#### HiggsTools Initial Training Program: Mid Term Review

Giulia Gonella Albert-Ludwigs-Universität Freiburg

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Giulia Gonella - Early Stage Researcher 6



...Where exactly? Experimentelle Teilchenphysik Abteilung Prof. Karl Jakobs

Albert-Ludwigs-Universität Freiburg

Giulia Gonella - ESR6

### The project

### Experimental analysis optimisation for vector boson scattering

The presence of a light Standard Model Higgs boson regularises the scattering of longitudinally polarised vector bosons by introducing additional diagrams



Is the Higgs boson fully doing its job?

Need to study VV interactions: VV scattering is the key process to probe EWSB





 $\rightarrow$  My main focus: scattering of same-sign W bosons

Albert-Ludwigs-Universität Freiburg

Giulia Gonella - ESR6

#### The project within the Work Package

#### GOALS

#### Investigation of VBS

with pp-collision data of the ATLAS experiment at 13 TeV center of mass energy

quartic gauge couplings

Measurement of same sign WW scattering cross section and comparison to predictions within the SM

#### WP1:

Assessment of the interpretation of experimental results. compatibility with the SM, constraints on physics beyond the SM discrimination of different models

#### **TECHNIQUES**

Development of an optimal analysis strategy with the new 13 TeV data

Determination of electrons charge mis-identification probability in the context of ATLAS authorship qualification project

Study of systematics in the context of Monte Carlo simulation



#### M 1.1.2

Extraction of model-independent results on the VV-VV cross section

#### M 1.3

Interpretation of experimental results in different models

### Main results - Research | Charge mis-identification

Opposite-sign events is a consistent background: a correct reconstruction of the charge is vital

Leptons charge can be mis-identifed



In this context a lot of work on-going:

• Work and present inside **combined-performance working group** *E/gamma* and *Tag & Probe*, in the context of the authorship qualification task (to be completed in 1 year)

Implementation of **official Tool** (part of common ATLAS software) to apply the correction for charge mis-identification

- Test, improve and apply Tool functionalities
- Monte Carlo studies for optimization of charge mis-identification estimation



### Main results - Research | Vector Boson Scattering

#### Analysis of WW scattering in same-sign final state



- Hands put on the framework for the analysis
- Started analysing special VBS features for the future analysis optimization, following Run 1 analysis structure
- Started a transversal collaboration with other people involved in the analysis (visits to CERN)
- Early data/Monte Carlo agreement in control regions

Aim of the analysis  $\rightarrow$  observation

### Main results - Training and Outreach

#### External training

- ATLAS HWW Software Framework Tutorial CERN, Geneva, CH December 2014
- ATLAS Software Tutorial CERN, Geneva, CH - January 2015





- Teaching activity in Laboratory classes
- German classes (2 terms so far, 1 on-going)
- Participation in weekly seminars from the *Research Training Group GRK 2044* in Freiburg (Students speaker from October 2015)

#### Outreach

• Participated to the interactive exhibition *Von Einstein zu Higgs* Freiburg, DE - June 2015



• Work on-going among ESRs for outreach activities...

#### Main results - Conferences and schools

#### HiggsTools events

- First Young Researchers Meeting @ Lumley Castle, UK - February 2015
- First Annual Meeting @ Freiburg, DE -April 2015  $\rightarrow$  Talk Measurement of cross sections in vector-boson scattering processes:  $W^{\pm}W^{\pm}$ production cross section measurement with the ATLAS detector  $@\sqrt{s} = 8$  TeV and 13 TeV prospects
- First Summer School @ Palleusieux, IT -June 2015

#### HiggsTools Journal Club:

 $\rightarrow \mathsf{Talk}$ 

Higgs Constraints from vector boson fusion and scattering

### Other events

 GRK 2044 - Fall Workshop Gengenbach, DE - September 2015 → Poster



 ATLAS e/gamma Workshop 2015 Annecy-le-Vieux, FR - *incoming* November 2015 → Talk
Talk

Topic: charge mis-identification effort summary talk

Technical issues and obstacles to jump are part of everyday life...

Two main encountered so far:

### • Approaching the new ATLAS software framework

• Work on the definition of the *truth* charge for the electrons WORK IN PROGRESS

#### Technical points

The ATLAS software framework has an articulate and complex structure  $\to$  not so easy to understand the operation at first glance

 $\downarrow$ 

- learning *C*++ and *Python*
- Useful workshops and constant help by many people in the node

The definition of **truth** electron that correspond to the reconstructed one is not straightforward

Many issues encountered to find an agreement on definitions and their implementation

- Code tested
- Many comparisons and validations performed
- Deep knowledge of code gained
- $\bullet~$  Bug found in official code  $\rightarrow~$  fixed





- Continue and constant work on the charge mis-identification in the Tag & Probe group
- Data and background preliminary results in 2016 along the lines of published analysis
- End of ATLAS qualification task: becoming ATLAS author
- Secondment at Maplesoft
- Further optimization of the analysis technique
- More data  $\rightarrow$  Secondment at CERI
- ullet Eventual reduction of systematics with a MC study o Secondment in Durham, UK
- Final results in 3 years with all statistic of LHC Run 2



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# Thanks for your attention!