

Data Analysis at AEGIS

By Alexander Ekman

CERN Summer Student Session 2018

Who am I?

- Alexander Ekman
- At home:
 - Master in Particle Physics
 - Jet Energy Scale Calibration for ATLAS
 - Lund University, Sweden
- At CERN:
 - Data Analysis
 - AEGIS, EP-SME

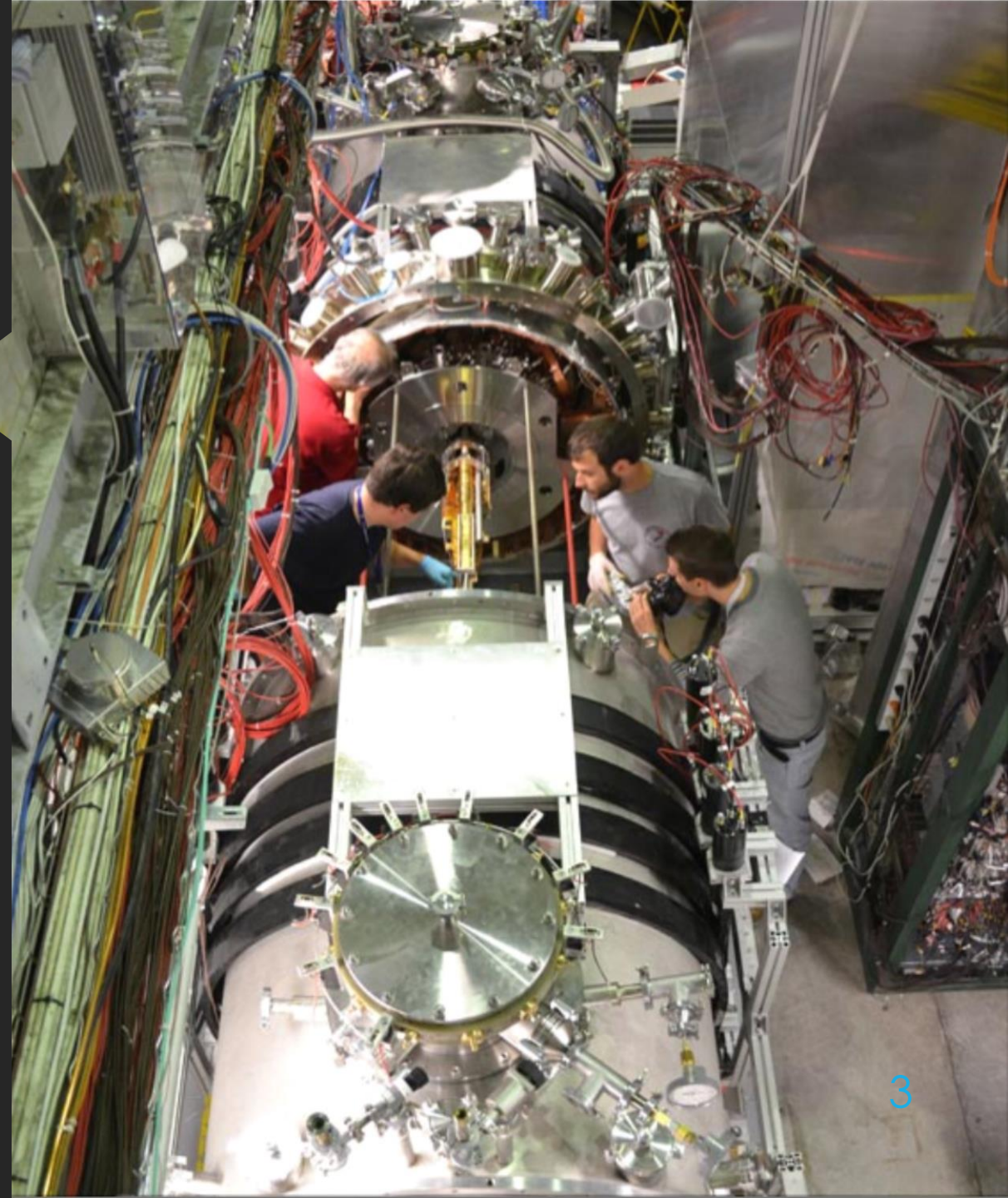
Image and media bank, Lund University,
<https://lu-mediaportal.qbank.se/en/login?next=/en/search/bilder>



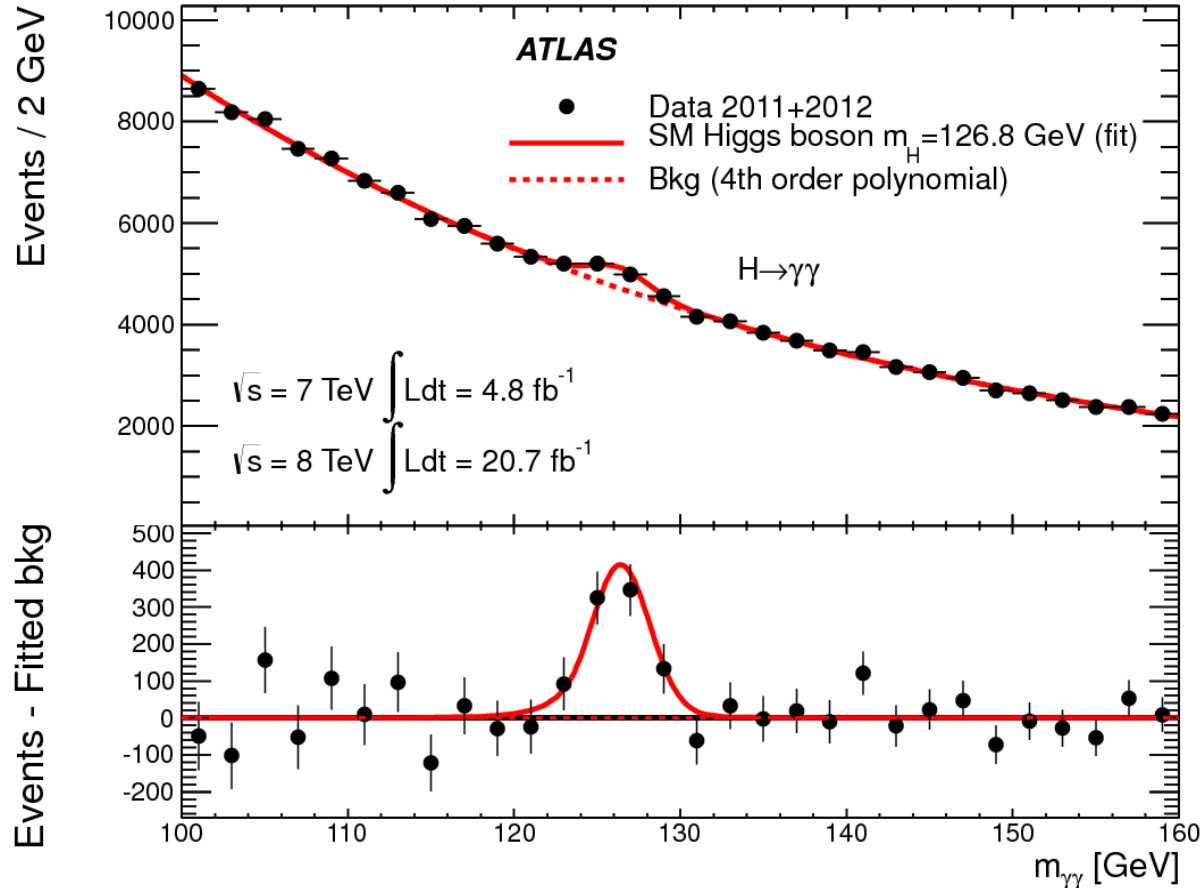
What is AEGIS?

- It is an **A**nihydrogen **E**xperiment investigating **G**ravity, **I**nterferometry, and **S**pectroscopy
- Currently focuses on antihydrogen production using charge exchange

AEGIS Experiment,
<http://aegis.web.cern.ch/aegis/multimedia.html>



What is Data Analysis?



ATLAS and the Higgs: Resources,
<http://www.atlasexperiment.org/HiggsResources/>

- Processing data with the goal of retrieving information
 - Estimating noise (background)
 - Looking for signals
 - Detector properties
- A signal is what's left when you subtract what you expect
 - Higgs Discovery

How to Make Antihydrogen

1. Trap antiprotons
2. Create positronium
3. Rydberg excite positronium
4. Add to antiprotons

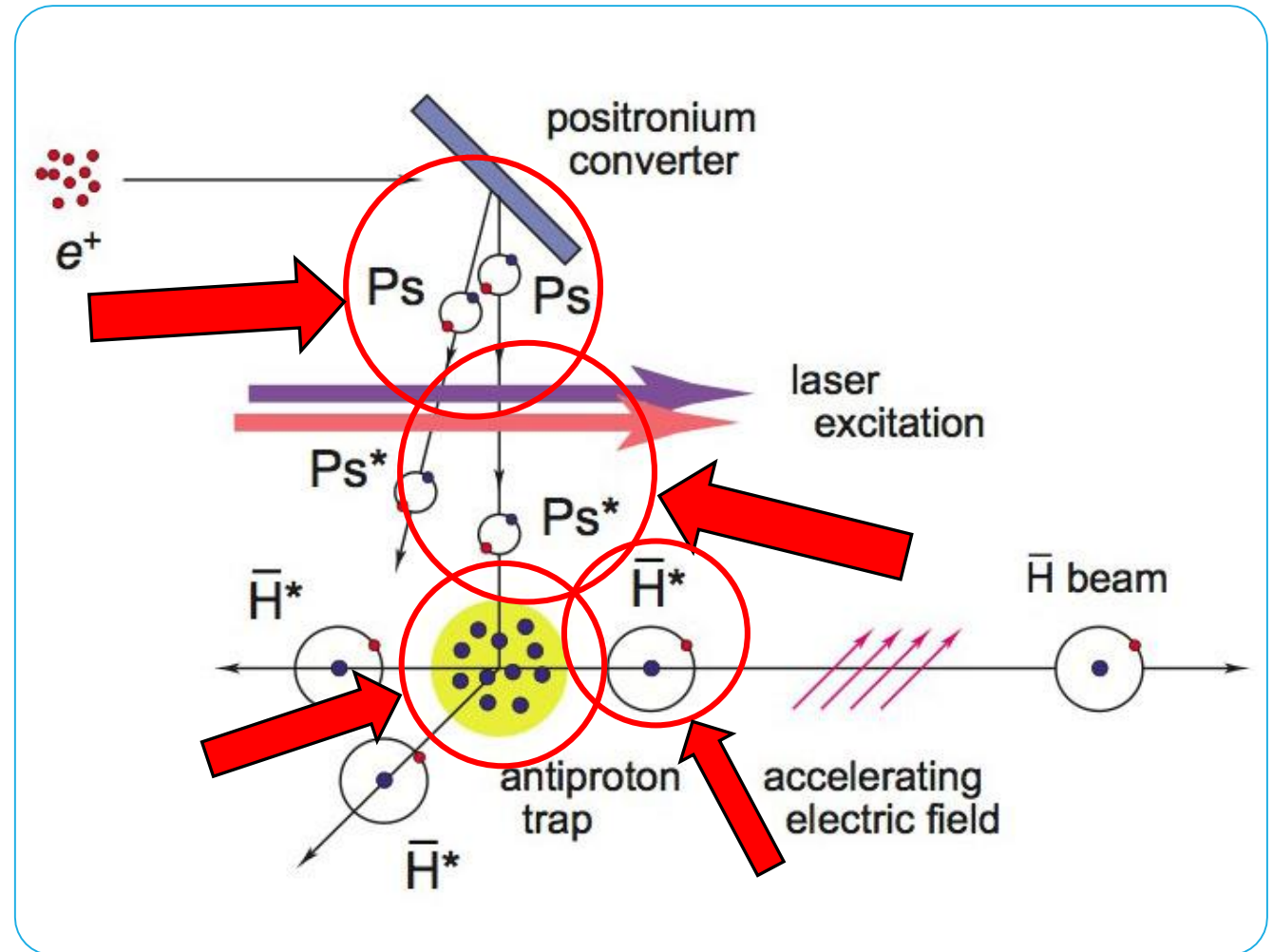
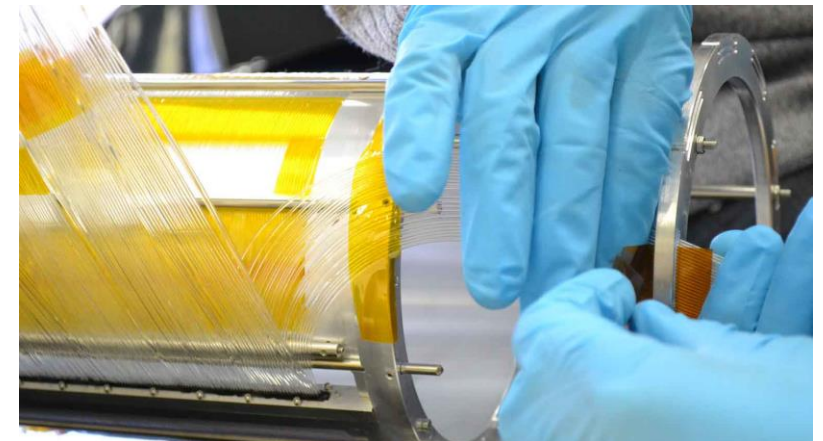


Figure from: M. Doser et al. Measuring the fall of antihydrogen: the AEGIS experiment at CERN, Physics Procedia Volume 17, 2011, Pages 49-56

Antihydrogen Detection

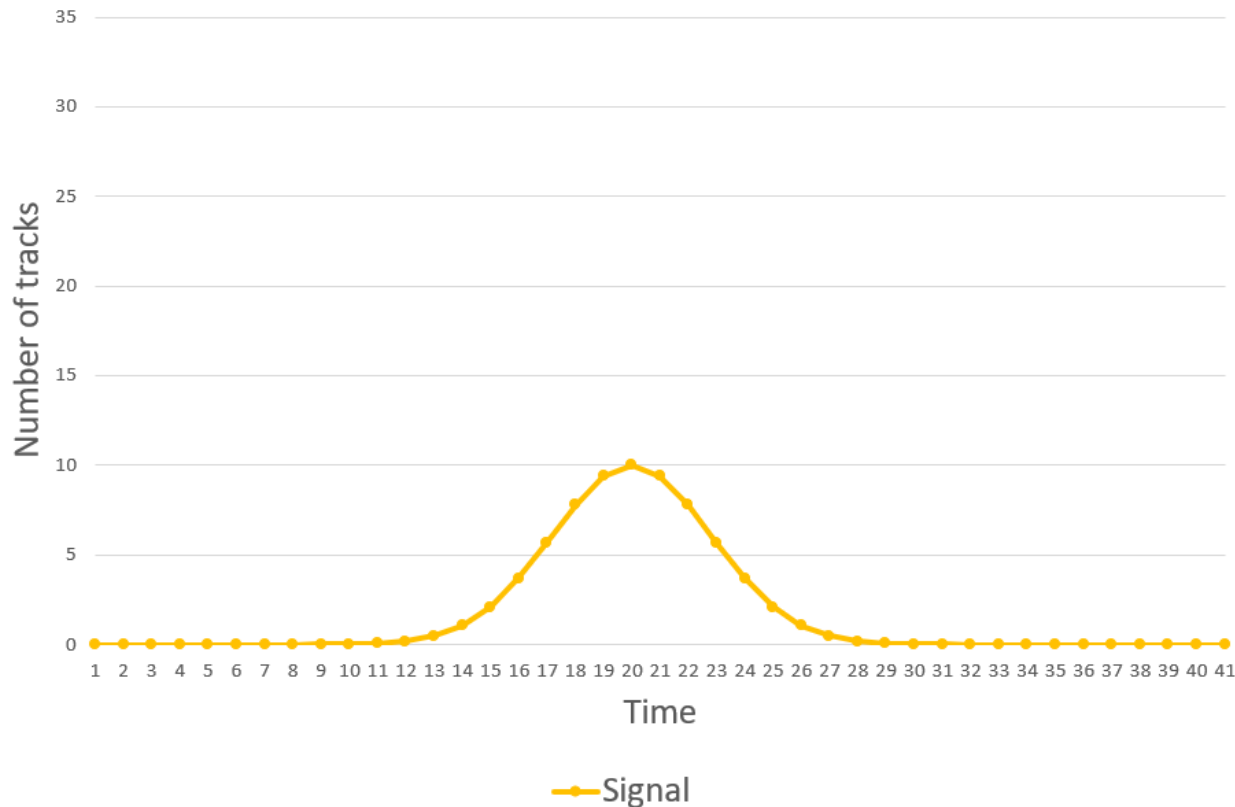
- Cylindrical structure of scintillating fibers
- Encapsulates the antiproton trap and positron converter
- Antihydrogen/antiproton annihilation on trap walls will produce pions
- Pions create tracks in our detector



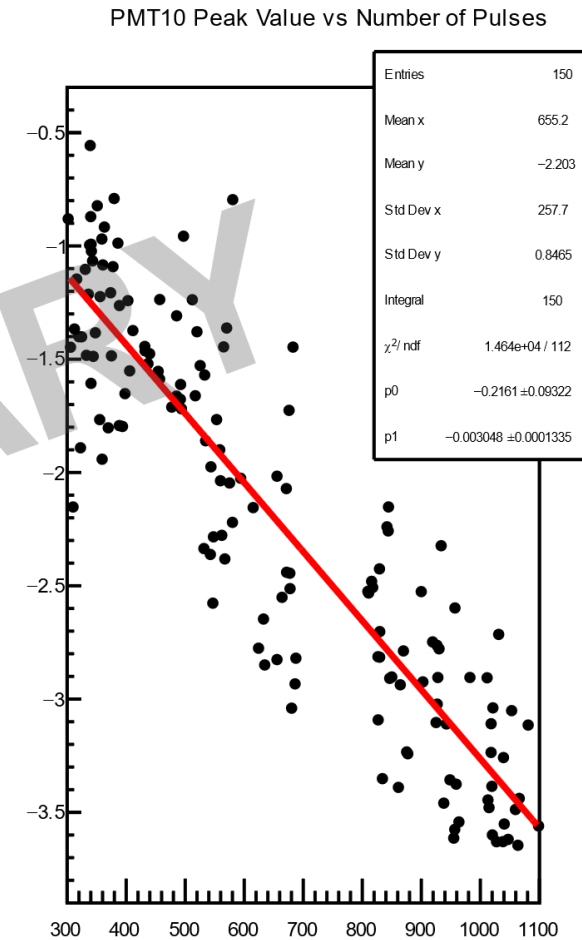
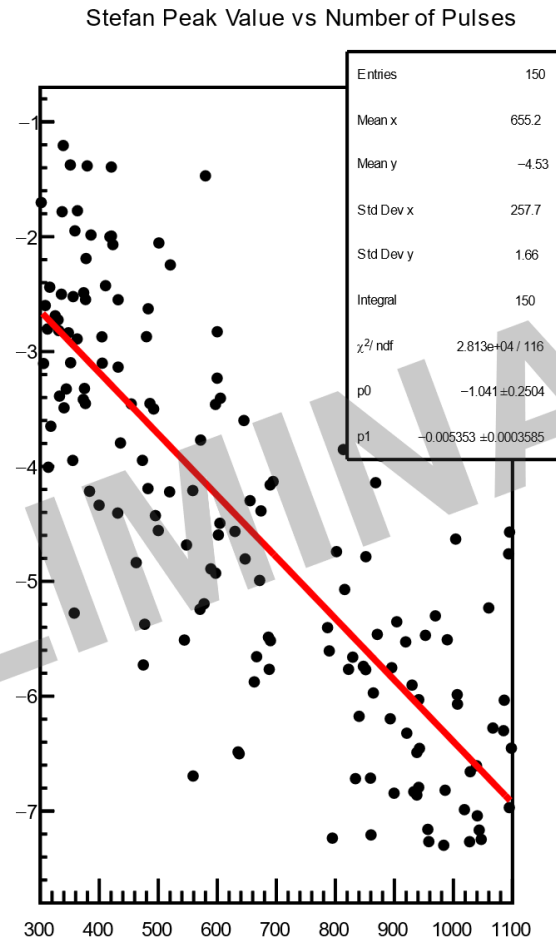
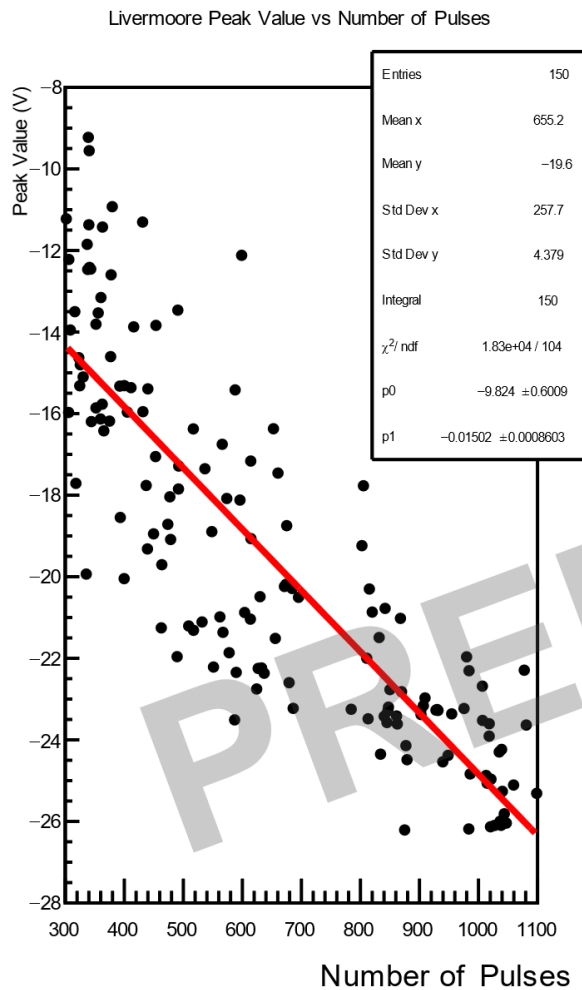
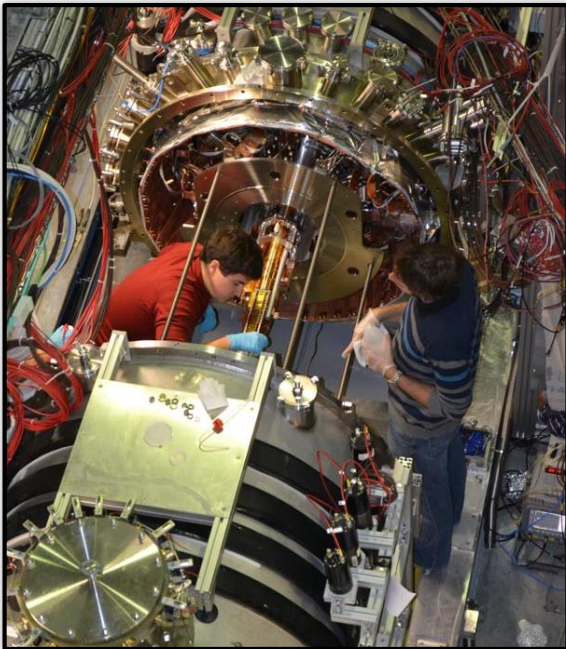
AEGIS Experiment,
<http://aegis.web.cern.ch/aegis/multimedia.html>

Finding the Signal

Laser On/Off Subtraction Demonstration



- Positron annihilation on converter produces a gamma burst
- Large energy deposit leads to different detector effects
- Signal is found by subtracting laser off from laser on



Data Analysis: Informed Decisions

- Detector properties
- Which detector is best for normalization?

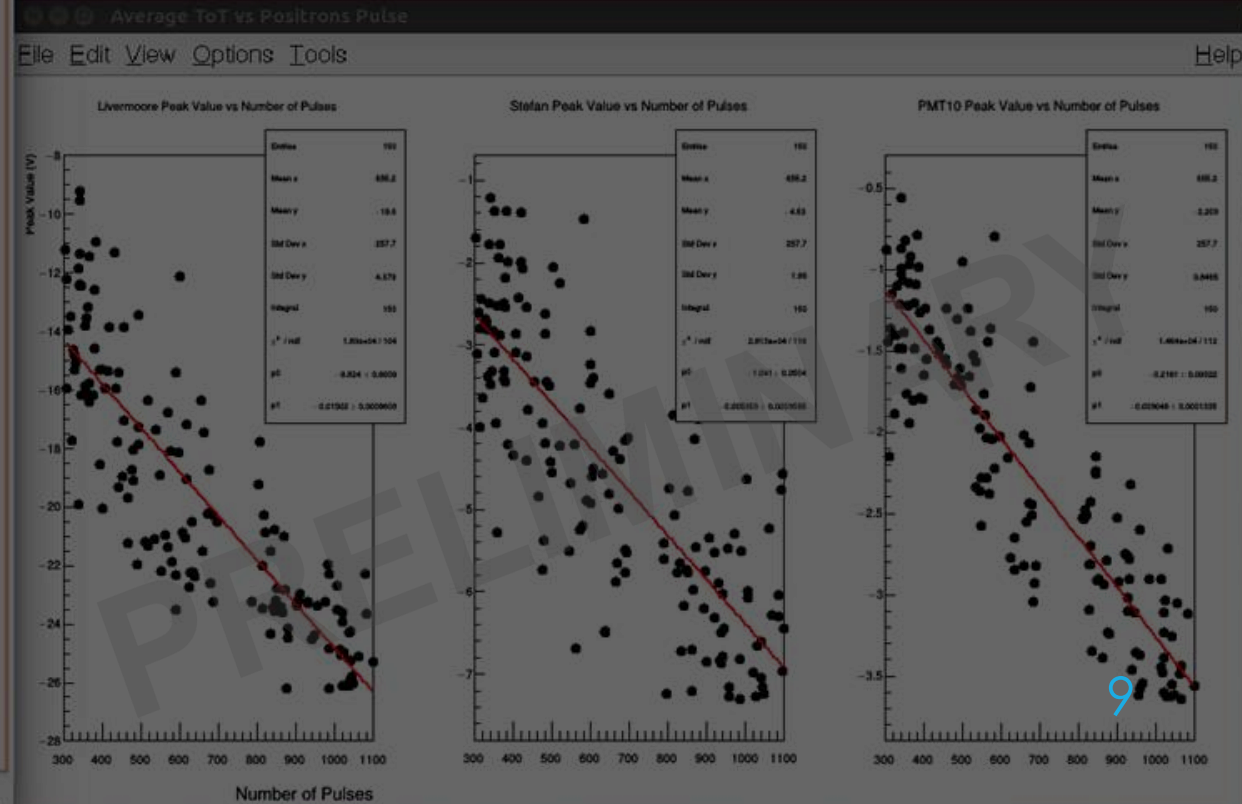
What am I Actually Doing?

- Programming.
- Coding
- Compiling
- Plotting

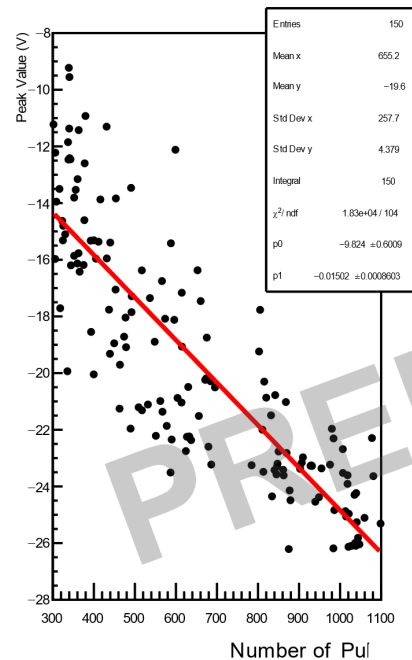
```
alexander@alexander-X555LNB:~$ cd workspace/gAn/
alexander@alexander-X555LNB:~/workspace/gAn$ make
sh Makefile.sh
alexander@alexander-X555LNB:~/workspace/gAn$ gAn FACT_tot ./runlists/positron_runs/positron2.txt
Analyses to execute: 1
===== Starting analysis
===== o0o =====
Analyzing run #144973
std::vector<double> AEGRun::FindADINT(bool) -> ERROR: AD-Trigger is not present in data/run_144973-11-06-2018-22:33:36.root

===== o0o =====
Analyzing run #144974
std::vector<double> AEGRun::FindADINT(bool) -> ERROR: AD-Trigger is not present in data/run_144974-11-06-2018-22:34:38.root

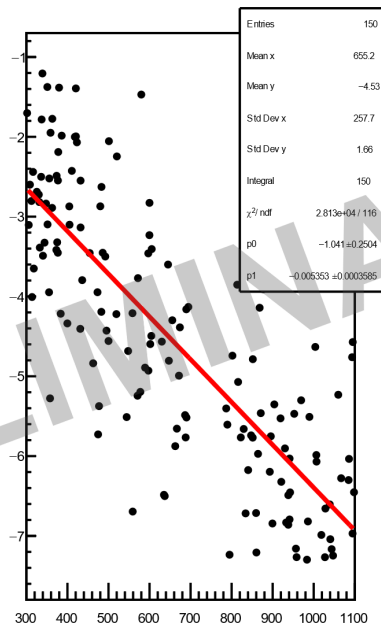
===== o0o =====
Analyzing run #144975
std::vector<double> AEGRun::FindADINT(bool) -> ERROR: AD-Trigger is not present in data/run_144975-11-06-2018-22:35:41.root
```



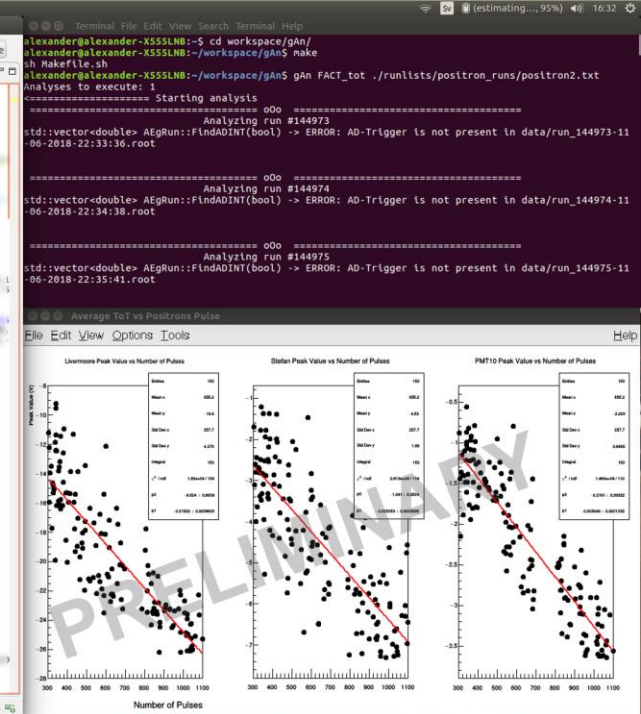
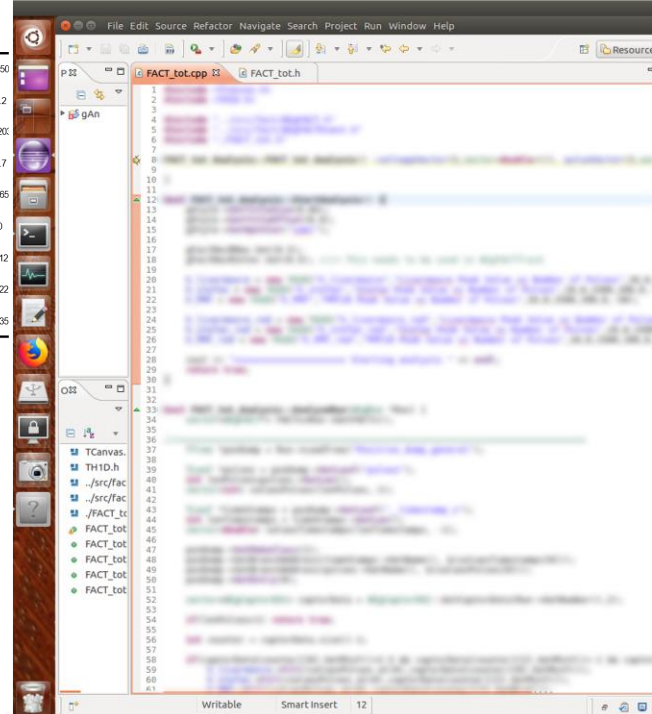
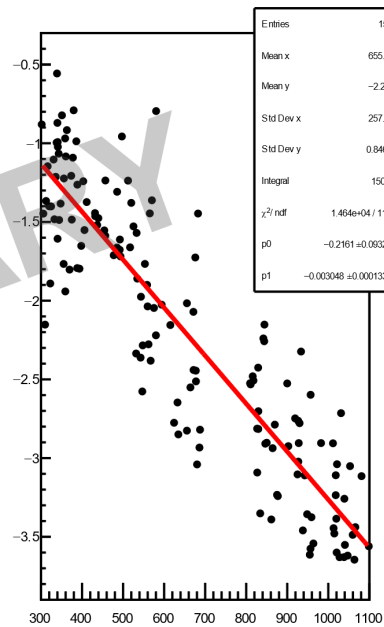
Livermore Peak Value vs Number of Pulses



Stefan Peak Value vs Number of Pulses



PMT10 Peak Value vs Number of Pulses



Questions?

