Big and Small

How we see different-sized objects:

We (you) are doing world-class research here

State of the Instrumentation Dev. Lab -- October 2011
New/Immediate Projects

High intensity MCP-PMT Charge Sensitive Amp GRAPH ASIC

Beam Test!!
Dec. 12 – Jan. 3

Cosmic Ray test
Nagoya Univ
Now – late Nov.

ExaVolt Antenna (EVA)

State of the Instrumentation Dev. Lab -- October 2011
Much, much going on…

- Hopeless to cover everything
- Just a brief overview of the most active projects
- For further detailed information, 2 websites:

  - Linked from: www.phys.hawaii.edu/~idlab
ANITA3

Physics Goals

- Discovery experiment for “BZ” neutrinos, created by the so-called GZK process
- Uses the entire Antarctic continent as a detector!
- Best near-term chance to observe neutrinos from earliest universe
- 3rd (final) flight in December 2013
ANITA3 – ID Lab

Our Developments

- Rebuild “space flight” readout instrumentation (half a decade old technology)
- Threshold limited – new trigger ASIC (RITC)
- New digitizer (LAB4) to go to longer waveforms
- “going for broke” – ARA is successor

New SURF & TURF
Askaryan Radio Array (ARA)

Physics Goals

- Gusev and Zheleznykh proposed in 1983!
- 100's of km3 volume at GZK nu range
- Inexpensive extension to IceCube
Our Developments

- ANITA trigger/digitizer electronics → to ARA
- “array crossing” waveform sampler (IRS)
- Built “testbed” almost 4 years ago….
- Finally deployed in January, taking data
- First “station” January 2012
Title: Time-Encoded Differential Absorption
Org/PI: University of Hawaii / John Madey

Broader Impact
- Focus on systems development and testing provides students with critical insights into the issues for detection of SNMs
- Project funds support 2 grad students and one student continuing as a postdoc in the second year
- Our laboratory has served as the centerpiece of numerous tours by visiting local high school students and teachers
- Required technologies are common to HEP and x-ray crystallography, establishing broad support for future development
- Integration of these advanced technologies will feed back into these communities in support of research and manufacturing

Technical Merit
- Real time detection and imaging of concealed SNMs through use of GHz avalanche PD arrays and multi Gigabit xfer links
- Based on differential absorption using a novel, rapidly tunable, high duty cycle, intense monochromatic gamma ray source

Technical Approach
- Exploit existing facilities and capabilities at UH for development and testing of source, detector and DAQ technologies
- Investigate source stability; quantum efficiency and time resolution of detectors; and operation of DAQ routing chips
- Initial system operation at x-ray wavelengths, scalable to gamma ray wavelengths by increasing the e-beam energy

Schedule/Cost:
- Duration:
  - FY09: $398K
  - FY10: $392K
  - FY11: $388K
  - FY12: $399K
  - FY13: $379K
  - Total: $1,956K

Major Milestones / Accomplishments
- FY09: basic testbed design, installation, integration and test
- FY10: detector v.2 eval; test ebeam and optics stabilization
- FY11: detector v.3 eval; ebeam and optics subsystems ass’y
  - FY12: detector v.4 eval, ebeam and optics integration
  - FY13: detector v.5 evaluation; tests of integrated system

Team
- co-PIs: Assoc. Prof. Gary Varner
  Assoc. Prof. Eric Szarmes

Last updated on: 04/13/2011
Bremsstrahlung x-rays: UH FEL

First x-rays: September 2010

50MeV max. (40MeV typ.)

Target: Thin Cu foil
Vacuum Al Exit Window
~15” 5 mil

Helium filled transport line

10 mil polyethylene 1mm 2.4um
300 um 200 um 62.5 mil

1 mil

Air

5 mil

3D & STURM testing

Free Electron Laser → just downstairs
Prof. Madey – Robert Wilson prize

State of the Instrumentation Dev. Lab -- October 2011
TEDA –ID Lab

cPCI crate (control room)

Detectors

ASICs

Master module

Front-end Module

Giga-bit Fiber links

Rx card

CPU

X-rays

Master module
Large Area Photodetector

Project goals

- Photomultipliers still built on vacuum tube technology
- CRT → flat panel screen transition
- Integrated readout electronics
- Necessary for next generation (large) detectors
Belle II – ID Lab

Our activities

- Electronics architecture
- iTOP readout
- Scin strip KLM readout
- KEKB nanometer beam
Got fiber?
Our activities

iTOP – ID Lab

BLAB3
ASIC
SCROD

Clock jitter cleaners

Subdetector Readout Module
ASICs
FPGA
or ADCs
On or in Detector

Giga-bit Fiber Transceiver Links

COPPER
FINESSI

Global Decision Logic
Clock/Event Timing Distribution

FPGA firmware consists of 3 parts:
1) ASIC/ADC driver (common)
2) Trigger feature extract (subdet, specific)
3) Unified DAQ transport protocol
Our activities

KLM – ID Lab

Results with prototype ASIC (TARGET)
SuperKEKB – ID Lab

Our Developments

- x-ray monitoring
- High speed sampler, compact RF amplifiers
- Test at the ATF2 facility
- Survived shaking
Personnel changes...

• Since this summer
  – Left for industry: Xi Zhao
  – Off to graduate school: Louis Ridley
  – Returned to Chicago: Daniel Booth
  – Fall arrivals:
    – Prof. Roberto Mussa (INFN Torino)
    – Zhe Cao (USTC postdoc)
    – Joachim Cohen (Paris)
    – Dmitri Liventsev (ITEP/KEK)
  – Next Finnish (Savonia) visitors (from January)
    – Lauri Virta, Janne Himanen, Ari Parviainen, Lauri Karpinnen
    – Jussi Kangaskoski
Manpower needed...

1. Endcap KLM 150 channel system (full quadrant test of muon system) →
2. iTOP beam test --> boards and board test plan
   [512 channel system = 4x 128ch]
3. ATF2 (Fermionics-based) DAQ [128 channels]
4. xFEL Fermionics readout [128 channels]
5. mini-Time Cube [12x 64-channel tube readout minimum?]
6. fDIRC2 readout [14x 64-channel tubes]
Announcements

Belle II -- Trigger/DAQ Meeting in Hawaii

January 16 - 18, 2012

Workshop will be held in the Vince Peterson Library on the 4th floor of Watanabe Hall (WAT417A) located at the University of Hawai‘i at Manoa

Agenda [link]

Non-uniform Time Sampling ASICs

Calibration and Next Generation Planning Workshop

January 19-20, 2011

Workshop will be held in the Vince Peterson Library on the 4th floor of Watanabe Hall (WAT417A) located at the University of Hawai‘i at Manoa

Agenda [link]

The goal of this workshop is to explore calibration and design methods that both improve the realized, picosecond timing performance of the current generation of Giga-sample’s Switch Capacitor Array waveform sampling ASICs, as well as brainstorm about next generation architectures to explore future directions in which this technology could evolve.
Milestones and Opportunities

- Belle II – iTOP/KLM by 2014, pixel upgrade thereafter
- Disruptive technology: LAPPD (Detector dev center – ANL)
- ANITA 3rd Flight approved → active R&D (ASICs, trigger...)
- New initiatives: ARA Test bed installed, year 2 & 3
- Great opportunities – life cycle of a university
  - Jr./Sr. research projects (EE 399/499, PHYS 499)
  - Directed study/NASA Space Grant/REU/PUF (Japan/Antarctica/Paris)
  - Publications (NIM/IEEE/JINST ...)
  - Board/firmware/chip design (PHYS476)
  - Many designs in queue; BLAB3B, STURM3, GRAPH...
    - Design, layout, simulation and test opportunities