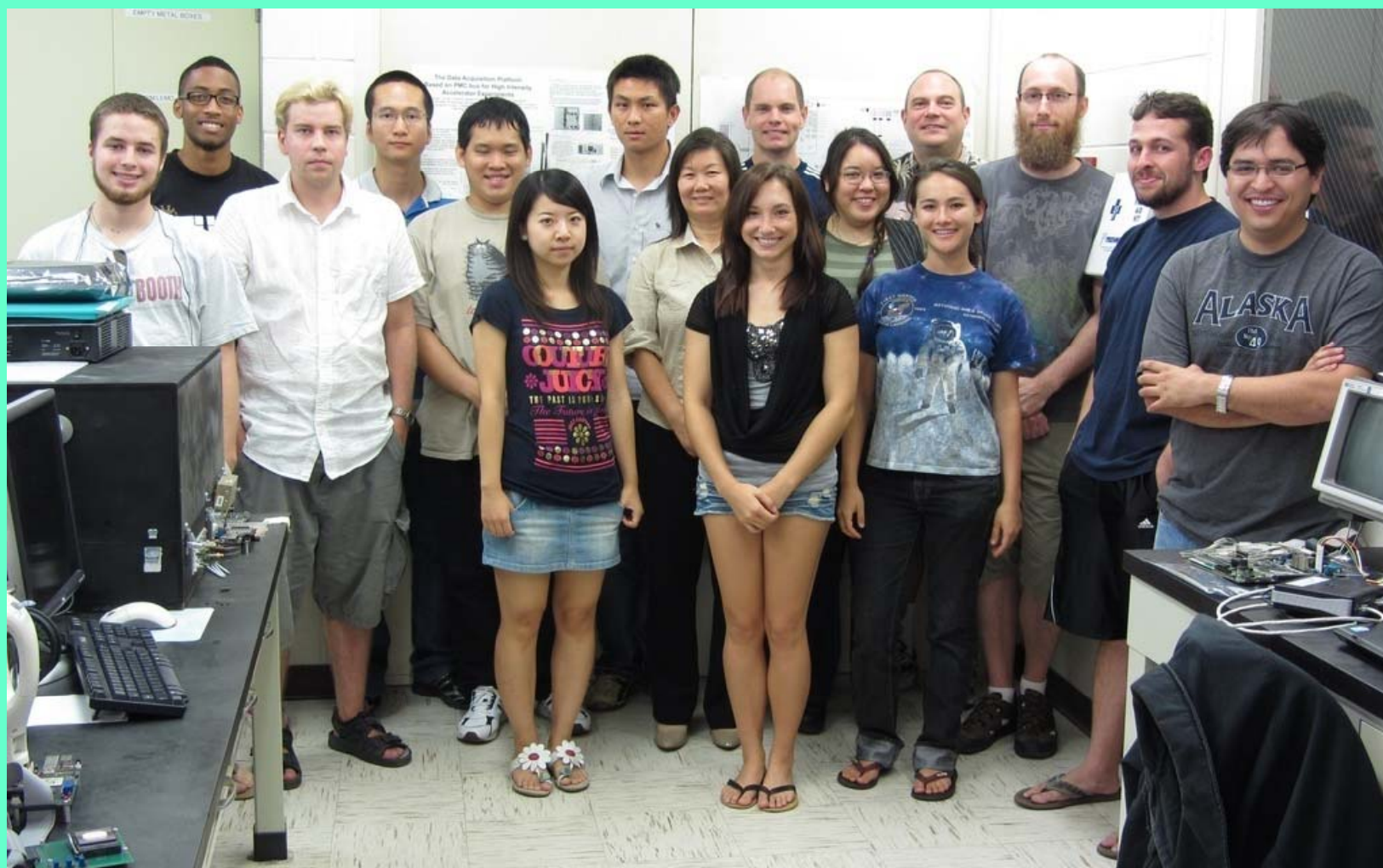


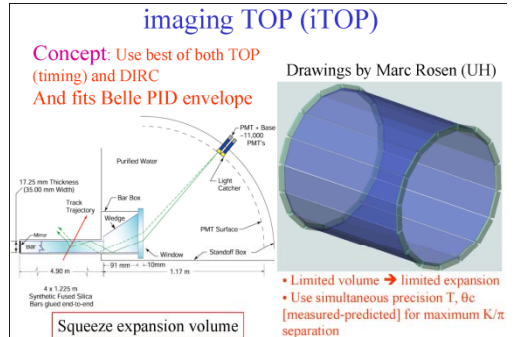
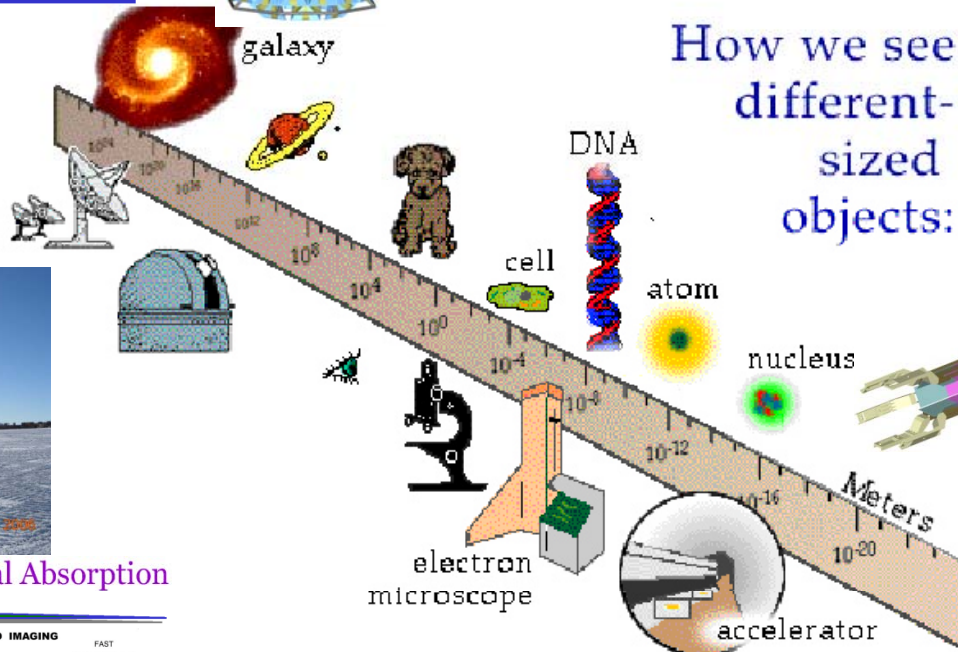
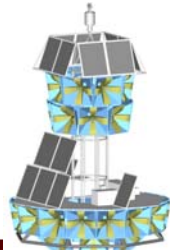


# Detector R&D At the Univ. of Hawaii

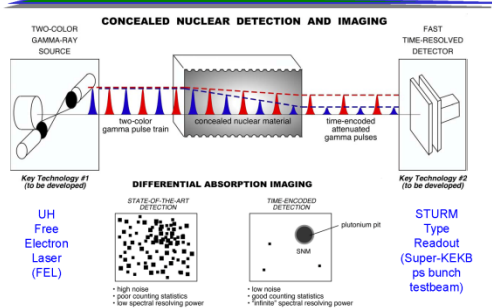
October,  
2011



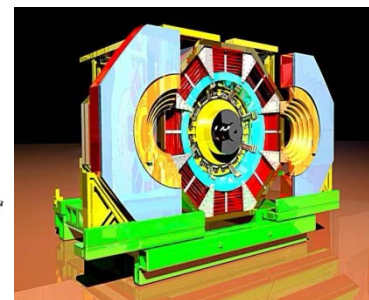
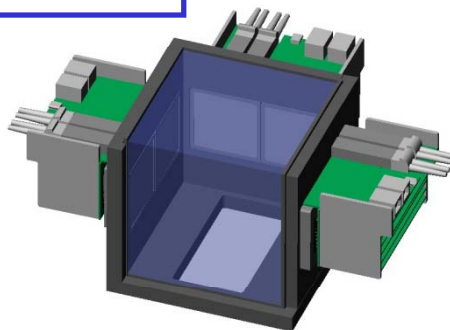
# Big and Small



Time-Encoded Differential Absorption

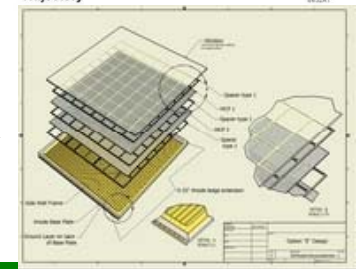
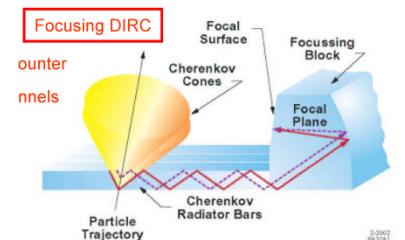
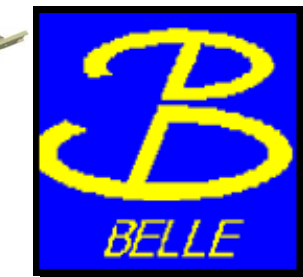


Neutrinos



BESIII

LAPPD →



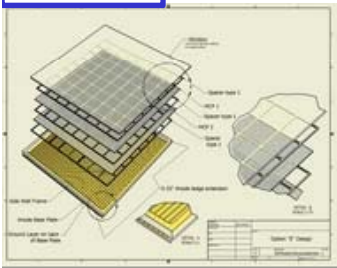
We are doing world-class research in Hawaii

State of the Instrumentation Dev. Lab -- October 2011

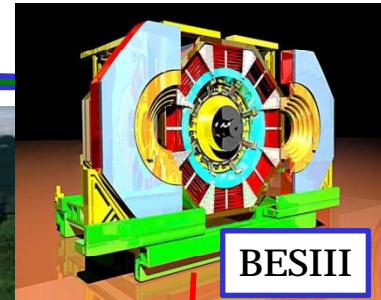
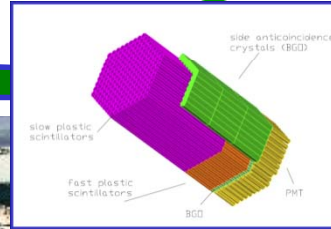


# Creating the physics...

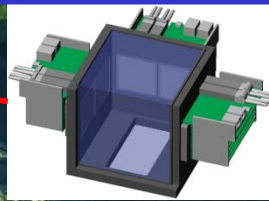
LAPPD



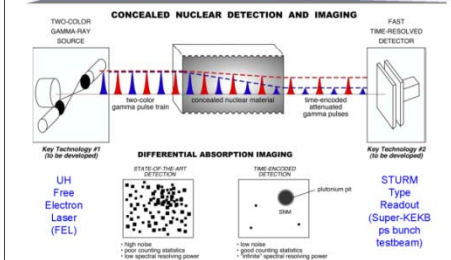
PoGO Lite  
The Polarized Gamma-ray Observer



Mini-Time Cube



Time-Encoded Differential Absorption



AMBER



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# New/Immediate Projects

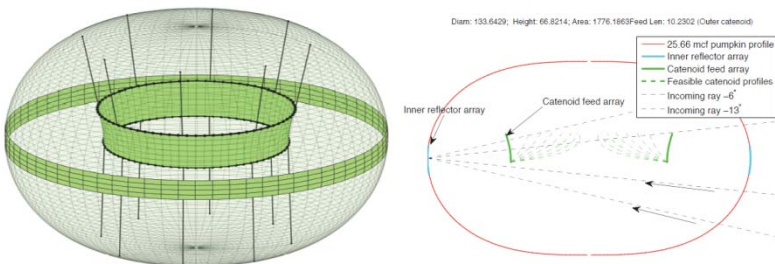
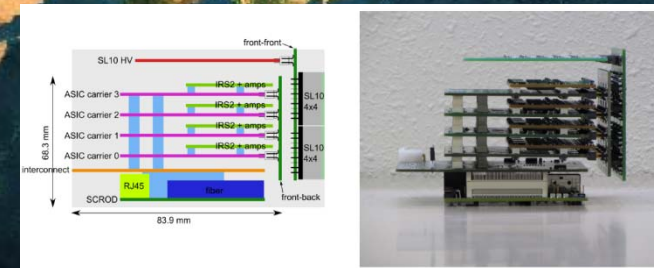
High intensity  
MCP-PMT  
Charge Sensitive  
Amp GRAPH  
ASIC

Beam Test!!  
Dec. 12 – Jan. 3

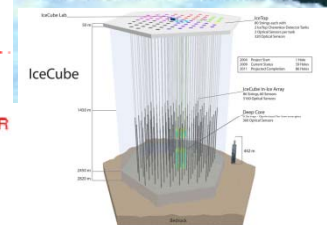
Cosmic Ray test  
Nagoya Univ  
Now – late Nov.

FERMILAB TEST BEAM FACILITY

Contact ELogs Schedule MOUs



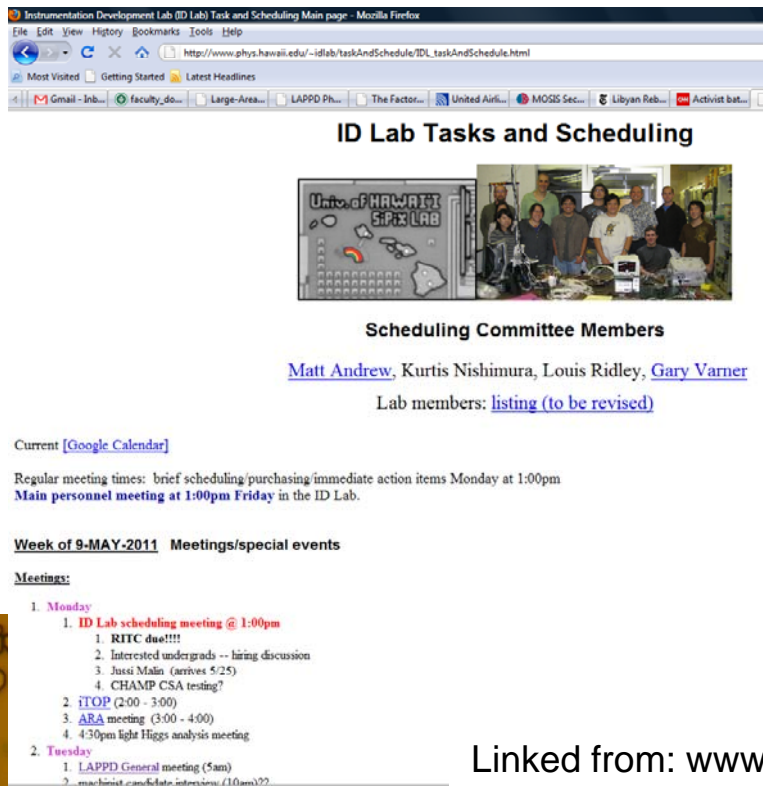
ExaVolt Antenna (EVA)



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:



The screenshot shows the 'ID Lab Tasks and Scheduling Main page' in a Mozilla Firefox browser. The page title is 'ID Lab Tasks and Scheduling'. It features a header with the University of Hawaii logo and a photo of the Scheduling Committee Members. Below the photo, the members are listed: Matt Andrew, Kurtis Nishimura, Louis Ridley, and Gary Varner. A link to 'Lab members: listing (to be revised)' is provided. The page also includes a 'Current' section with a link to a Google Calendar, 'Regular meeting times' (brief scheduling/purchasing/immediate action items Monday at 1:00pm; Main personnel meeting at 1:00pm Friday in the ID Lab), and a 'Week of 9-MAY-2011 Meetings/special events' section. A 'Meetings:' section lists meetings for Monday and Tuesday.

**ID Lab Tasks and Scheduling**

**Scheduling Committee Members**

[Matt Andrew](#), Kurtis Nishimura, Louis Ridley, [Gary Varner](#)

Lab members: [listing \(to be revised\)](#)

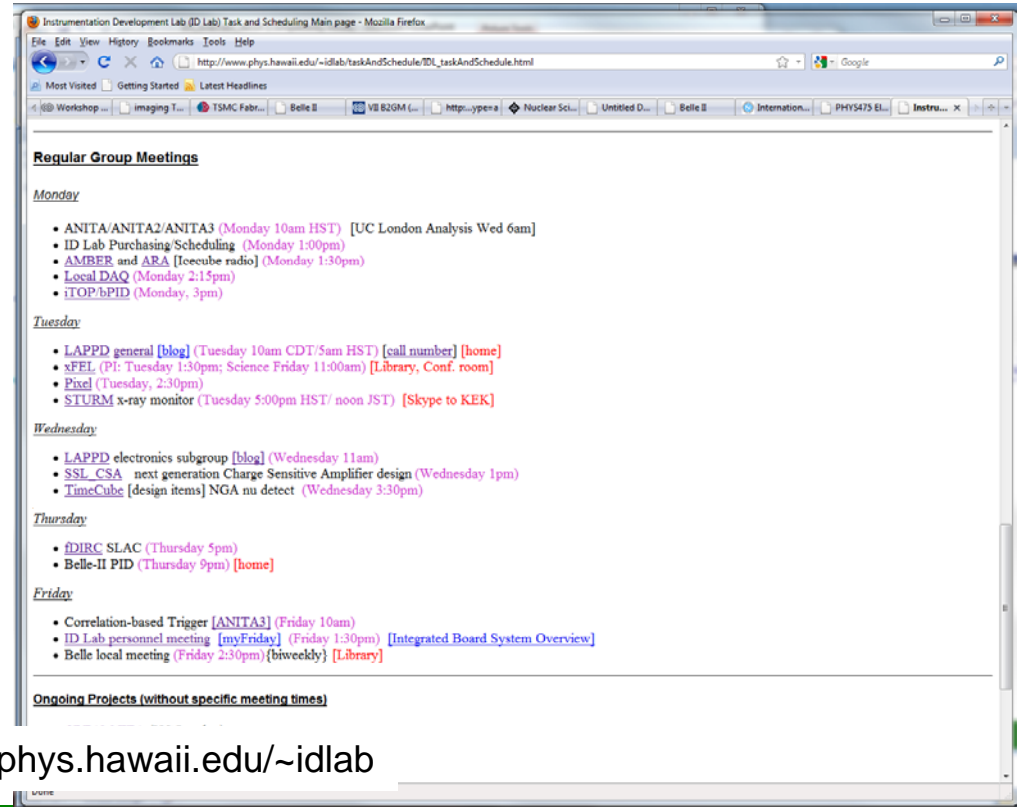
Current [\[Google Calendar\]](#)

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Main personnel meeting at 1:00pm Friday in the ID Lab.

**Week of 9-MAY-2011 Meetings/special events**

**Meetings:**

1. **Monday**
  1. **ID Lab scheduling meeting @ 1:00pm**
    1. RITC due!!!!
    2. Interested undergrads -- hiring discussion
    3. Jussi Malin (arrives 5/25)
    4. CHAMP CSA testing?
  2. **iTOP (2:00 - 3:00)**
  3. **ABA meeting (3:00 - 4:00)**
  4. 4:30pm light Higgs analysis meeting
2. **Tuesday**
  1. **LAPPD General meeting (5am)**
  2. **machinist candidate interview (10am)??**



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Linked from: [www.phys.hawaii.edu/~idlab](http://www.phys.hawaii.edu/~idlab)

State of the Instrumentation Dev. Lab -- October 2011

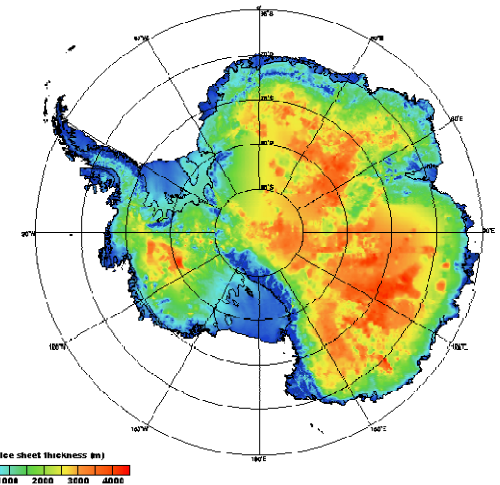
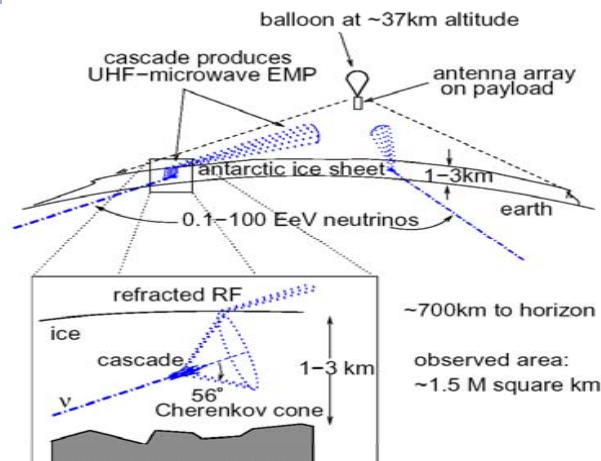


# ANITA3



## 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
- 3<sup>rd</sup> (final) flight in December 2013

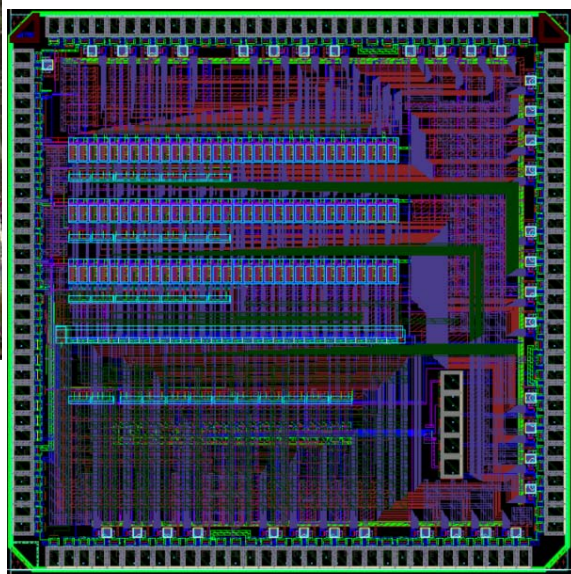
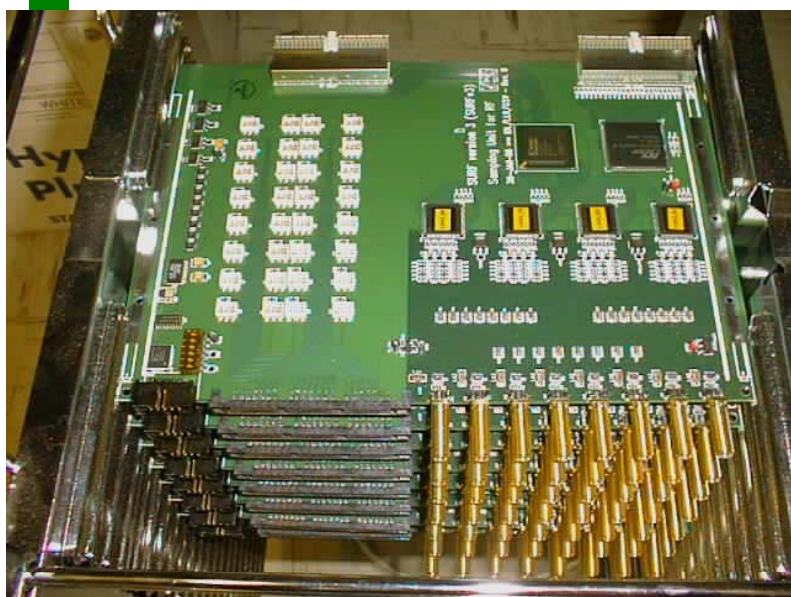


# ANITA3 – ID Lab

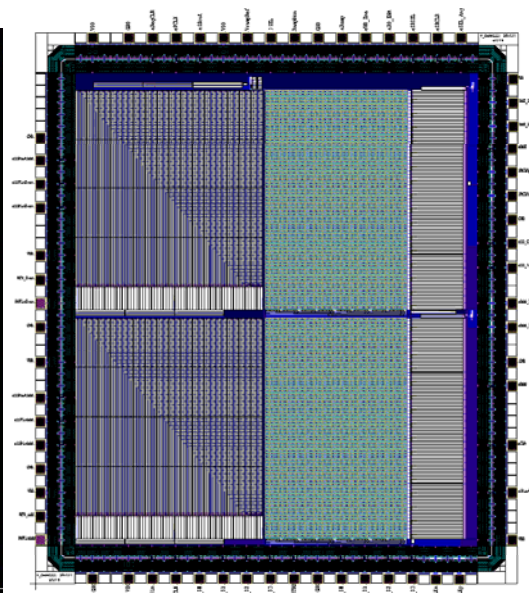
## Our Developments

### New SURF & TURF

- 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



RITC



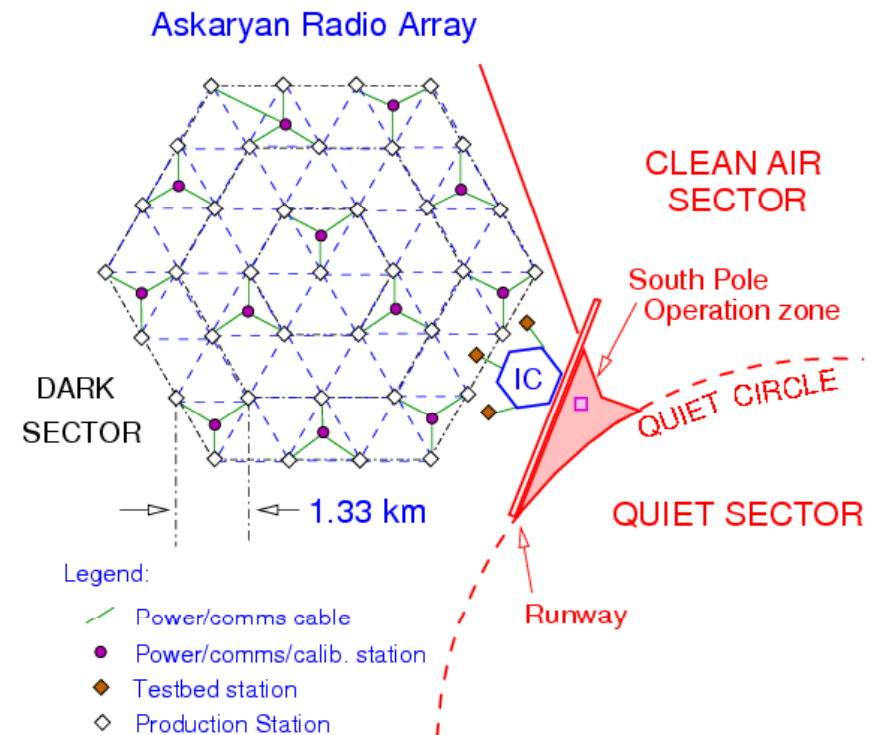
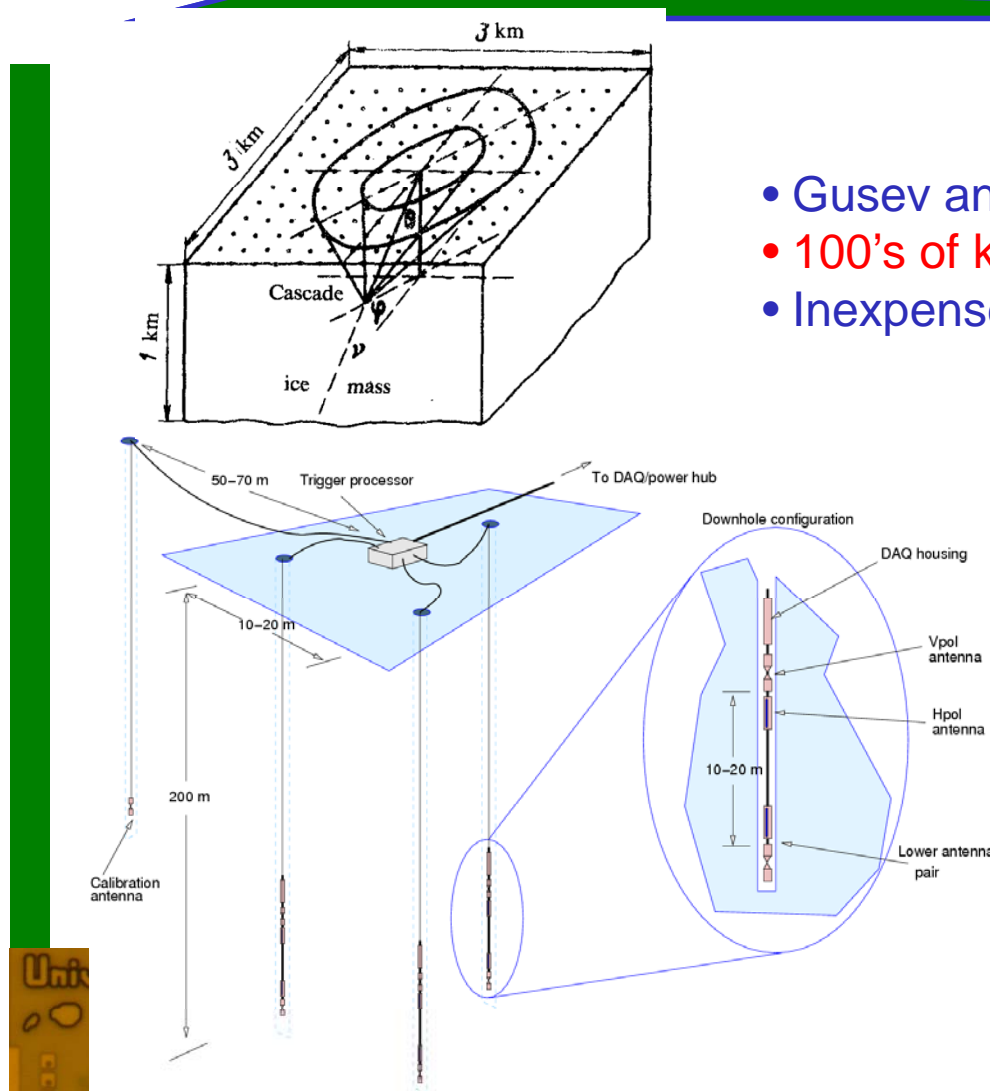
LAB4



# Askaryan Radio Array (ARA)

## Physics Goals

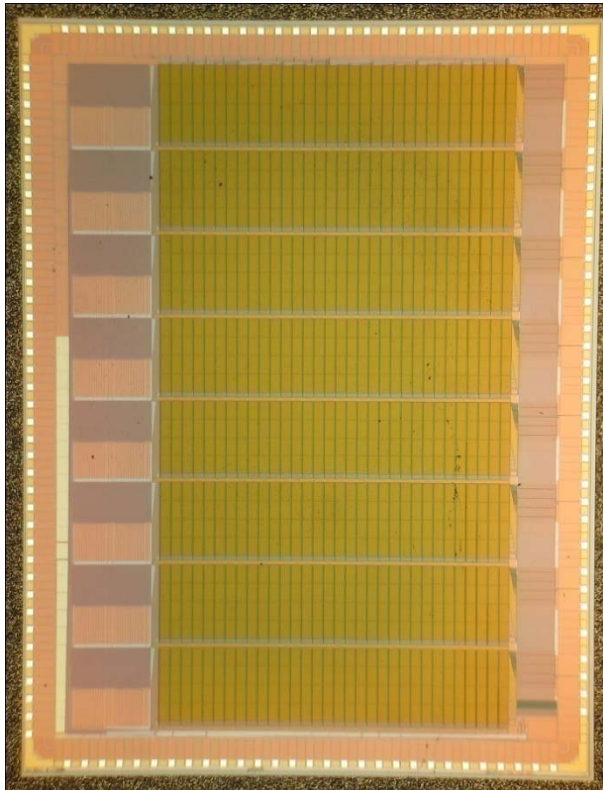
- Gusev and Zheleznykh proposed in 1983!
- 100's of km<sup>3</sup> volume at GZK nu range
- Inexpensive extension to IceCube





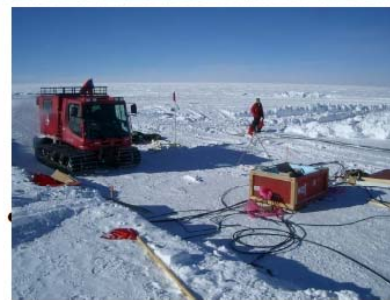
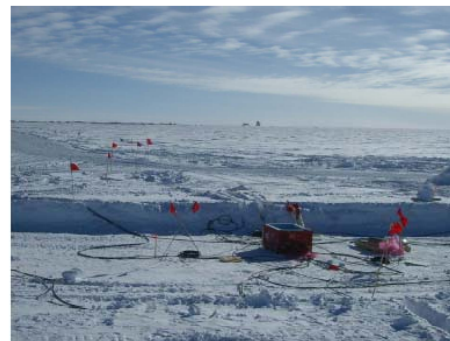
# ARA – ID Lab

## IRS, IRS2, IRS3 ASIC



## 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

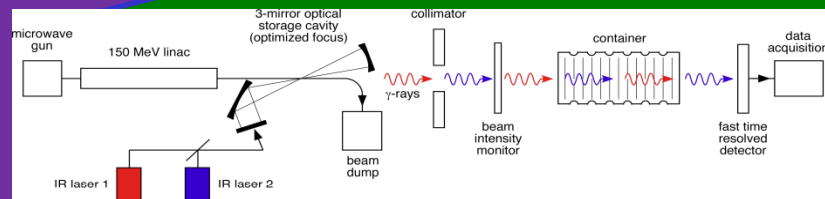


## ARA Test Bed

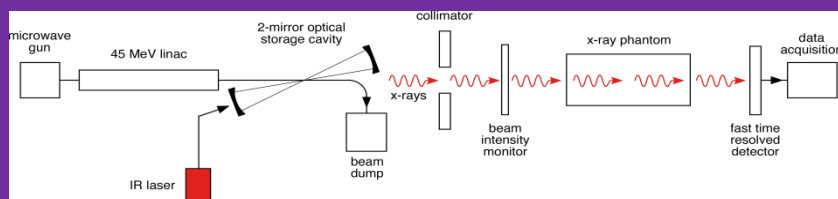
State of the Instrumentation Dev. Lab -- October 2011

# Title: Time-Encoded Differential Absorption

## Org/PI: University of Hawaii / John Madey



Configuration of operational gamma-ray differential absorption detection system for fissile nuclear materials.



Configuration of proposed x-ray scaled prototype detection system for proof-of-principle experiments.

### 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

### 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

•FY09: \$398K

•FY12: \$399K

•FY10: \$392K

•FY13: \$379K

•FY11: \$388K

•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

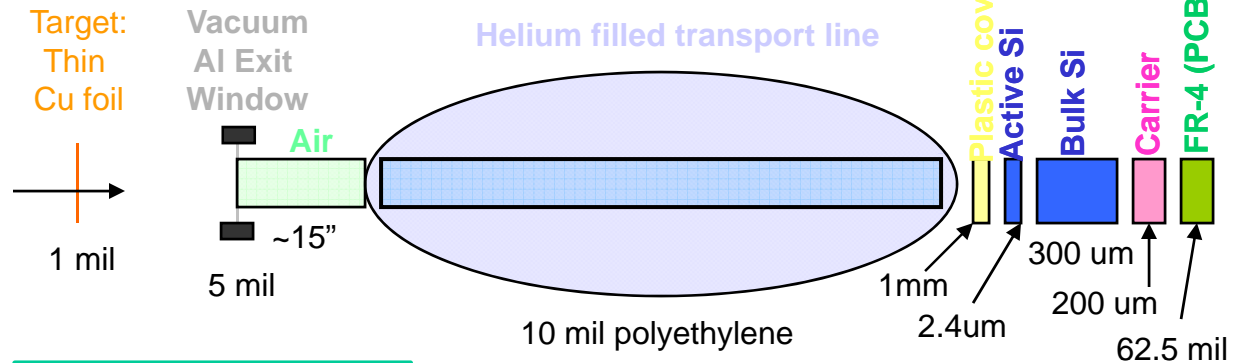
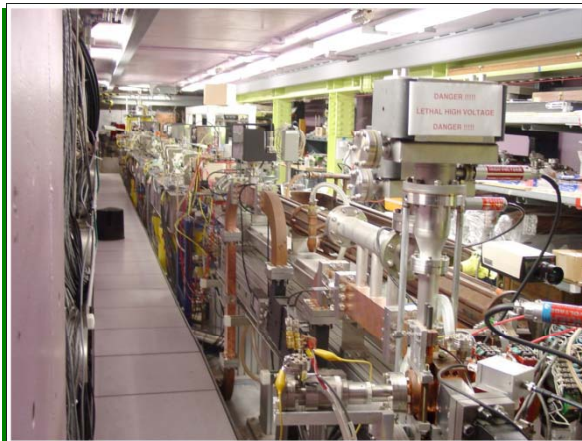
- co-PIs: Assoc. Prof. Gary Varner  
Assoc. Prof. Eric Szarnes



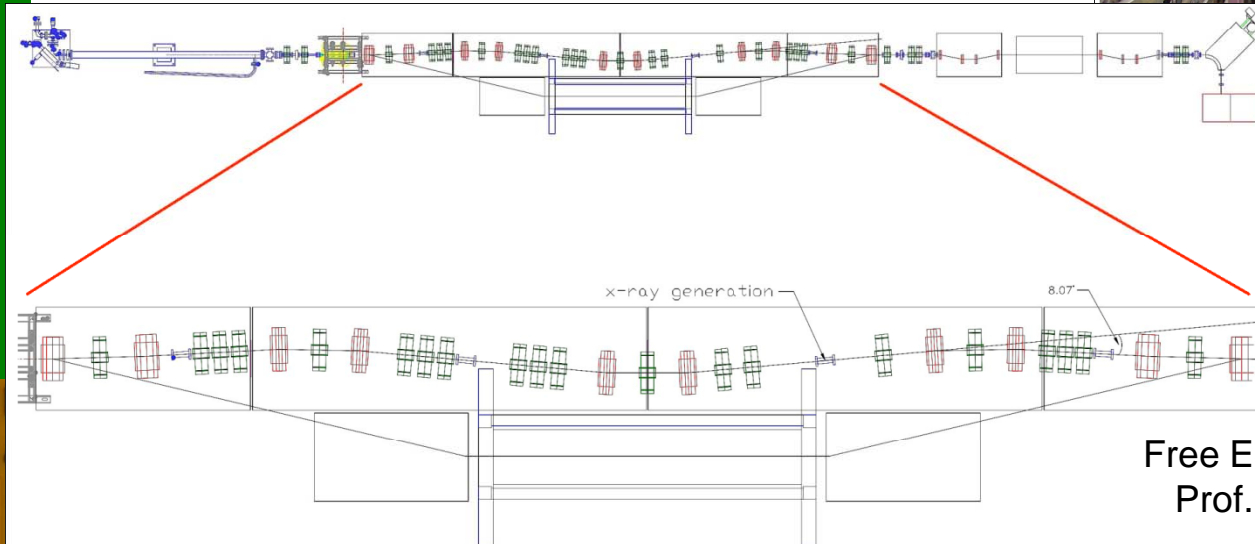
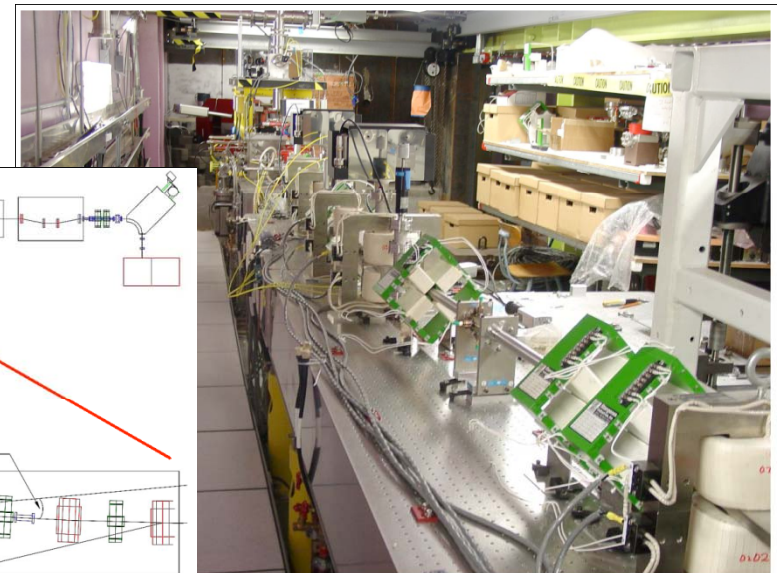
# Bremsstrahlung x-rays: UH FEL

First x-rays: September 2010

50MeV max. (40MeV typ.)



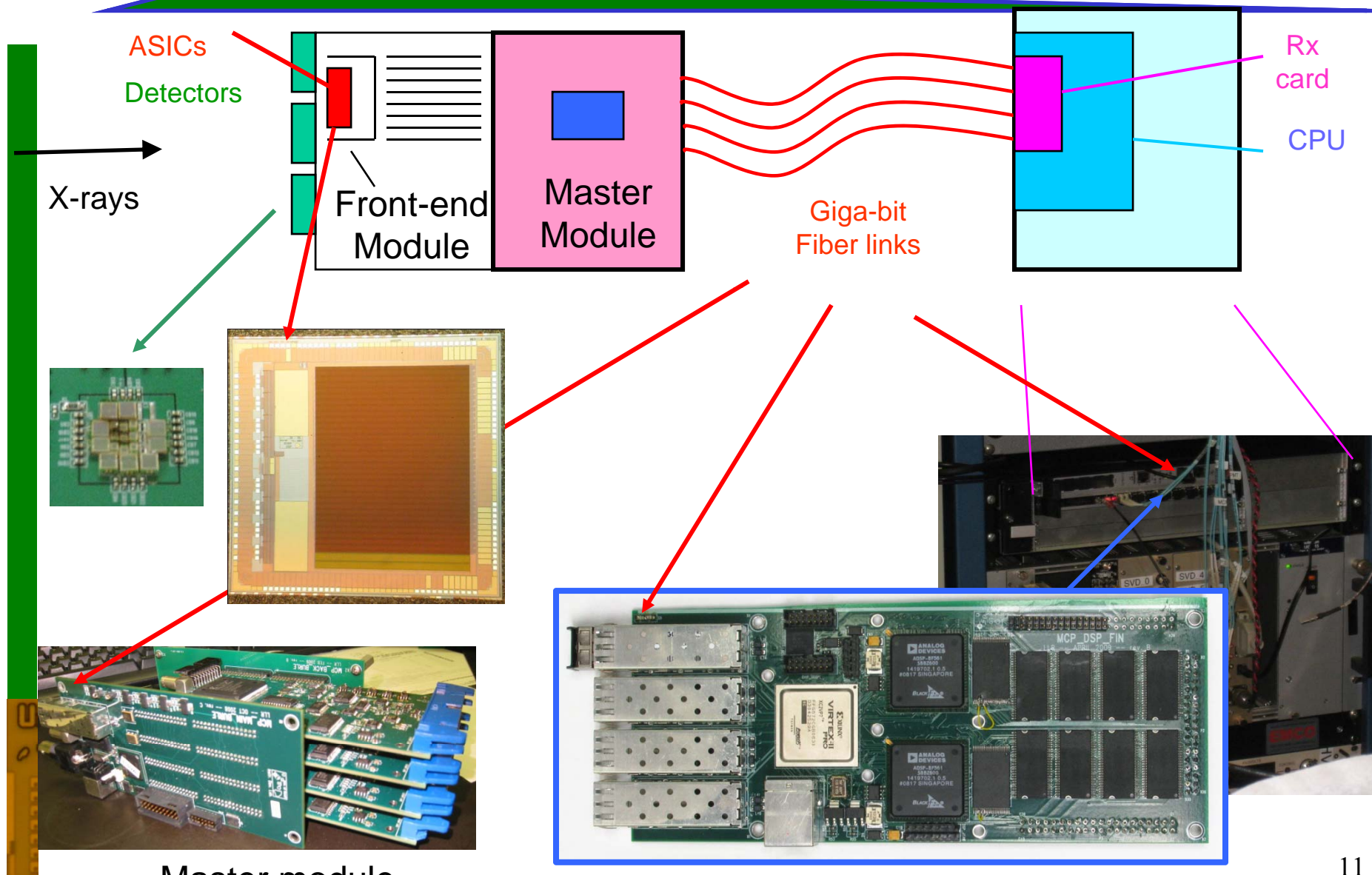
3D & STURM testing



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

# TEDA –ID Lab

cPCI crate (control room)



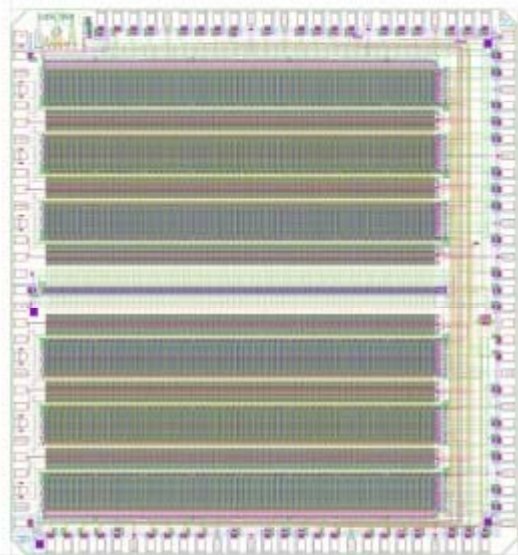


# Large Area Photodetector



## Project goals

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



PSEC, IRS calibration/readout

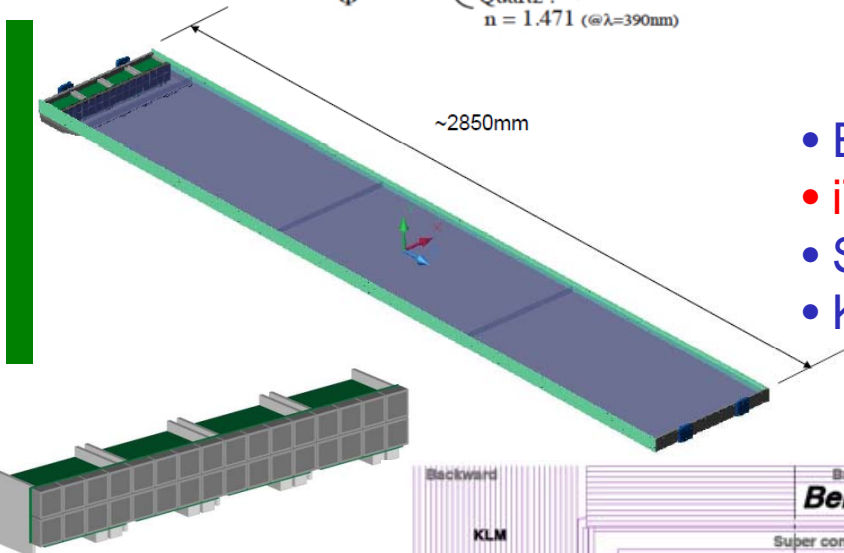
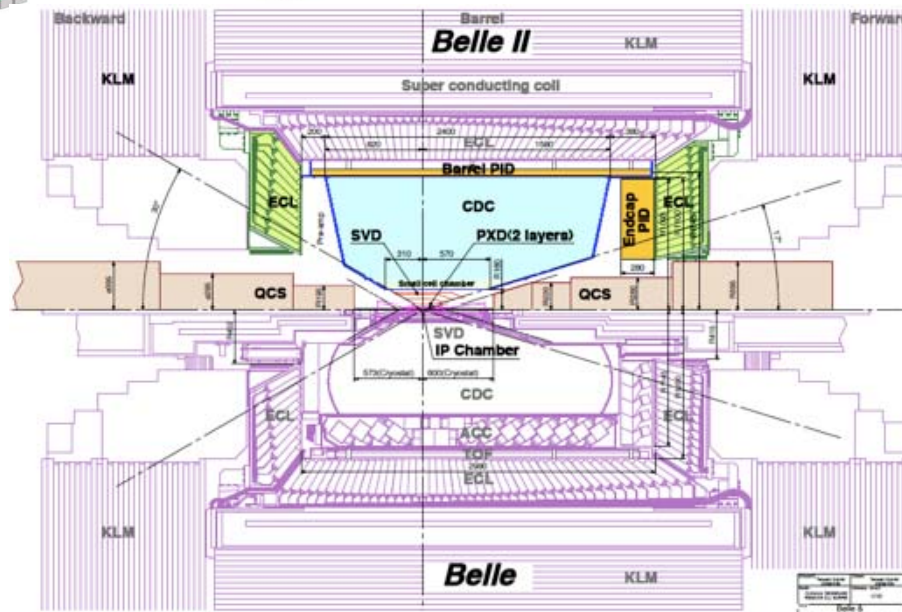
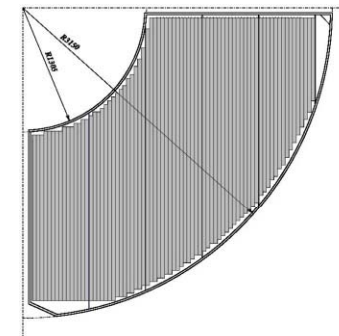
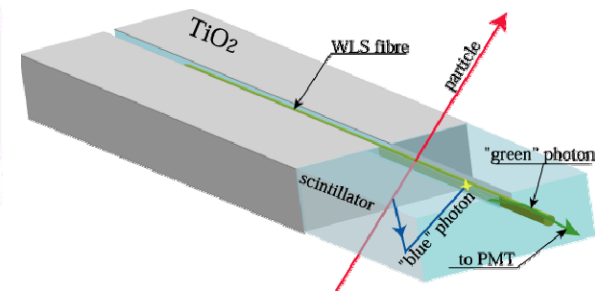
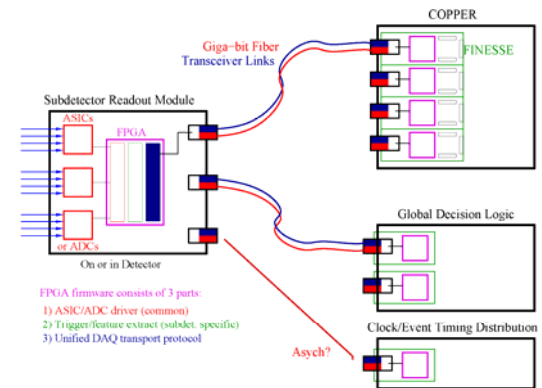
CHAMP

State of the Instrumentation Dev. Lab -- October 2011

# Belle II – ID Lab

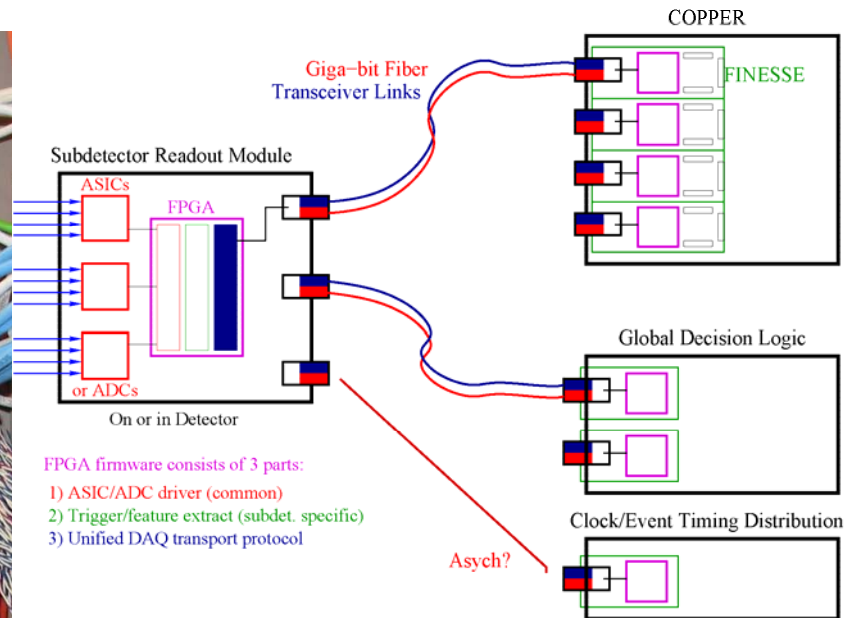
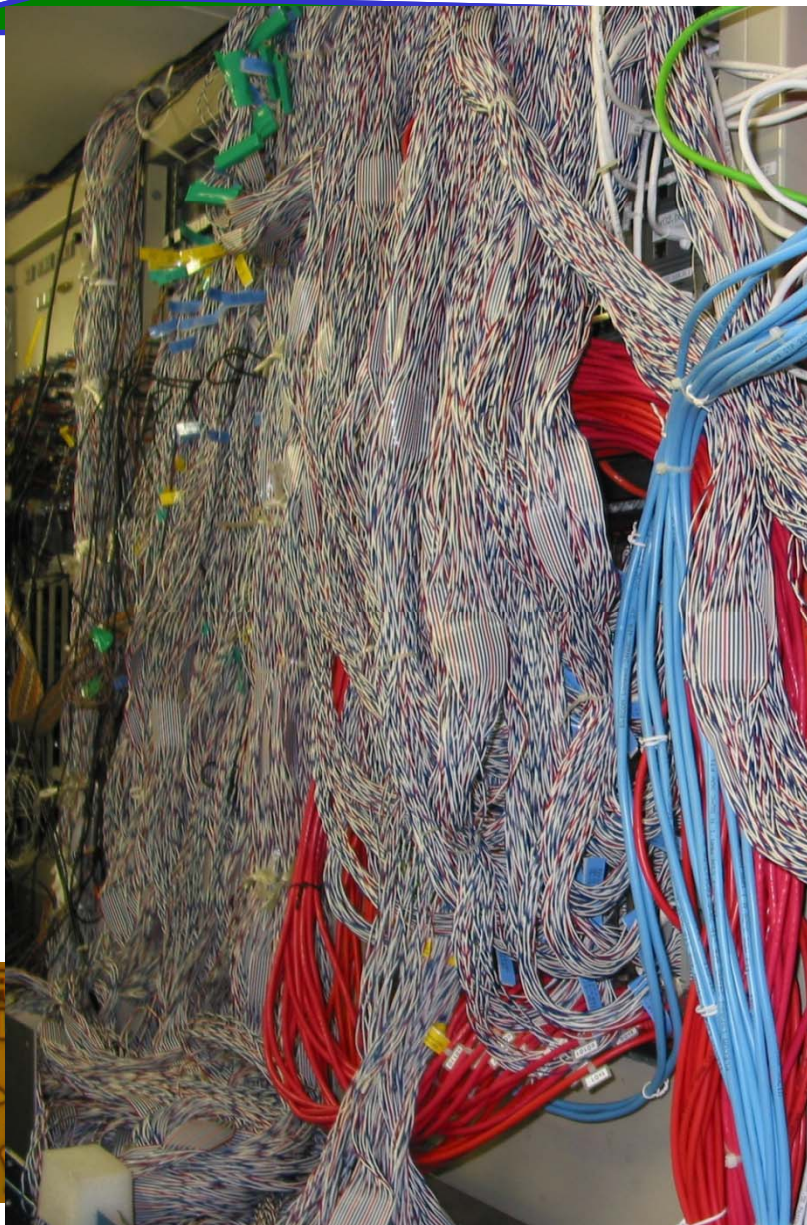
## Our activities

- Electronics architecture
- **iTOP readout**
- Scin strip KLM readout
- KEKB nanometer beam





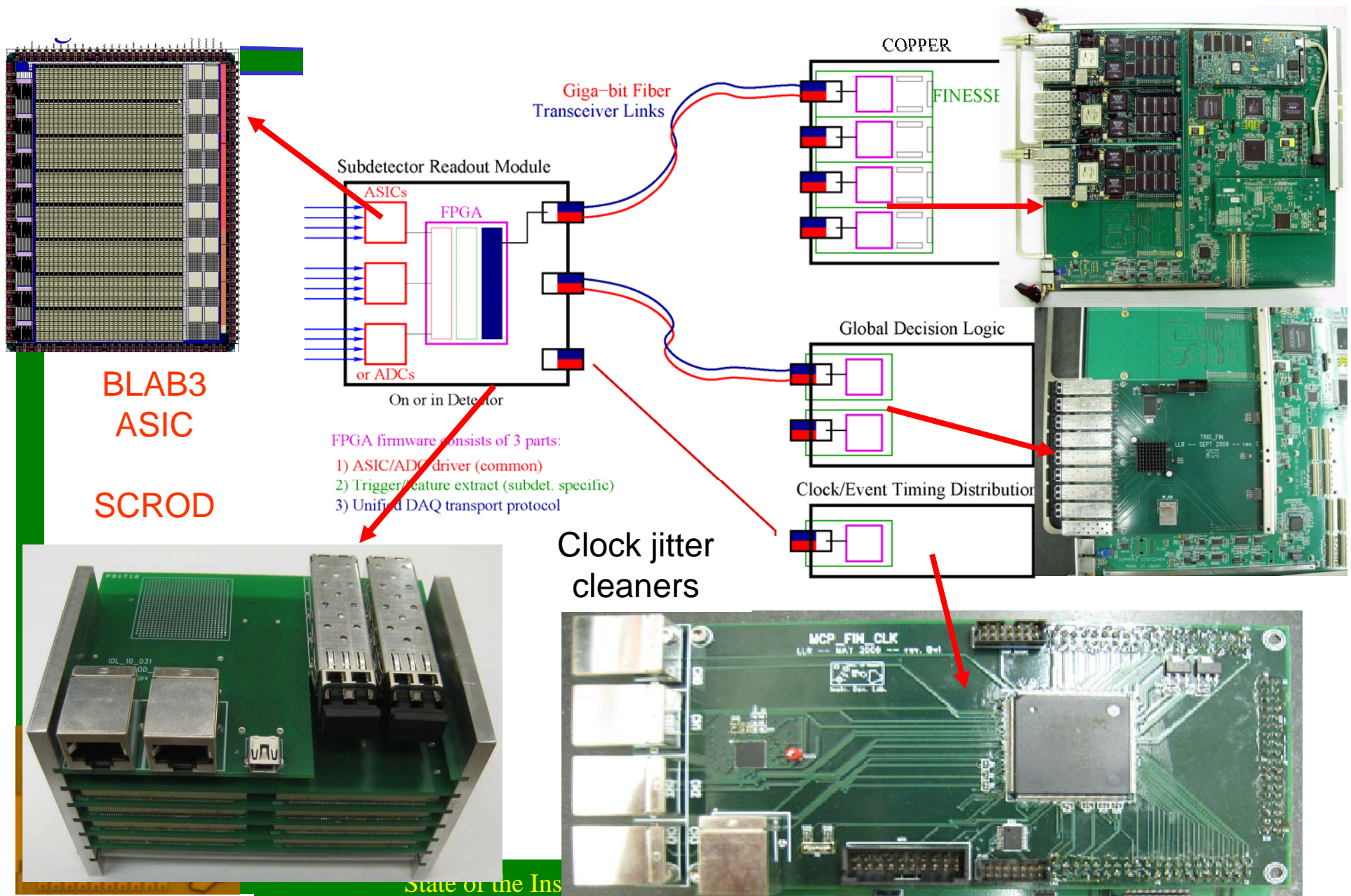
# Got fiber?





# iTOP – ID Lab

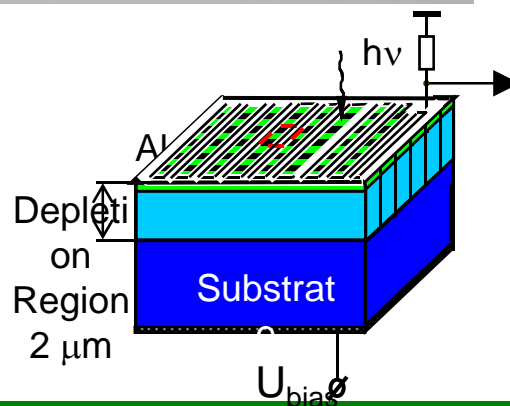
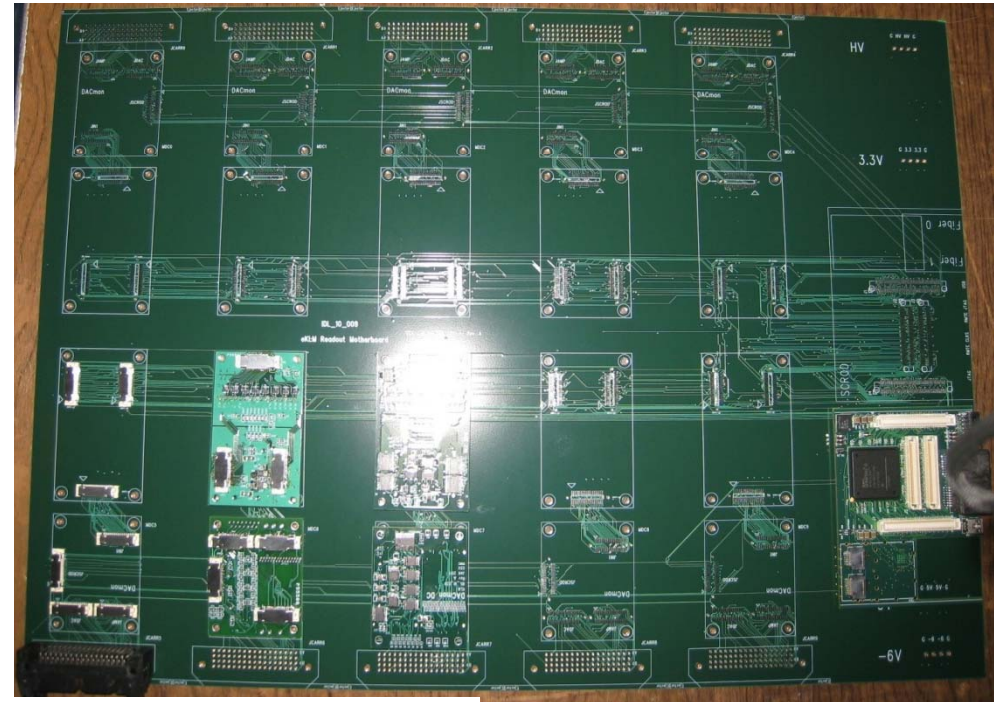
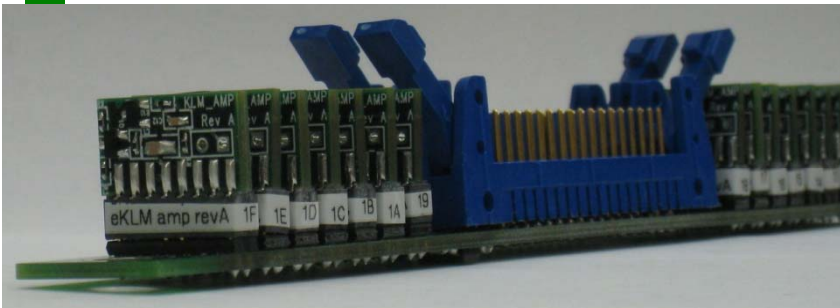
Our activities



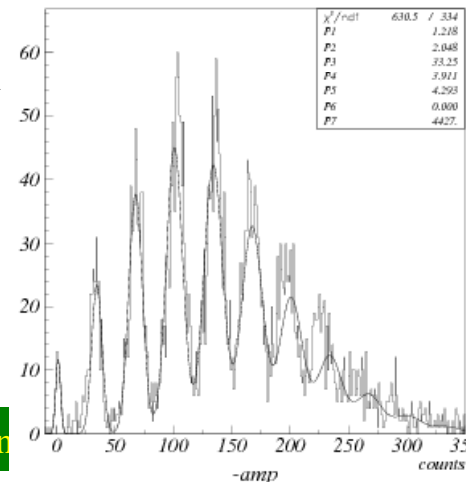


## Our activities

# KLM – ID Lab



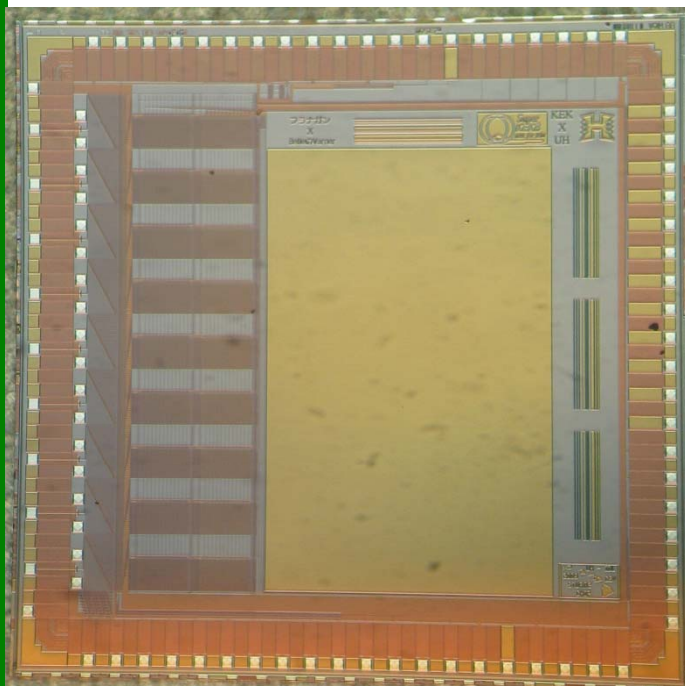
State of the Instrument



Results with  
prototype ASIC  
(TARGET)

# SuperKEKB – ID Lab

## STURM2 ASIC



## Our Developments

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





# Major Research Thrusts

- Belle II – iTOP/KLM by 2014
- Disruptive technology: LAPPD (Detector dev center – ANL)
- ANITA 3<sup>rd</sup> Flight approved → active R&D (ASICs, trigger...)
- New initiatives: ARA Test bed installed, year 2 & 3
- Next generation, high-speed image sensors
- Advanced x-ray detection for nanometer beam bunch size monitoring and next generation x-ray telescope
- Belle-II pixel vertex detector v2.0
- Highly integrated, column parallel CCD readout
- Low-power RF electronics for future massive detectors

