



Advanced Instrumentation

Beam Diagnostics

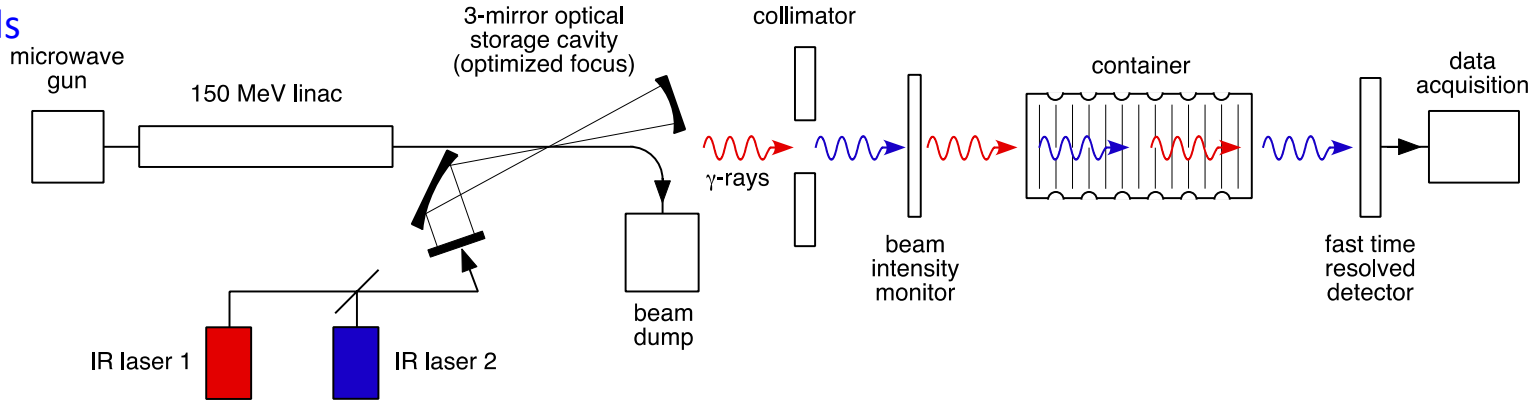
- Fundamental new approach to beam position monitoring:
 - High-level heterodyne detection
 - Single chip signal processing
 - Reduce coaxial cable distortion
- Augment with advanced GHz transient digitizers
- Key development components:
 - Direct downconversion
 - Wide dynamic range logarithmic amplifiers
 - Transport modelling
- UH system is model for future beam position monitoring systems

Advanced Detection

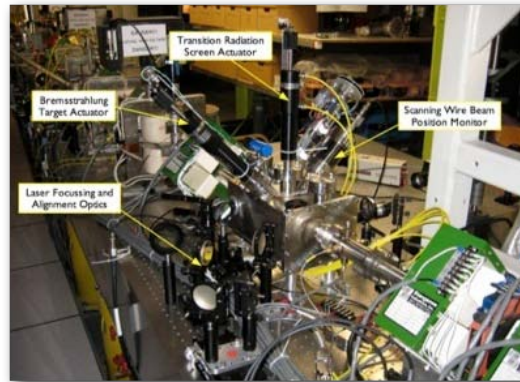
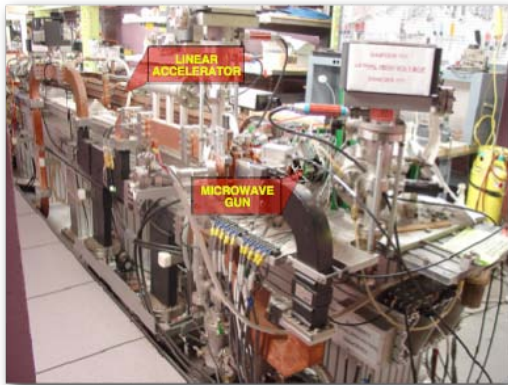
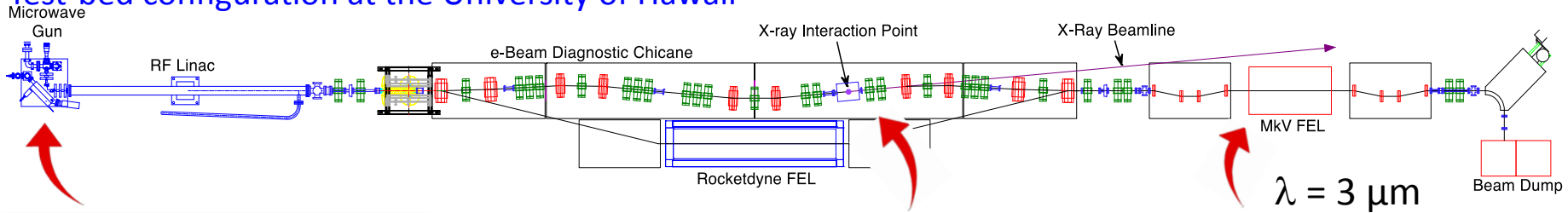
- Complete simulation package for x-ray production, transport & detection:
 - 2 source configurations
 - ~1ps timing, intense flux
 - Exploit pulsed structure
- x-ray beamline and first readout commissioned Sept 2010
- Key development components:
 - GHz timing Detectors
 - High speed sampling ASICs
 - High throughput readout
 - Real time, fast feature extraction
- Giga-Hertz, Giga-Samples/s and Giga-bits/s tools now available

Pico-second timing x-ray source

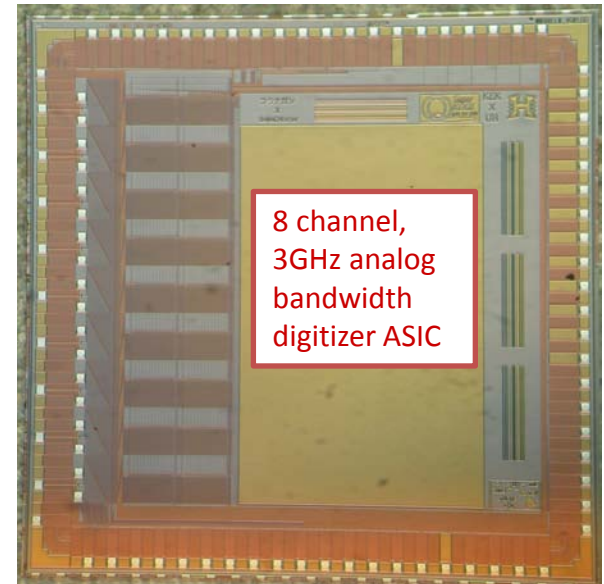
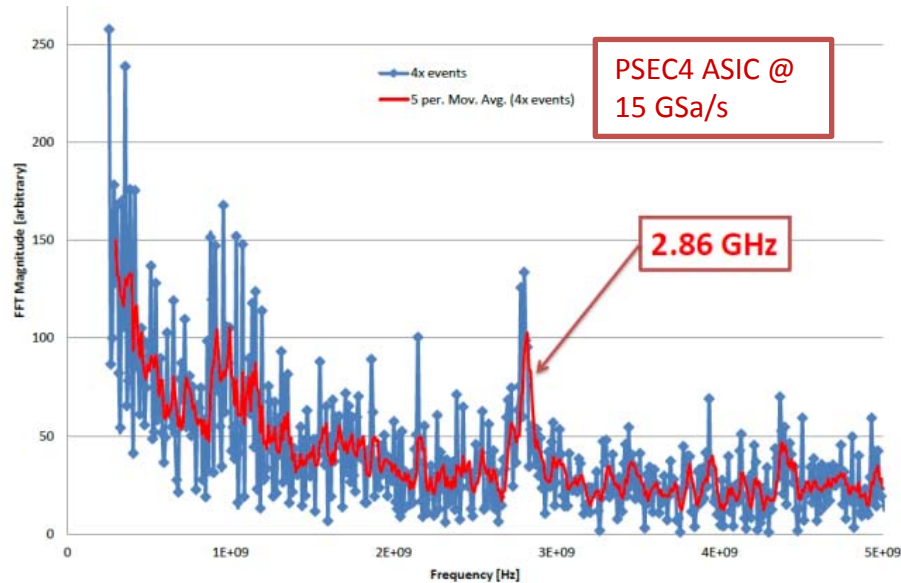
Configuration of operational gamma-ray differential absorption detection system for fissile nuclear materials



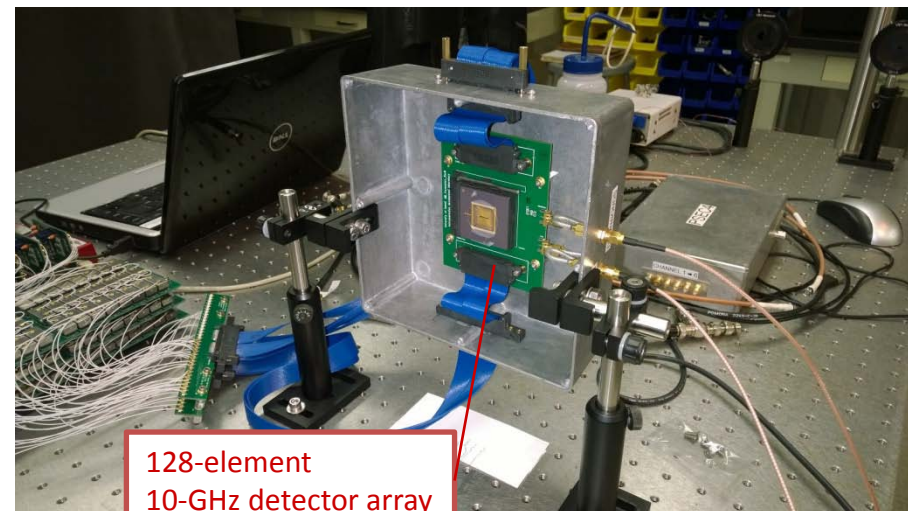
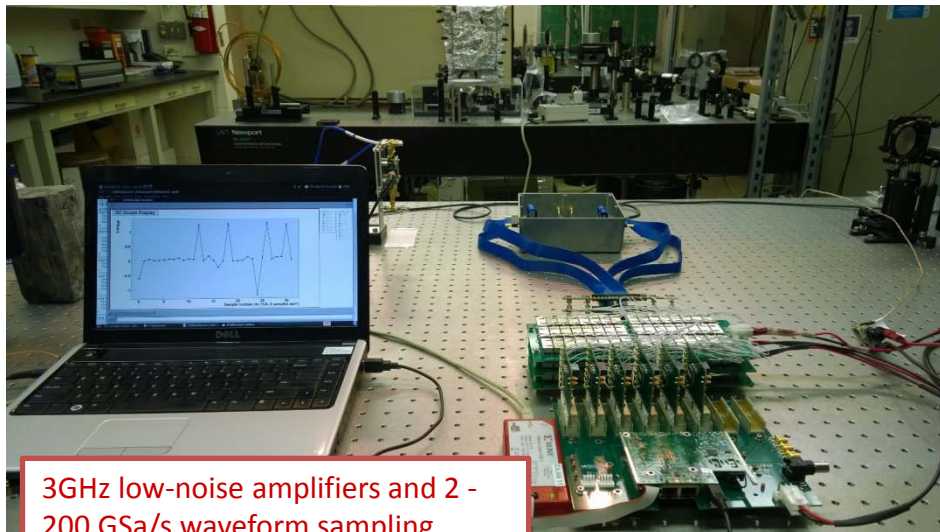
Test-bed configuration at the University of Hawaii



Ongoing Evaluation Program



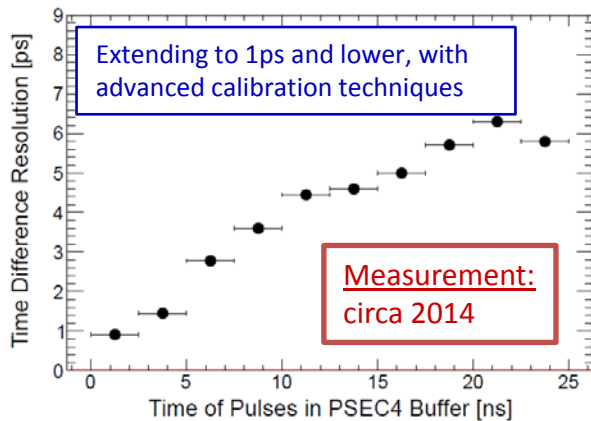
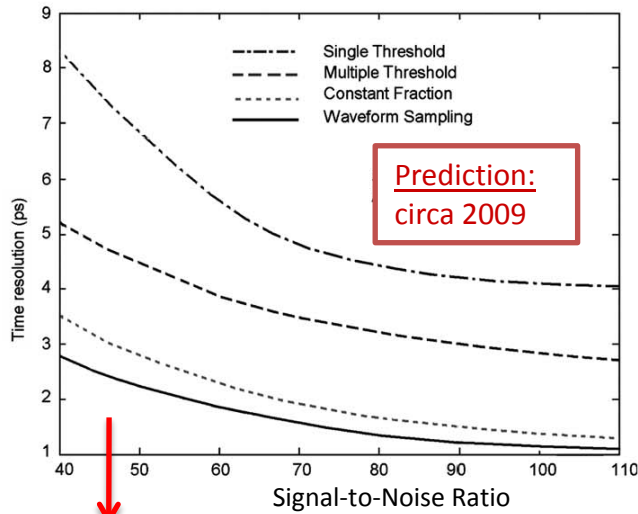
Detectors and readout with pico-second timing and μm spatial resolution



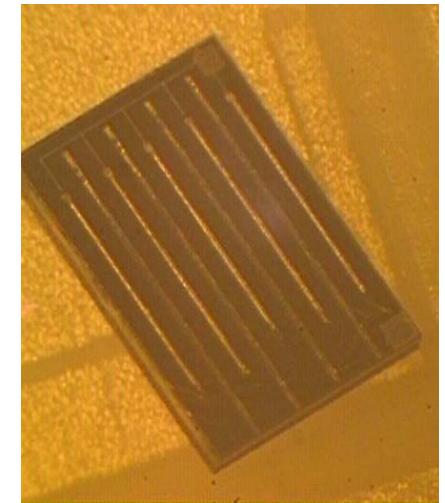
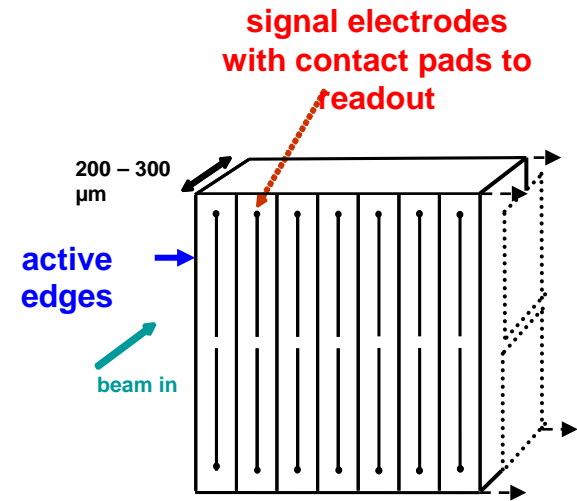
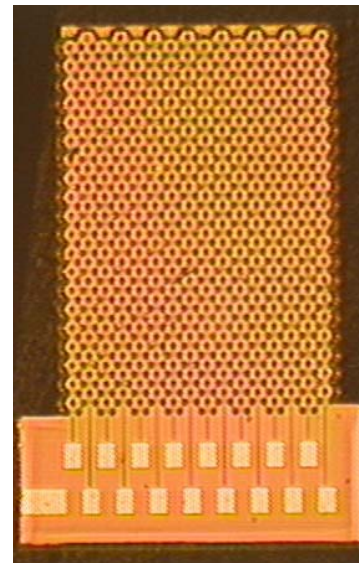
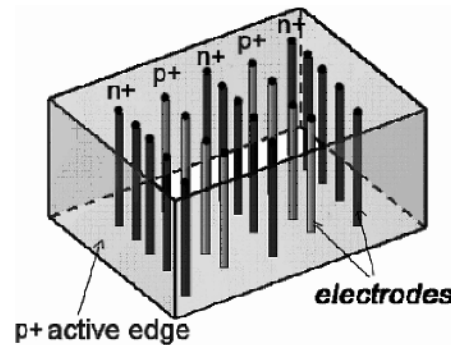


High space-time Resolution

In a number of communities (future particle/astroparticle detectors, PET medical imaging, etc.) a growing interest in detectors capable of operating at the pico-second resolution and μm spatial resolution limit (for light $1 \text{ ps} = 300 \mu\text{m}$)



Front-End Electronics



Fast signal collection x-ray detectors



Next Steps

- Complete Evaluation of existing detectors and readout ASICs
 - Detectors: InGaAs linear, 3-D and trench proto, diamond
 - ASICs: PSEC4, STURM2, IRS3C, IRSX
- Further Developments in pipeline:
 1. Nano-meter bunch size x-ray detectors for Super-KEKB accelerator (and future ILC damping ring) [ATF2]
 2. Next generation ASICs (PSEC5, STURM3, ...) [PHYS476]
 3. Advanced TCA migration for fast Data Acquisition
 4. Real time, fast feature extraction
- Use 3 facilities:
 1. UH FEL
 2. KEK ATF2 & photon factory (SuperKEKB from fall 2015)
 3. Hawaii Muon beamline