Building ATLAS pixel DAQ test Lab at UW

05/12/15, Spring 2015 Quarter Report

by
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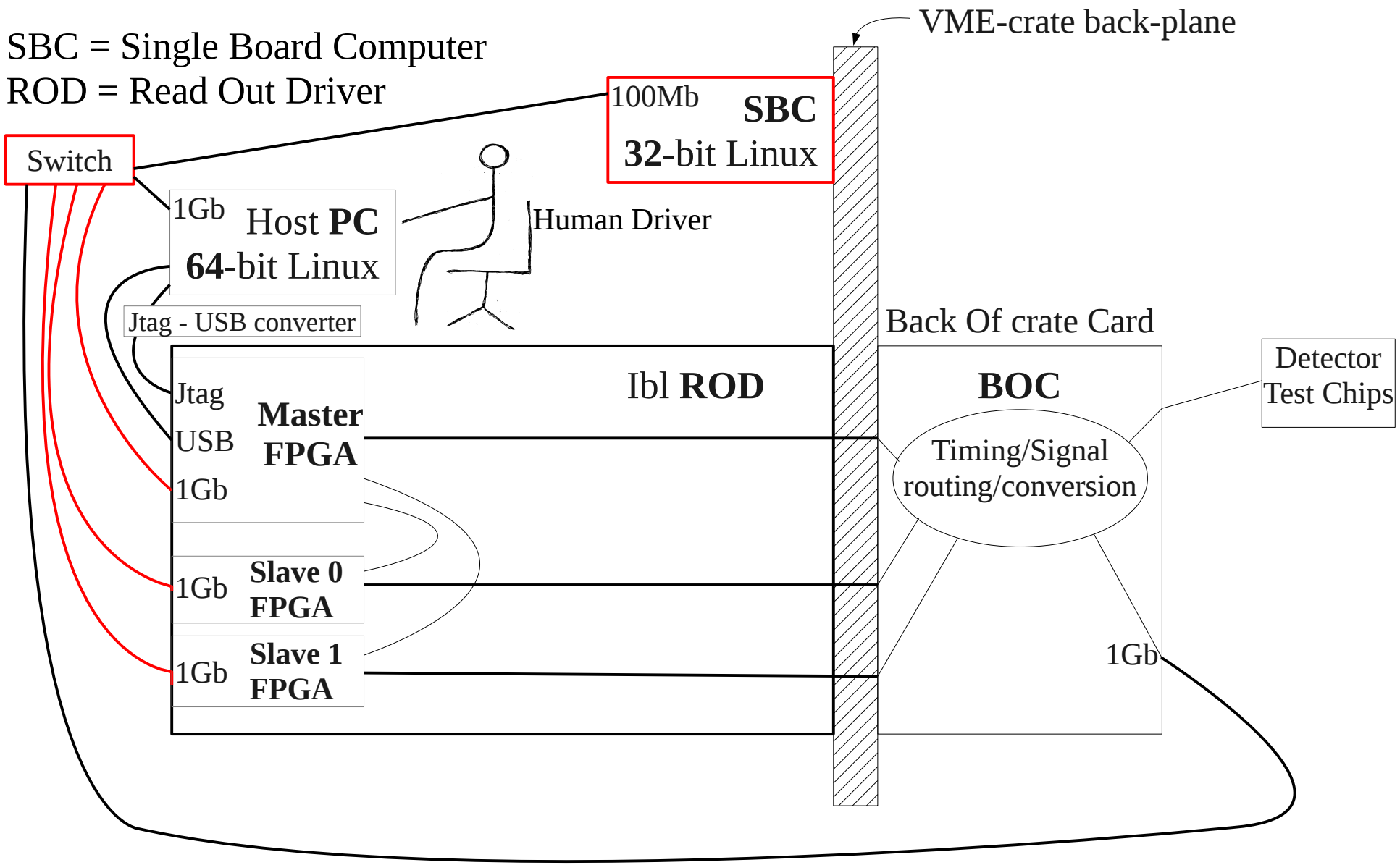
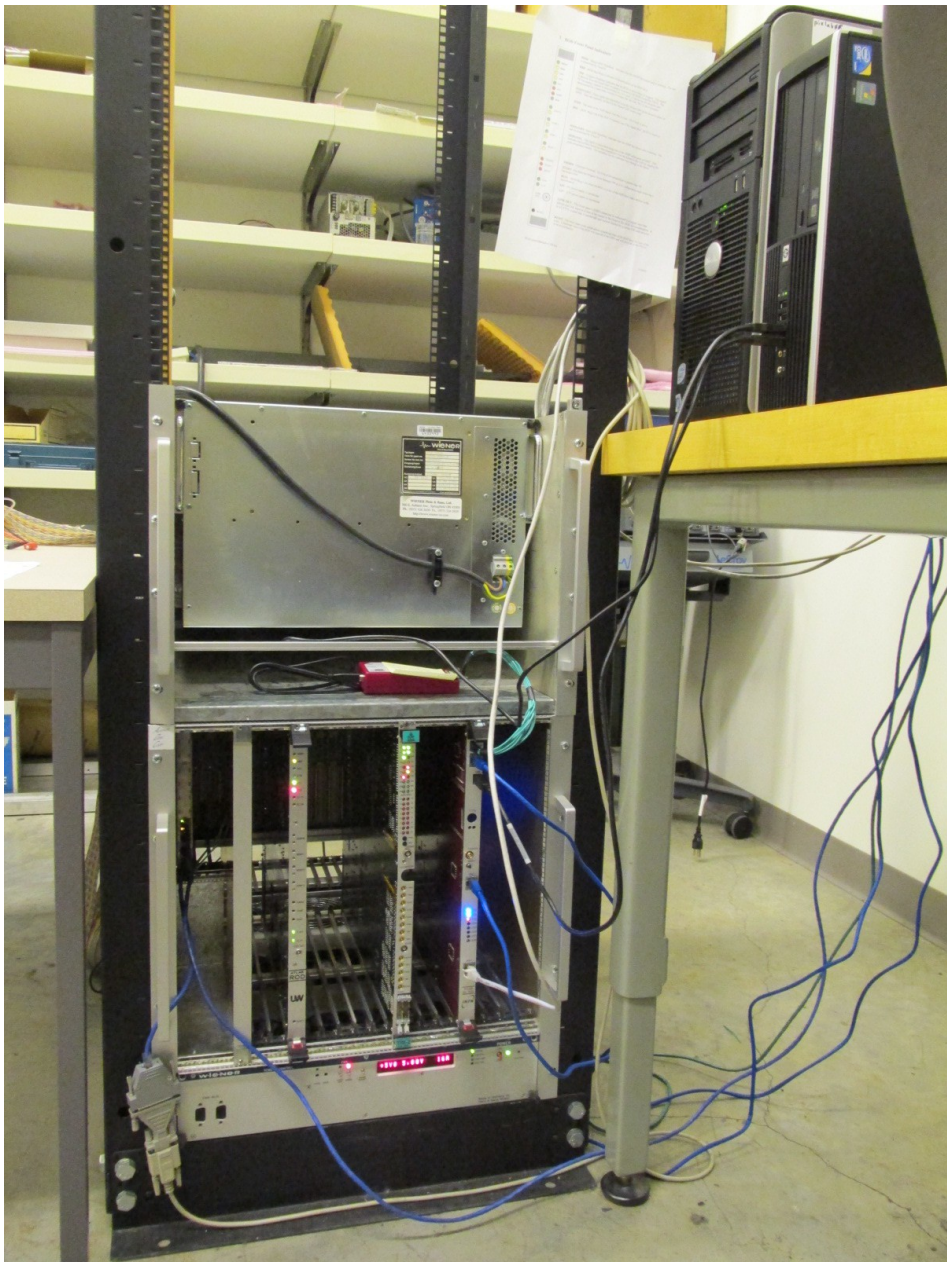
Summary of Work Activities this Quarter

- **Hardware** work to make Crate fully functional
- **Slave software** work on L1/L2 upgrade
- **Fit Farm software** work on L1/L2 upgrade
- Look forward to working at CERN for rest of 2015

Crate Hardware from Human Driver perspective





The ATLAS pixel detector has 9 of these Crates filled with up to 16 RODs

Troubleshooting Unexpectedly Delicate components

- Ethernet LAN for Ibl ROD

  After a week running around in circles we discovered:

  - ROD electronics too delicate for anything but highest-quality equipment
  - Our initial switch and cables were good enough for a regular PC LAN, but **not** enough for ROD

- SBC

  - Flaky VME interface on original SBC, a VP CP 1: Replaced by VP 110 last Qtr.
  - Since first attempt in January: Unable to run DAQ software on SBC
  - Solution much closer: Issue narrowed down to same as at CERN, where it also needs to be solved to get SR1 test Lab there working.

SBC Success Finally: Our VP 110 is as good as at CERN !!

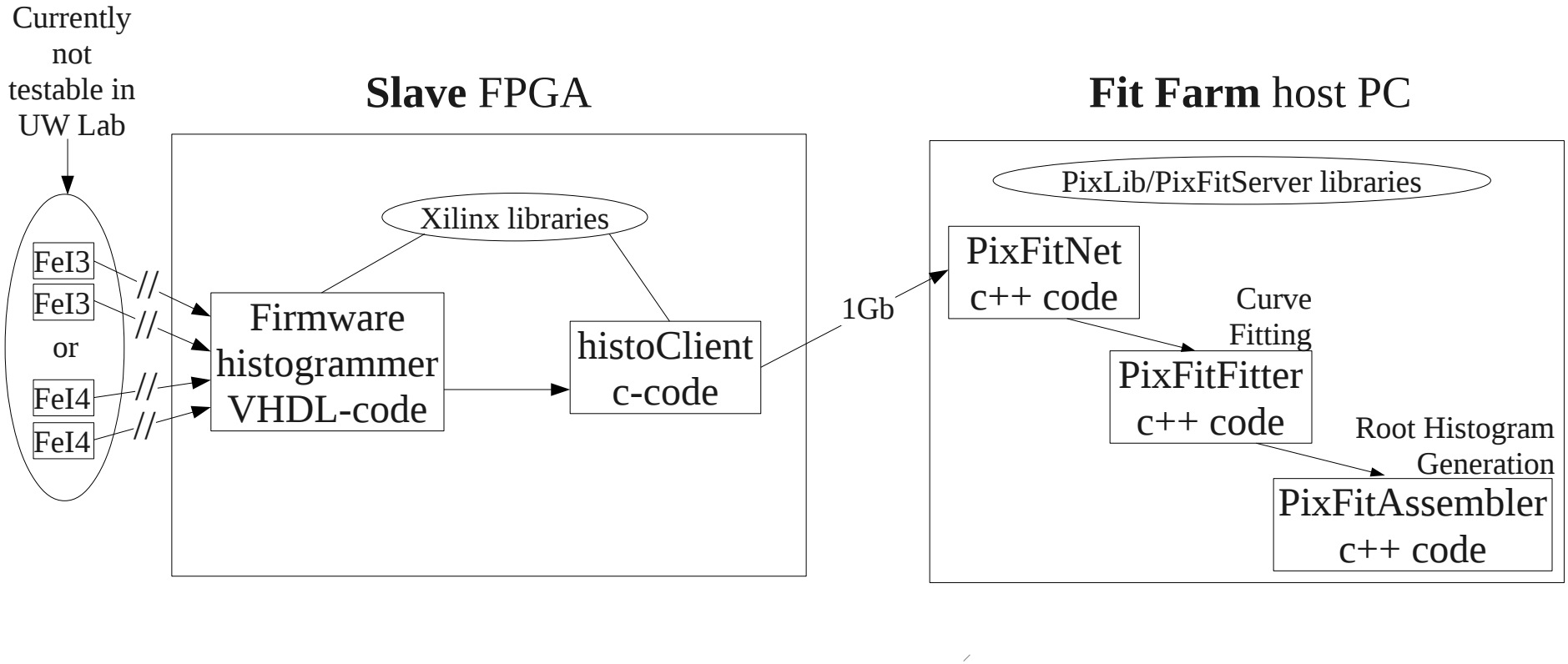
(**unfortunately** that just means it **fails** to work in the **same way**)

- **Major Progress**
  Installations of TADQ version 505 and pixeldaq as of May 31'st fully documented at
  https://sharepoint.washington.edu/phys/wiki/tev-cluster/Pages/Detector/PixRODSLC6.aspx

- **Most difficult part streamlined**
  Three host PCs now have been setup (from scratch) in UW Lab for net-booting SBC
  (thanks to instruction-troubleshooting help by two students Mat and Sean)

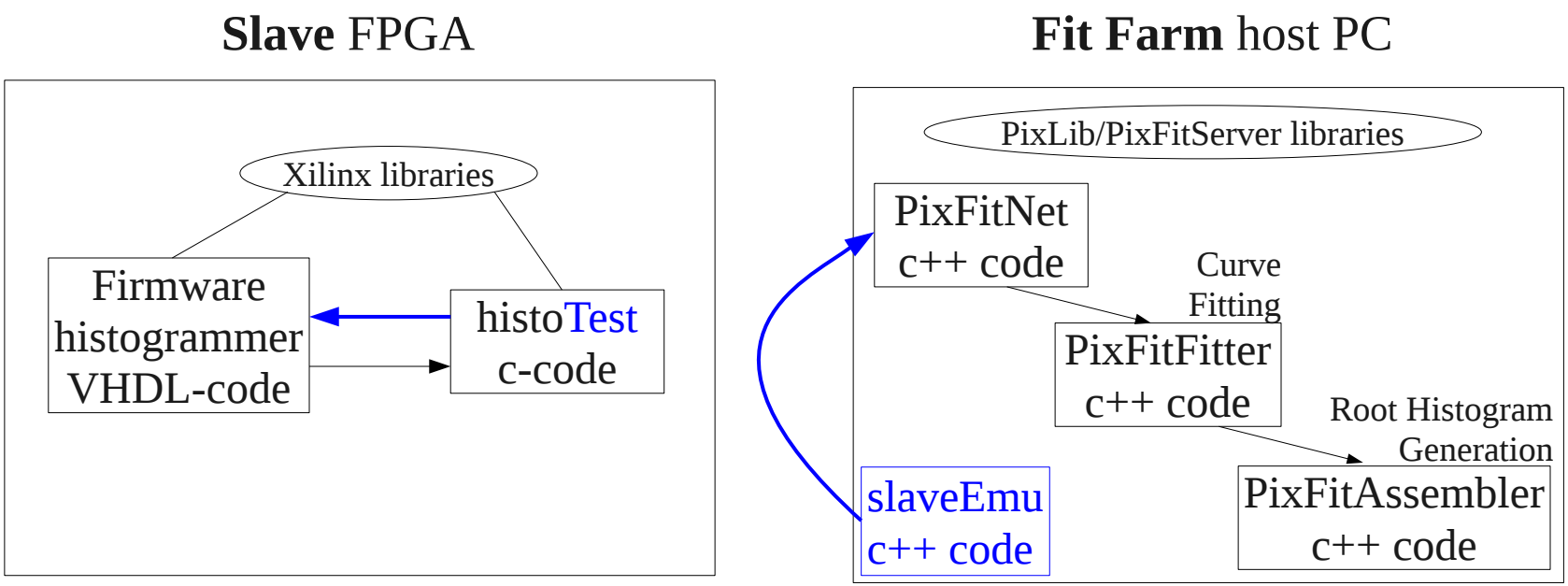
- **How are we stuck?**
  SBC crashes PixActionsServer whenever a static variable is accessed.
  I will try out an alternative to static variables (class encapsulation) next week.

L1/L2 Upgrade: Affects Slaves working on Fit-Farm



L1/L2 Upgrade: Affects Slaves working on Fit-Farm

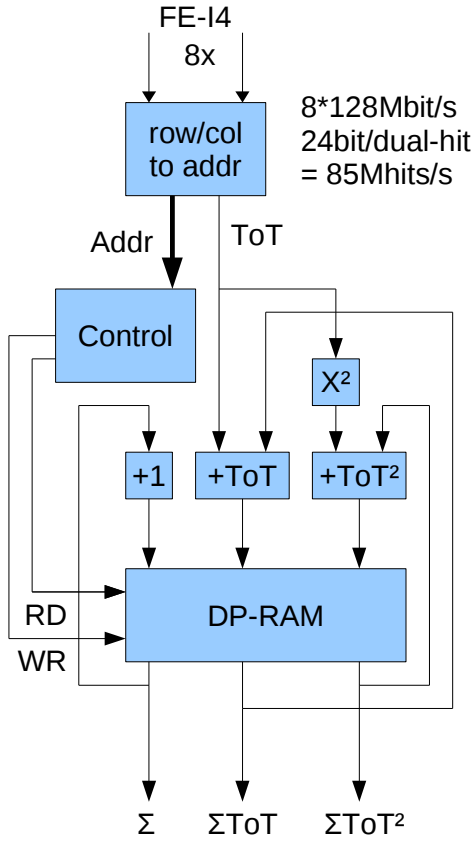
Code Test Procedure



Slave Code Overview

VHDL code for “Histogramming” just fills one register each with

sum of occupancy counts
sum of time-over-threshold
sum of squares time-over-threshold



From Figure 4 in [3]

c-code organizes accumulated histogrammer results into one long data buffer, which is then sent via LWTCP over LAN, once all pixels of the requested number of chips done.

Coding Issues of L1/L2 Upgrade

- Up until now, coding on Ibl ROD only worked for FE-I4 (all parameters hard coded)
- Many more FE-I3 chips must be handled at once, since they are much smaller
- Twice as many chips must be handled by L1, since its readout speed is two times L2
- TOT data transfer format per pixel requires more words, because FE-I3 TOT larger

L1/L2 Upgrade Status

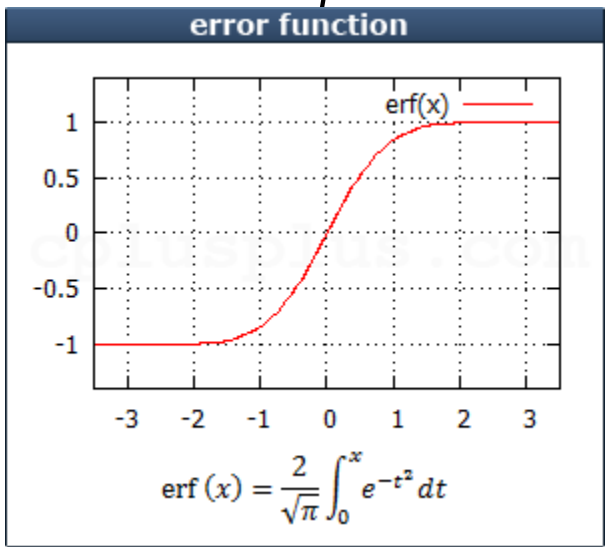
- Slave c-code successfully tested for FE-I3 configuration via software: histoTest.c
- Firmware assumptions I made passed on to firmware developer Kazuki Todome
- Enhanced slaveEmu.cpp shows new FE-I3 data stream format works
- Minor modifications to fitting and Root histogramming code for FE-I3 configuration (not sure where Nils is on this as I haven't heard from him in a while)
- Still to do: Tweak code for actual firmware changes. Should be easy, since template-code is ready to go.

  Test on full readout chain, probably as CERN.

Fit Farm Curve Fitting

Side bonus of the L1/L2 upgrade project: Got to study and understand entire PixFitServer library code.

Turns out the only curve fitting fully integrated into PixFitServer is the S-curve for threshold scan, modeled using the standard *erf* error function built into c++:



For each pixel, threshold μ and σ are determined by minimizing $RMS = \sum \left(Oc(V) - f_V(\mu, \sigma) \right)^2$ over a range of Voltage values V, where $Oc(V)$ is the observed occupancy count for N injections at V, and

$$f_V = N \frac{\left(1 + erf\left(\mu - V\right)\right)}{\left(\sqrt{2}\sigma\right)} \quad .$$

Look forward to working at CERN for rest of 2015

I'll be . . .

- Learning how to fully test coding projects such as the L1/L2 upgrade worked on this quarter.
- Working to enhance and create many other types of tunning and callibration scans.
- Helping all around to troubleshoot and become an expert in CERN DAQ software.
- Gain enough experience to make UW pixel Lab a truly functional test/learning site.

Thank you for listening!
Time for Questions?

References

1. ATLAS Collaboration, *The ATLAS Experiment at the CERN Large Hadron Collider*, Institute Of Physics Publishing And SISSA (2008)

2. ATLAS Collaboration, *ATLAS pixel detector electronics and sensors*, Institute Of Physics Publishing And SISSA (2008)

3. 10. IBL-WG4, Calibration of the ATLAS IBL detector using the new VME readout architecture, project document, Rev. No. 0.2 (2013)