DETECTOR DEVELOPMENT GROUP

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

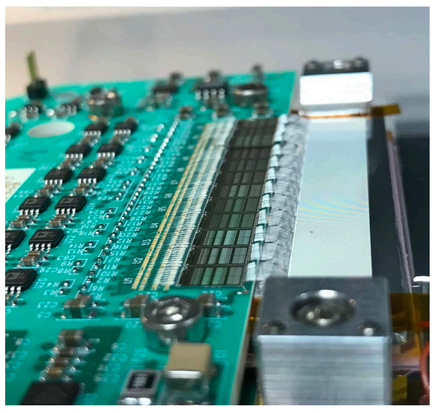
MISSION

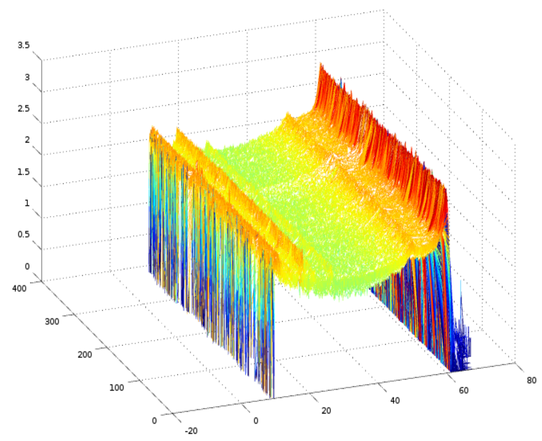
To develop and deploy advanced detector systems to address beamline needs.

PROJECTS

Germanium microstrip detector for XPD

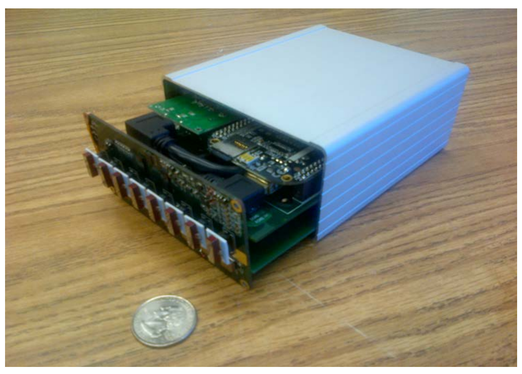
The project aims to provide a photon-counting, position-sensitive detector for hard x-rays in the 50keV range. It has 384 microstrips in a linear array, each 0.125mm x 8mm. The signals are read out by a custom integrated circuit, designed at BNL, coupled to a fast processor based on the new ZynQ series of FPGA / CPU devices. Another, similar detector is in use at APS, where it allows rapid diffraction tomography through a novel optical scheme.





Left: photograph of the 384-strip germanium detector showing the sensor and ASICs wire-bonded together. Right: spectral from all 384 strips (241Am source, logarithmic scale).

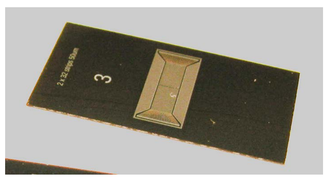
A multi-element CZT detector for high-resolution powder diffraction

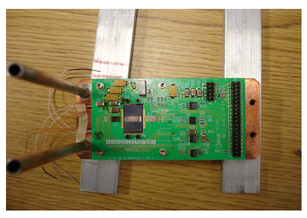


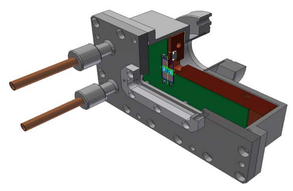
We have built two detectors designed to handle the output from an 8-crystal analyzer array soon to be installed at XPD. This one is based on the room-temperature semiconductor cadmium-zinc telluride. It has eight sensors, each having 16 segments for high throughput. The compact housing contains everything needed to operate the detector, bias generator, amplifiers, discriminators and counters, plus a microcomputer to administer it all, with a solid-state disk which can store data directly for later download if required.

A custom-designed silicon microstrip detector for IXS

The IXS instrument produces 6 beams per analyzer, and this detector was designed to allow each beam to be separately recorded. It consists of 2 sets of 32 strips arranged side-by-side. The six analyzer crystals are steered to direct their diffracted beam on to a set of four strips. The additional strips act as a guard to ensure the beams are truly separately recorded. A key feature of the detector is its very low background count.







The left-hand image shows the 64-strip sensor, arranged as two sets of 32, side-by-side. The signals are read out by two custom ICs, each strip having a complete counting chain with amplifiers, window discriminators and counters. The center image shows the sensor mounted on a PCB with its two Ics. The sensor is cooled to -20 C by Peltier devices mounted below the PCB. The whole thing is water-cooled, and in vacuum to prevent condensation.

VIPIC: a custom-designed detector for XCS

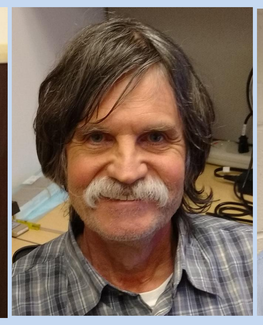
This is a project still in progress. A prototype has been built and demonstrated to provide time-stamped data at the 100ns level, based on a novel scheme which avoids reading out empty pixels (sparsified readout). It will have over a million pixels and allow uninterrupted data acquisition from 100 ns to hours.

Overview

The Detector Development Group is a small group dedicated to providing solutions to beamline detector needs which are not satisfied by commercial products, and which are designed according to the needs of the particular technique or instrument.

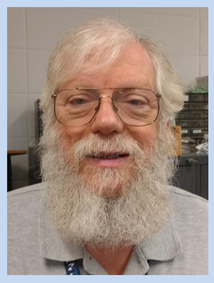
Group Staff

Tony Kuczewski
Electrical Engineer

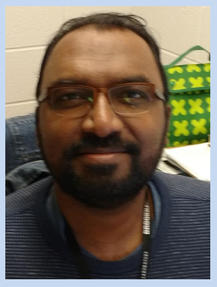


Rich Michta
Electrical Engineer

Abdul Rumaiz
Scientist



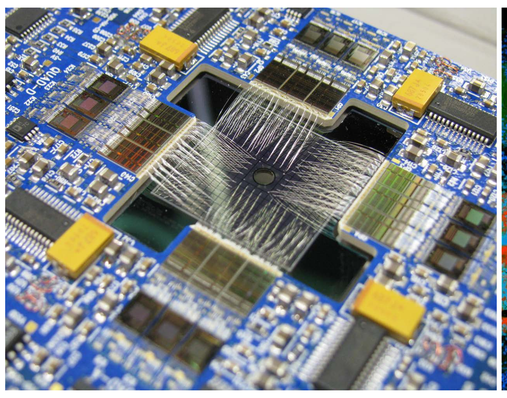
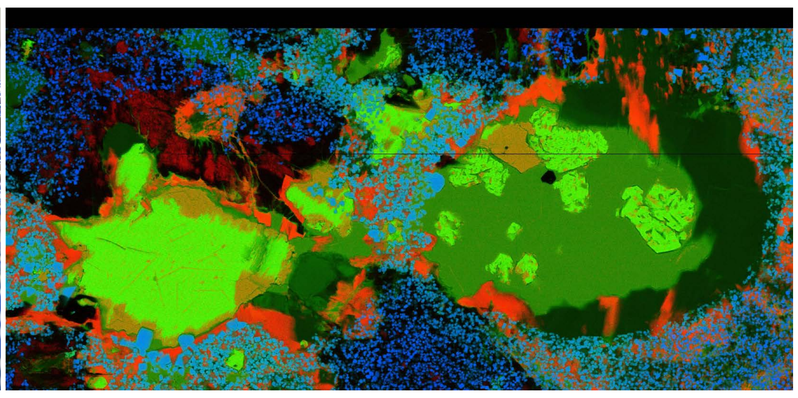
Peter Siddons
Group leader



Tareque Aziz
Postdoc

4-channel electrometers for general beamline use

There was a need for many channels of low-current readout. Several beamlines needed to instrument slit-jaws and other apertures with photocurrent readout to aid in alignment. These two devices were designed to satisfy that need. Over 90 of the smaller unit have been deployed. The larger one has outputs for feedback, and a detector bias supply.

Maia: a revolutionary spectroscopy detector for X-ray fluorescence microprobes

We recently installed a Maia fluorescence microprobe system at the SRX beamline. The first users were able to capture a large amount of data, an example of which is shown below. It is a mineral from a large deposit of metal-bearing minerals in Siberia. The image is 3751 x 1822 pixels, each pixel is 1 micron in size, and the beam dwell time per pixel was 0.8 ms. The image is color-coded; red=Rb, green=Fe, blue-Cr. The left-hand image shows the internals of the detector, with its 384 detector elements and readout ICs wire-bonded to them.