# WP1: "New particles search": status and future plans

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FP7 meeting
November 13 2014

# Outline

- Summary of status of
  - activities
  - Events/secondments
  - Notes
  - Plans for 2015

- Going through the effort on the analyses
  - Individual contributions

# WP1 activities in 2014

- 1.1 SM Higgs discovery in the H→ZZ→4l:
  - Interpretation of 4l results in the context of the EWK singlet model → contribution to the "High mass" paper.
  - Optmization of signal and bagkround fits, statistical analysis
  - Measurement of the differential cross section
- 1.2 Search for Z'→ee/μμ and W'→μν
  - consolidation of Z'→ee analysis with studies about validation of ECAL crystal calibration for high ET electrons and contribution to CSA14
  - New Z'→μμ analysis; strong controbution first to reproduce existing results, then to exercise for CSA14
  - W'→μν analysis with contribution to study the MET from data
  - Z' in B-L and Higgs single
- 1.3 Setup of a CMS analysis center at AINSHAM U.
  - Tier-3 cluster working at AINSHAM U.
  - but also at Zewail City and ??

# Schools/Secondments in 2014

4th School:

- 4th Egyptian School on High Energy Physics, 26th April - 5th May 2014, the British University and Ain-Shams University
- quite successful school: many students, prize for the best students, several contacts established.
- multiple visits in Egypt → improved the collaboration

We got 4 people at POLIBA and 1 at ECOLE for WP1:

- Ahmed Ali Abdelalim  Reham Aly  at poliba
- Asmaa Fawzi Ali HassanAhmed Fouad at poliba
- Sherif Elgammal at Ecole Poly
- **Shaban Khalil**  at Ecole Poly
- the activity was quite intense and efficient both at Bari and Poliba (thanks to Sherif and Ahmed Ali) →  a lot of progress
- We need to finalize the work and continue the effort with efficiency.

# Notes/Documents

- “High mass” paper: HIG-13-031 to be approved by end of the year
- 4l analysis: arXiv in prep.: (Reham, Ahmed Ali)
- Z’(B-L): http://arxiv.org/abs/1405.7550
- 4l resonance: Higgs sector: arXiv in prep. (Ahmed Ali Abdelalim, Ahmed Hammad, Shabaan Khalil)
- AN for calibraion of High ET electrons by P. Mine, S. Elgamma

# Plans for 2015

- To continue with the current effort on analyses for the Run 2.
- To get more involved in studies for the upgrade
- To organize service work in Muon and Egamma POG
- To do more effort to ensure visibility, competitivity and realibility of students in the collaboration

# Going through

# Going through the analyses

- Z’ to di-lepton analysis.
- Higgs differential cross-section H->ZZ*-> 4 lepton.
- Heavy Neutrino, Z’ (B-L) and Higgs Singlet+SM phenomenology studies.
- H -> ZZ* -> 4 lepton analysis at 14 TeV.
- W’ to muon + MET at 14 TeV.
- Mu* analysis (two channels: mu+mu* -> mu mu gamma, and mu+mu*-> mu mu Z -> 4 mu)

# Z' -> mu mu analysis

- Nicola De Filippis, Sherif Elgammal (also Z'->ee), Ahmed Fouad
- Ahmed Ali Abdelalim.

Working within the Z' –> 2 mu analysis Italian group.

Step 0: is to reproduce the results of Z'-> mu mu at 8 TeV analysis (AN 12 422). Done
Preparing for Run II
Here is a like for the last group meeting
https://indico.cern.ch/event/317926/

- Sherif is developing his own code (producing flat root trees and analyze them) and the code is used by Ahmed Fouad.

Here is the results from Sherif from the last group meeting
https://indico.cern.ch/event/317926/contribution/2/material/slides/0.pdf

- I am looking at the existing code (Zprime2muAnalysis) package (also others in the Zprime 2 mu italian group, Raffaella Radogna, Bari)

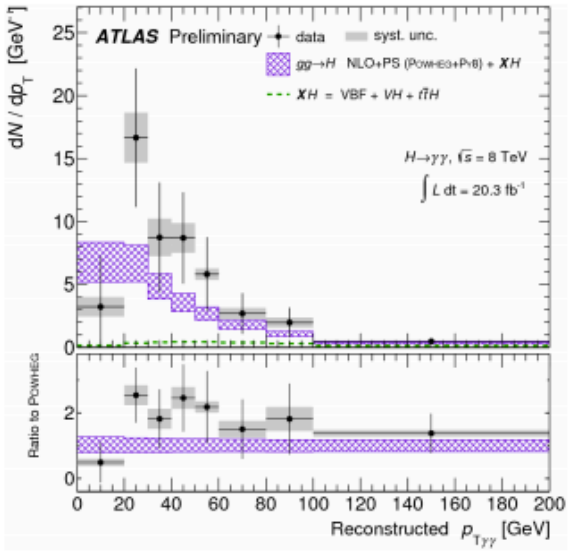
# Higgs differential cross-section

Aim: is to measure the Higgs boson differential cross-sections in the H->ZZ*->4l decay channel.

Strategy:

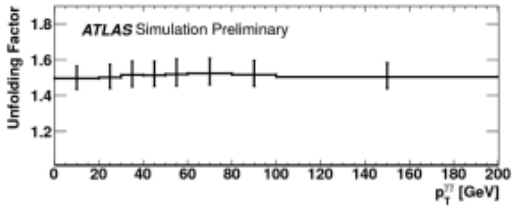
- Pick some distribution at reconstruction level after full selection.
- Unfolding the distribution to particle level:
  - Bin-by-bin multiplicative factor: $c_{bin\_i} = (n_{bin\_i})^{part}/(n_{bin\_i})^{reco}$
  - Both of $(n_{bin\_i})^{part}$ and $(n_{bin\_i})^{reco}$ will be determined from simulation.
  - Define fiducial region at particle level (close to the reco. level), i.e., same kinematic cuts as reco. level, remove cracks, dead regions…
- Unfolded distributions allow for direct comparison with theory prediction.

Nicola De Filipes,
Ahmed Ali Abdelalim




Atlas H to diphoton analysis

Correction of detector effect

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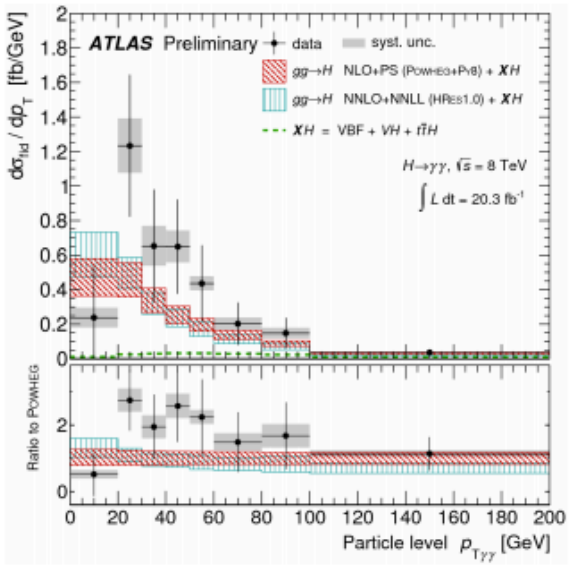


# Heavy Neutrino and Z' (B-L) phenomenology

Ahmed Ali Abdelalim, Ahmed Hammad, Shabaan Khalil http://arxiv.org/abs/1405.7550

In this paper (submitted to PRD) we studied the possible signatures at LHC of the heavy neutrinos and neutral gauge bosons Z' in a TeV scale B-L extension of the SM. We showed that because of the new decay channels of Z' into heavy and/or inert neutrinos current bounds on Z' mass can be relaxed. We analyzed several signatures in detail:

- $4\,l + 2\,\upsilon_l$
- $4\,j + 2\,l$
- $3\,l + 2\,j + \upsilon_l$

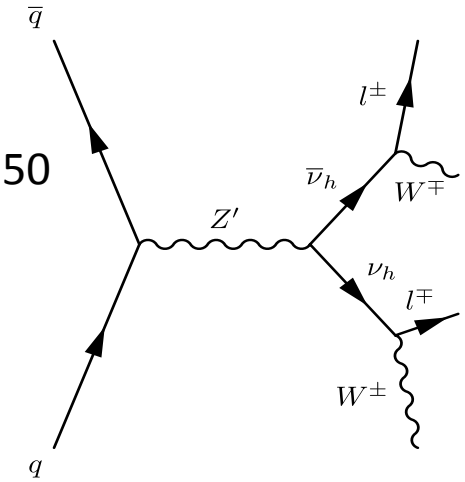
We showed that the most promising channel is $4\,l + 2\,\upsilon_l$ .

A comparison with the proper SM background. Moreover a comparison with the SSM were also done.

**Acknowledgments**

http://arxiv.org/abs/1405.7550

This work was partially supported by ICTP grant AC-80. The work of A. A. Abdelalim was supported by EENP2 FP7-PEOPLE-2012-IRSES grant. We would like also to acknowledge Florian Staub for the useful discussion.



# Four lepton Resonance at LHC "Higgs Sector"

Not final

On arXiv soon

Ahmed Ali Abdelalim, Ahmed Hammad, Shabaan Khalil

In this paper we studied a minimal extension of the scalar sector of the SM that contains an additional real scalar field with no gauge quantum numbers, such a field does not couple to the quarks and leptons directly but rather through its mixing with the SM Higgs field. We considered a small mixing between the SM Higgs and the new heavier scalar particle. We studied the new "Higgs" 4 leptons signatures at LHC through the channels

- h1 → ZZ → 4 *l*
- h1 → ZZ → 4 *l*
- h1 → ZZ → 4 *l*

We tested also the computability between the light Higgs and SM Higgs.

See Ahmed Hammad's talk today

**Acknowledgments**

This work was partially supported by ICTP grant AC-80. The work of A. A. Abdelalim was supported by EENP2 FP7-PEOPLE-2012-IRSES grant. We would like also to acknowledge Florian Staub for the useful discussion.

# Higgs -> ZZ*-> 4 l

Nicola De Filippis, Reham Aly, Ahmed Ali Abdelalim

New MC study on at 14 TeV (will be published soon)

Reproduce limits for SM Higgs and do the same for the high mass Higgs

See Reham's talk today

# W' to muon + MET at 14 TeV

Asmaa Hassan, Ahmed Ali Abdelalim

New MC study on at 14 TeV (will be published soon)

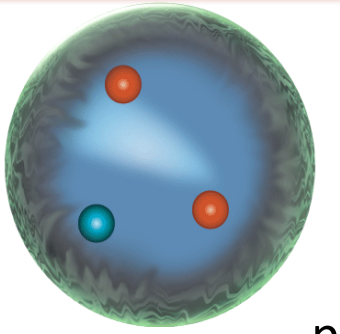
See Asmaa's talk today

# Mu* analysis

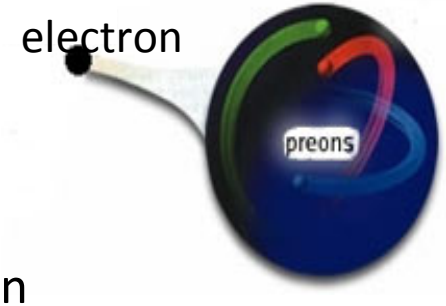
Waleed Ahmed, Walaa Elmetenawee, Amr Mohammed, Ahmed Ali Abdelalim

**Compositeness model:** leptons and quarks are agglomeration of smaller constituents called preons. The constituents could be 3 fermions or a fermion and a boson. These features are visible above a characteristic energy scale Λ below which quarks/leptons appear point like. Compositeness model can address some of the SM shortcomings like:

- **Fermion generations and their masses hierarchy**
- **Free parameters:** it may explain parameters such as electric charge, and color charge.

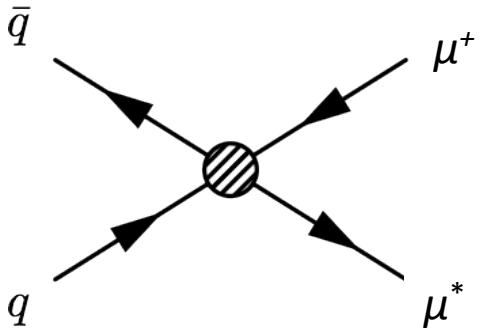


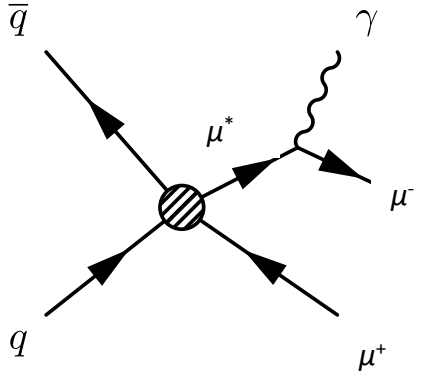
proton

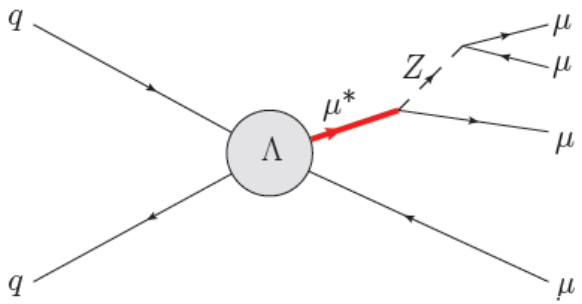


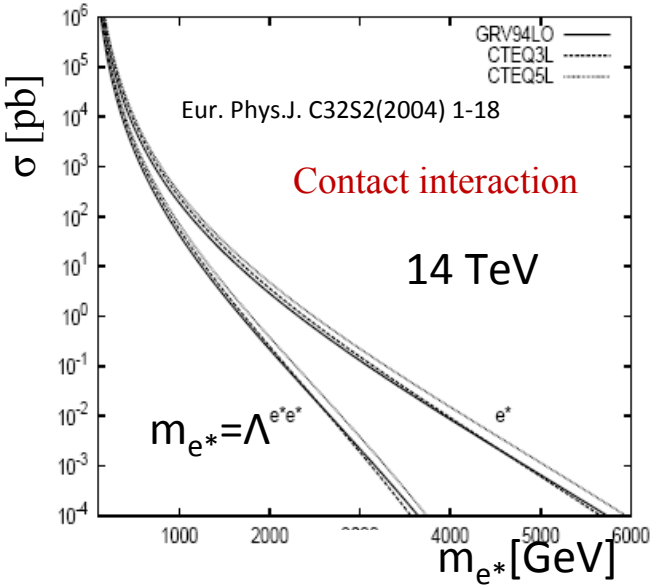

Only 2 free parameters Λ and $m_{\mu^*}$

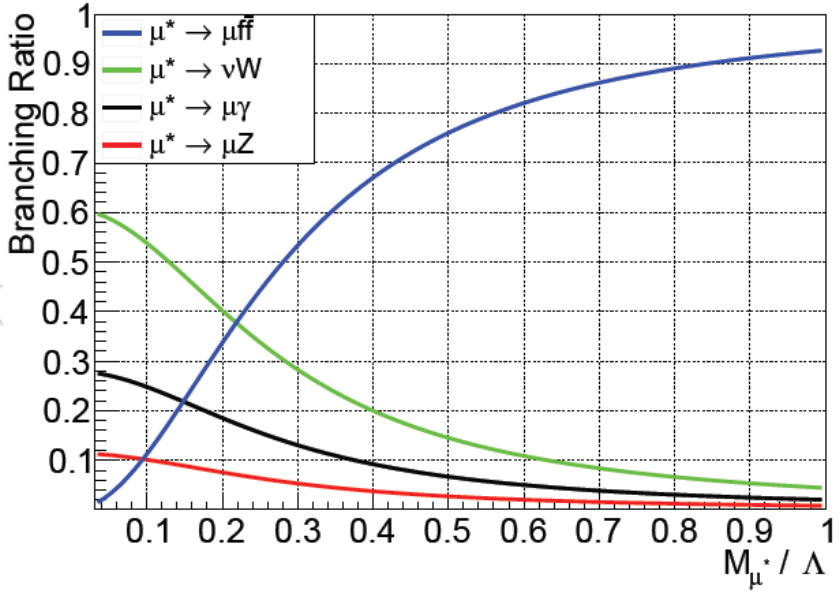
# μ*: Production and decay



# Mu* analysis (3)

Waleed Ahmed, Walaa Elmetenawee, Amr Mohammed, Ahmed Ali Abdelalim

Coated from Waleed's talk for the status of mu+mu*->mu mu Z-> 4 mu
https://indico.cern.ch/event/331528/contribution/0/material/slides/1.pdf

"I have used the data collected in 2012 with center of mass energy 8TeV, and corresponding luminosity 19.7fb$^{-1}$.
Dataset name: **DoubleMuParked/Run2012A-22Jan2013-v1/AOD.**
Trigger**: dimuon trigger HLT_Mu17_Mu8_v**
Number of events**:** 6432930
Release used**: CMSSW_5_3_14"**

**Status of mu+mu* -> mu mu gamma analysis is in Walaa latest talk**
**https://indico.cern.ch/event/331528/contribution/0/material/slides/3.pdf**

See Waleed's talk today