

INSIGHTS Mid-term review

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THE UNIVERSITY
of EDINBURGH



Briefly introduction:

- ↪ **Serena Palazzo** born in Calabria (Italy), 29 years.
- ↪ ESR within the INSIGHTS network → Started middle of June 2018.
- ↪ Institute: The University of Edinburgh.
- ↪ Supervisor: Michele Faucci Giannelli

Education:

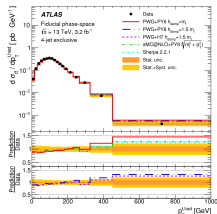
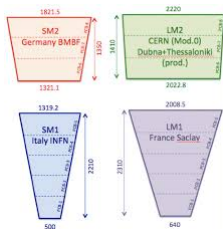
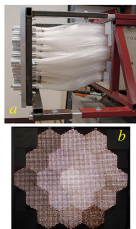
- ↪ Bachelor's degree in 2011 at the University of Calabria, Italy
- ↪ Master's degree in 2014 at the University of Calabria, Italy
- ↪ PhD 2018 (after being hired in the INSIGHTS) at the University of Calabria, Italy



My previous experience

- ↪ Calibration of DREAM calorimeter.
- ↪ MicroMegas chambers for the Phase1 upgrade of the Muon Spectrometer of the ATLAS experiment.
- ↪ Measurements of differential cross sections of top quark pairs in association with jets.

- ◆ Unfolding work for the extraction of the cross sections (ATLAS experiment).



My INSIGHTS project

I am working within the ATLAS collaboration at CERN involved in:

↪ Top quark working group.

↪ Fast Simulation group.

Top quark group:

↪ Differential cross section measurements of top quark pairs in both $l+\text{jets}$ and all hadronic channels (2 analyses)

↪ Extraction of top quark pole mass from double differential $t\bar{t}$ measurements.

↪ I was appointed for the role of Muon Liaison for the Top quark working group (1 year, started in November).

Fast simulation group:

↪ Use of deep neural network techniques, in particular GANs, for the ATLAS Calorimeter Fast Simulation.

Long term plan (next year):

↪ Lead a new differential measurement in top quark or Higgs physics.

Unfolding procedure

- ↪ The **unfolding** is used to measure differential cross sections from detector level distributions.
- ◆ Corrects for detector effects.
 - ◆ The correction from the detectors effects is needed to do a comparison with theoretical predictions.

Inverse problem

$$y = Ax \longrightarrow x = A^{-1}y$$

Determine the particle level ("truth") distribution y from the measured distribution x .

A is the *response matrix* which represents the transition from x to y → estimated from the MC signal simulation.

Status of work within Top group

Measurements of differential $t\bar{t}$ cross sections in both the ℓ +jets and All hadronic channels (2 analyses):

My roles in these analyses:

- ↪ Carry on the unfolding work for the extraction of the cross sections.
- ↪ Carry on several tests to validate the unfolding.
- ↪ Build of covariance matrices and χ^2 tables.
- ↪ General debugging work (all hadronic channel).
- ↪ Editor of the Internal note (all hadronic channel).

Extraction of top quark pole mass

- ↪ use as input 2D histograms of quantities of interest (from ℓ +jets analysis).

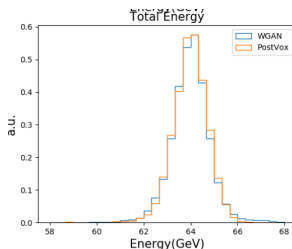
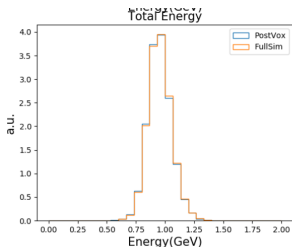
My roles in this analysis:

- ↪ Covariance matrices calculation.
- ↪ general covariance studies.

Status of Simulation work

Use of deep neural network techniques for the ATLAS Fast Simulation.

- ↪ Using of "Generative Adversarial Networks (GANs)".
- ↪ Work started this summer with a master and a summer student.
- ↪ the framework (with TensorFlow) is in place and working.
- ↪ first results ready and promising already presented to ATLAS internal meetings.



- ↪ Example result (from summer student thesis).

Secondments

- ↪ **Fiscal Technology** (3 months 2/19-4/19): improve fraud detection and reduce false positives by applying ML algorithms exploiting the large Account Payable data collected by the company.
- ↪ **Pangea** (3 months): profile of a large database of bank transactions to discover fraud through graph theory algorithms and Bayesian techniques.
- ↪ **CERN** (3 months): work in ATLAS with the Higgs and Top groups.
- ↪ **RHUL** (1 month): Work on developing new unfolding tool (to be used in the scientific project).

Training

I participated to the following training:

- ↪ Fourth Machine Learning in HEP Summer School (6-12 August 2018, Oxford, UK).
- ↪ Insights Workshop on Statistics, Machine Learning and Outreach (17-21 September 2018, CERN, Switzerland).
- ↪ Workshop on Advanced Statistics for Physics Discovery (24-25 September 2018, Padova, Italy)
- ↪ Insights Kick-Off Workshop (26-27 September 2018, Padova, Italy)

Complementary training:

- ↪ Language training: "Simply English school" (October-December 2018, Edinburgh. One weekly session of 60-90 minutes, no fixed schedule).

Incoming events:

- ↪ INFN School of Statistics 2019 (3-7 June 2019, Paestum, Italy)

Conclusions

- ↪ My INSIGHTS project is advancing and is in good shape.
- ↪ Work within the top quark working group ongoing:
 - ◆ Measurements of differential cross sections in the ℓ +jets and all-hadronic channels.
 - ◆ collaboration in the group for the extraction of the top quark pole mass.
- ↪ Work within the Fast simulation group ongoing:
 - ◆ Use of DNN techniques.
- ↪ Plan for the next year:
 - ◆ Further differential measurement in top or Higgs physics final states.
 - ◆ Increase my profile in the ATLAS collaboration by taking more responsibility:
 - MC contact for the Top working group.
 - lead an analysis.
 - Aim at a sub-group convenership (lead 100 people) by the end of project.

Thank you for the attention!

BACKUP