T-958’ Fast Timing R&D

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T-958 Originally formed for FP420 timing R&D (a joint ATLAS/CMS effort focused on diffractive Higgs) using Cherenkov light/Microchannel Plate PMT

CMS timing group (Albrow) joins with Ronzhin, Ramberg, Chicago to form T-979 focus on different detectors/siPM while ATLAS group focuses on MCP-PMT development/electronics chain/laser tests

Many thanks to all of the FTBF team for a great facility at a fantastic week of beam!
Atlas Forward Protons (AFP)

AFP: a set of spectrometers that use points measured along the trajectory of scattered protons along with the LHC lattice to tag and measure their momentum and scattering angle.

CEP: Momentum lost by protons goes entirely into mass of central system

Conceived for diffractive Higgs

pp→pHp

Central Exclusive Production (QCD)

Detector stations
~210m from IP
Fast Timing Detector Motivation…

Pileup background rejection/signal confirmation

Use arrival time difference between protons to measure z-vertex compared with the central tracking primary vertex

Ex: Two protons from one interaction and two jets from another

and Requirements

10 ps resolution (including electronics)
High efficiency and acceptance
High rate capability (~5 MHz/pixel)
Segmentation for multi-proton timing
L1 trigger capability
Robust operation in high radiation environment
Proposed AFP Timing Detector (QUARTIC)

Only need a 30 ps measurement, as each proton goes through 8 bars
Components of AFP Fast Timing

Detector (Cerenkov Radiator)

MCP-PMT → Preamplifier → Constant Fraction Discriminator → HPTDC

“Scope”
T958 DAQ

Just your garden variety
20 channel, 20 GHz/ch,
40 Gs/s channel (point every 25 ps) 500k$ LeCroy 9Zi scope!

Thanks to LeCroy for lending it to us for the week!

Also used HPTDC readout
Jan 3-10 2012 Test Beam@Fermi

GOALS:

- 8 channel test with 5x5 mm ~10 cm long quartz bars
- Compare analog and digital results with LeCroy 9ZI super oscilloscope
- Full electronics chain test AMP/CFD/HPTDC
- Test Giessen Fiber QUARTIC
- Various other test to help optimize detector design
New Test Beam Setup

New Stony Brook Amp cards plug directly onto PMT

Prepared @UTA for easy alignment and versatility
19 Nsec Bunch Structure
Quartic bars compared to reference detector

Tail due to events that saturate amp and are poorly measured

FWHM = 47 ps consistent with design goals
UTA Grad Students at work
And posing with the star
A First pass at the data

Require at least 4 quartic hits + SiPM, and some removal of poorly measured Si events
Conclusions

• Analysis is ongoing
• Preliminary results show promising time measurements on par with our design goals
• Thank you again to the devoted FTBF staff, we appreciate the opportunity and look forward to future test beams