Cross Strip MCP Detector Systems for Spaceflight

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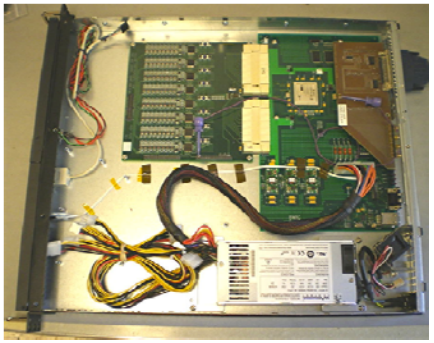
Description and Objectives:

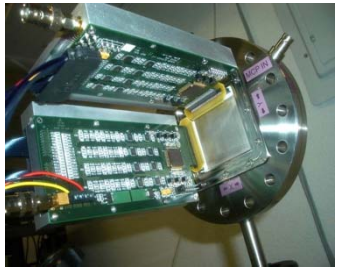
- Cross strip (XS) MCP photon counting UV detectors have achieved high spatial resolution (12µm) at low gain (500k) and high input flux (MHz) using laboratory electronics and decades old ASICs. We plan to develop new ASICs ("GRAPH") that improve this performance, which includes amps and ADCs in a small volume, mass and power package crucial for spaceflight and demonstrates its performance to TRL 6.

Key Challenge/Innovation:

- A new ASIC with amplifiers a factor of 5 faster yet with similar noise characteristics as existing amplifier ASIC
- GHz analog sampling and a low power ADC per channel
- FPGA control of ASIC chip(s)



Existing 19" rack mounted XS electronics



Two small, low mass, low power ASIC and FPGA boards qualified for flight

Approach:

- We will develop the ASIC in stages, by designing the four major subsystems (amplifier, GHz analog sampler, ADC and output multiplexor) using sophisticated simulation tools for CMOS processes. Small test runs of the more intricate and untested designs can be performed through shared access of CMOS foundry services to mitigate risk. We plan 2 runs of the full up GRAPH design (CSA preamp and "HalfGRAPH"). In parallel, we will design and construct an FPGA readout circuit for the ASIC as well as a 50mm XS MCP detector that can be qualified for flight use.

Key Collaborators:

- Prof. Gary Varner, U. Hawaii
- Dr. Oswald Siegmund, U.C. Berkeley

Development Period:

- May 1, 2012 – Apr 30, 2016

Accomplishments and Next Milestones:

- 50 mm detector design and fabrication complete
- Confirmed detector performance with PXS electronics
- Designed, fabricated and tested first half-GRAPH1 ASIC
- Design and fabrication of half-Graph ver2 - Dec 2014
- Successful Thermal test of detector (-30ºC to +55ºC) - Aug. 2014
- Successful Vibration test of detector (14.1 Grms) - Dec. 2014
- Fabrication and performance testing of CSA – Sept. 2015
- ASIC integration with control FPGA boards (Winter 2015)
- Environmental tests of Detector + ASICs (Spring 2016)

Applications:

- High performance UV(1-300nm) detector for astrophysics, planetary, solar, heliospheric, or aeronomy missions
- Particle or time of flight detector for space physics missions
- Neutron radiography/tomography for material science

TRLin = 4 ***TRLcurrent = 4*** ***TRLtarget = 6***