq Cl qqqt Cl uutt	– 2 e,μ 2 e,μ (SS) ≥ 1 b	2j - o,≥1j Y	- 4.8 - 5.0 /es 14.3	Λ Λ Λ		7.6 TeV 3.3 TeV	$\eta = +1$ 13.9 TeV $\eta_{LL} = -1$ C = 1	1210.1718 1211.1150 ATLAS-CONF-2013-051
d EW direct	$ \begin{array}{c} \tilde{\ell}_{\mathrm{L,R}} \tilde{\ell}_{\mathrm{L,R}}, \tilde{\ell} \rightarrow \\ \tilde{\chi}_{1}^{\dagger} \tilde{\chi}_{1}^{-}, \tilde{\chi}_{1}^{+} \rightarrow \tilde{\ell} \\ \tilde{\chi}_{1}^{\dagger} \tilde{\chi}_{1}^{-}, \tilde{\chi}_{1}^{+} \rightarrow \tilde{\ell} \\ \tilde{\chi}_{1}^{\dagger} \tilde{\chi}_{1}^{-}, \tilde{\chi}_{1}^{+} \rightarrow \tilde{\tau} \end{array} $	EFT D5 operator EFT D9 operator	- 1 - 1 J,	-2j Ya ≤1j Ya	Yes 10.5 Yes 20.3	M. M.	731 GeV	2.4 TeV	at 90% CL for $m(\chi) < 80$ GeV at 90% CL for $m(\chi) < 100$ GeV	ATLAS-CONF-2012-147 1309.4017
	$\begin{array}{c} \chi_1 \chi_2 \rightarrow \ell_L \nu \ell_L \\ \tilde{\chi}_1^{\pm} \tilde{\chi}_2^{0} \rightarrow W \tilde{\chi}_1^{0} \\ \tilde{\chi}_1^{\pm} \tilde{\chi}_2^{0} \rightarrow W \tilde{\chi}_1^{0} \\ \end{array} \qquad \qquad$	Scalar LQ 1 rd gen Scalar LQ 2 nd gen Scalar LQ 3 rd gen	2e ≥ 2μ ≥ 1e,μ,1τ 1b	:2j - :2j - o,1j -	- 1.0 - 1.0 - 4.7	LQ mass LQ mass LQ mass	660 GeV 685 GeV 534 GeV		$\beta = 1$ $\beta = 1$ $\beta = 1$	1112.4828 1203.3172 1303.0526
Long-live particles	Stable, stopp GMSB, stabl GMSB, $\tilde{\chi}_1^0 \rightarrow \tilde{q}\tilde{q}, \tilde{\chi}_1^0 \rightarrow qq\mu$	Vector-like quark $TT \rightarrow H$ Vector-like quark $TT \rightarrow M$ Vector-like quark $BB \rightarrow Z$ Vector-like quark $BB \rightarrow M$	$\begin{aligned} t + X & 1 e, \mu & \ge 2 t \\ t + X & 1 e, \mu & \ge 1 t \\ b + X & 2 e, \mu & \ge \\ t + X & 2 e, \mu & (SS) & \ge 1 t \end{aligned}$	b,≥4j Ya b,≥3j Ya 2b - b,≥1j Ya	res 14.3 res 14.3 - 14.3 res 14.3	T mass T mass B mass B mass	790 GeV 670 GeV 725 GeV 720 GeV		T in (T,B) doublet isospin singlet B in (B,Y) doublet B in (T,B) doublet	ATLAS-CONF-2013-018 ATLAS-CONF-2013-060 ATLAS-CONF-2013-056 ATLAS-CONF-2013-051
RPV	LFV $pp \rightarrow \tilde{v}_{\tau}$ Bilinear RPV $\tilde{\chi}_{1}^{+}\tilde{\chi}_{1}^{-}, \tilde{\chi}_{1}^{+} \rightarrow V$ $\tilde{\chi}_{1}^{+}\tilde{\chi}_{1}^{-}, \tilde{\chi}_{1}^{+} \rightarrow V$ $\tilde{g} \rightarrow qqq$ $\tilde{g} \rightarrow \tilde{r}_{1}t, \tilde{t}_{1} \rightarrow b$	Excited quark $q^* \rightarrow q\gamma$ Excited quark $q^* \rightarrow qg$ Excited quark $b^* \rightarrow Wt$ Excited lepton $\ell^* \rightarrow \ell\gamma$	1 γ 	1j - 2j - 2jor1j Yi 	- 20.3 - 13.0 /es 4.7 - 13.0	q* mass q* mass b* mass (* mass	870 GeV	3.5 TeV 3.84 TeV 2.2 TeV	only u^* and d^* , $\Lambda = m(q^*)$ only u^* and d^* , $\Lambda = m(q^*)$ left-handed coupling $\Lambda = 2.2 \text{ TeV}$	1309.3230 ATLAS-CONF-2012-148 1301.1583 1308.1364
Other	Scalar gluon Scalar gluon Scalar gluon WIMP intera	LRSM Majorana ν Type III Seesaw Higgs triplet $H^{\pm\pm} \rightarrow \ell\ell$ Multi-charged particles Magnetic monopoles	$2 e, \mu$ $2 e, \mu$ $2 e, \mu$ (SS) $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$	2 j	- 2.1 - 5.8 - 4.7 - 4.4 - 2.0	Nº mass N* mass 245 G H** mass multi-charged particle mass monopole mass 10-1	409 GeV 409 GeV 490 GeV 862 GeV	1.5 TeV	$m(W_R) = 2$ TeV, no mixing $ V_e =0.055, V_{\mu} =0.063, V_{\tau} =0$ DY production, BR $(H^{\pm\pm} \rightarrow \ell\ell)=1$ DY production, $ q = 4e$ DY production, $ g = 1g_D$	1203.5420 ATLAS-CONF-2013-019 1210.5070 1301.5272 1207.6411
On	y a selectió		13 = 7 10			10-*		1	Mass scale [TeV]	

*Only a selection of the available mass limits on new states or phenomena is shown.

Performance tasks and detector studies

Physics at LHC: ATLAS photons and electrons studies



Performance tasks and detector studies

Performances : MET

Widely used in ATLAS, in standard model measurement, and particularly interesting in new physics (SUSY, Dark Matter,...) searches

naive definition: measurement of what is missing in the transverse plane to balance the event



Performance tasks and detector studies



Qualification tasks

- Aurélien : Lar channel patching study
- Camila : study of impact pf electrode resistors on HV in the calorimeter
- **Carlo :** FTK TDAQ pattern bank for 2015 data taking and performance studies.
- **Guillaume** : EM calorimeter performance, impact of HV corrections on energy resolution
- **Heberth** : Development and optimization of software tools to access calorimeter L1 trigger tower info at L2, documentation of HLT calo monitoring. Develoment of software tool to propagate energy calibration from L1TT to L2TT
- **Kun** : photon medium trigger for 2012 data taking (8 TeV) and measure of the trigger efficiency, mainly used <u>for H->gammagamma</u> analysis.
- **Liwen** : Parametrisation of automatic data checks algo for the whole <u>Calorimeter</u> Trigger HLT.
- Sylvestre : B-tagging performances with IBL, simulation for <u>e-gamma</u>
- **Timothée :** calorimeter high voltage studies
- Yee : optimisation of converted photon reconstructions with the EM calorimeter for the run2

ATLAS R&D at LPNHE

- The LPNHE was largely involved in the Liquid Argon calorimeter building and implementation
- Thermal studies
 - Slaves
 - Silicon buried micro-channels based cooling
- Mechanical studies for the Inserted B-Layer (IBL), which has been inserted last weeks in ATLAS
- Switch to the updates for High Luminosity phasis (internal pixel detector)
 - Edgeless sensors
 - TCAD studies
 - Radiation hardness studies
 - Beam tests





Edgeless pixels @ LPNHE

- Joint FBK-LPNHE project
- Soal: thin, edgeless pixel sensors
- > Target: intermediate layers
- How: make the border a damage free ohmic contact by DRIE
- 200 µm thick n-on-p production
 - 500 µm temporary support wafer
- Pixel-to-trench distance as low as 100 μm

M. Bomben - R&D for Atlas Planar Pixels for the HL-LHC - 28/03/2014







Radiation damage studies





• Used to extract information about depletion voltage, current density, etc

logC logV





Thanks for your attention

