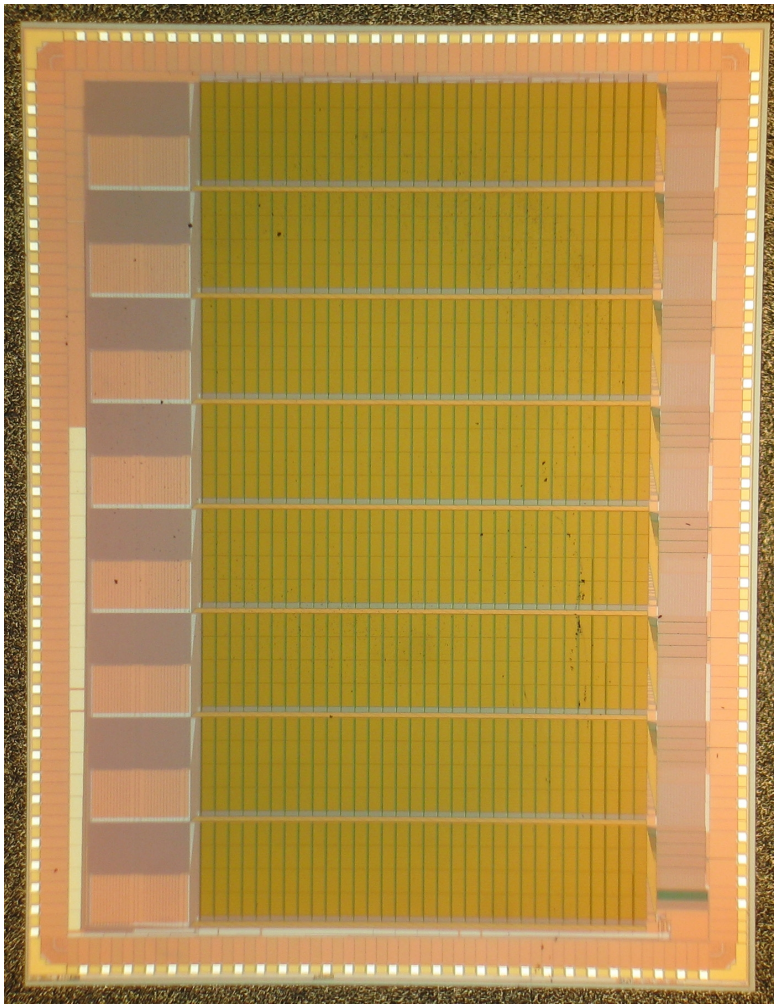
BLAB3A Trigger evaluation for mini-Time Cube



Michinari Sakai & Joshua Murillo

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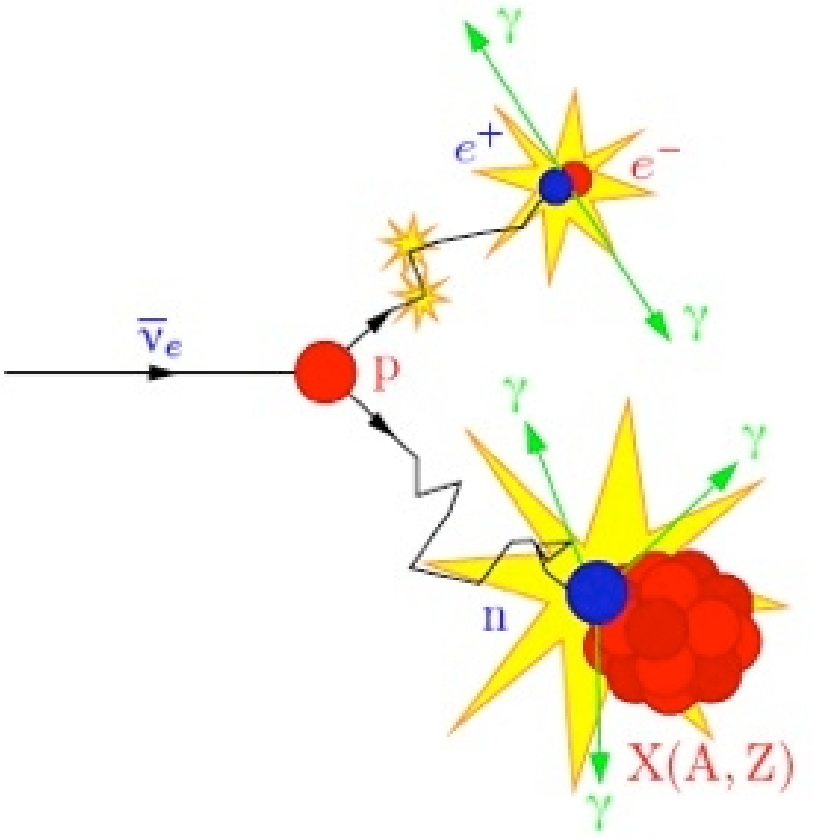
Detecting Neutrinos

- In most modern neutrino experiments the anti-neutrinos are detected through the inverse-beta decay process using a technique known as “delayed coincidence”

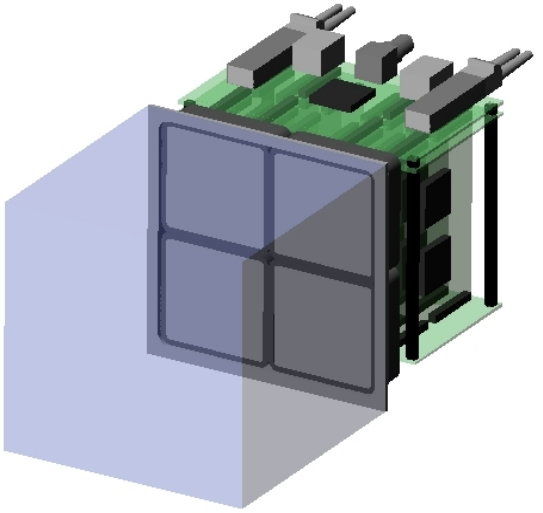
- Coincidence time is on the order of μs



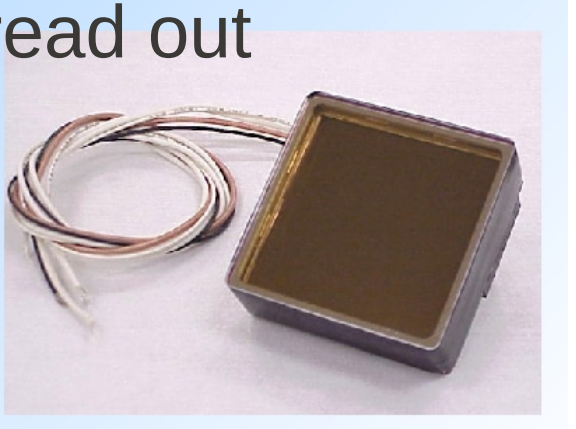
Inverse beta decay schematic

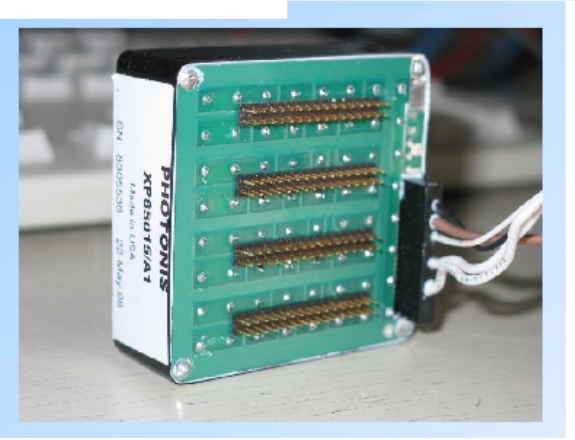
mini-Time Cube

- mTC is a prototype neutrino detector, designed to detect inverse-beta decay interactions caused by (anti)neutrinos.
- The BLAB3A is our candidate front-end read out digitizing ASIC for the mTC.



mTC with read-out electronics on one face

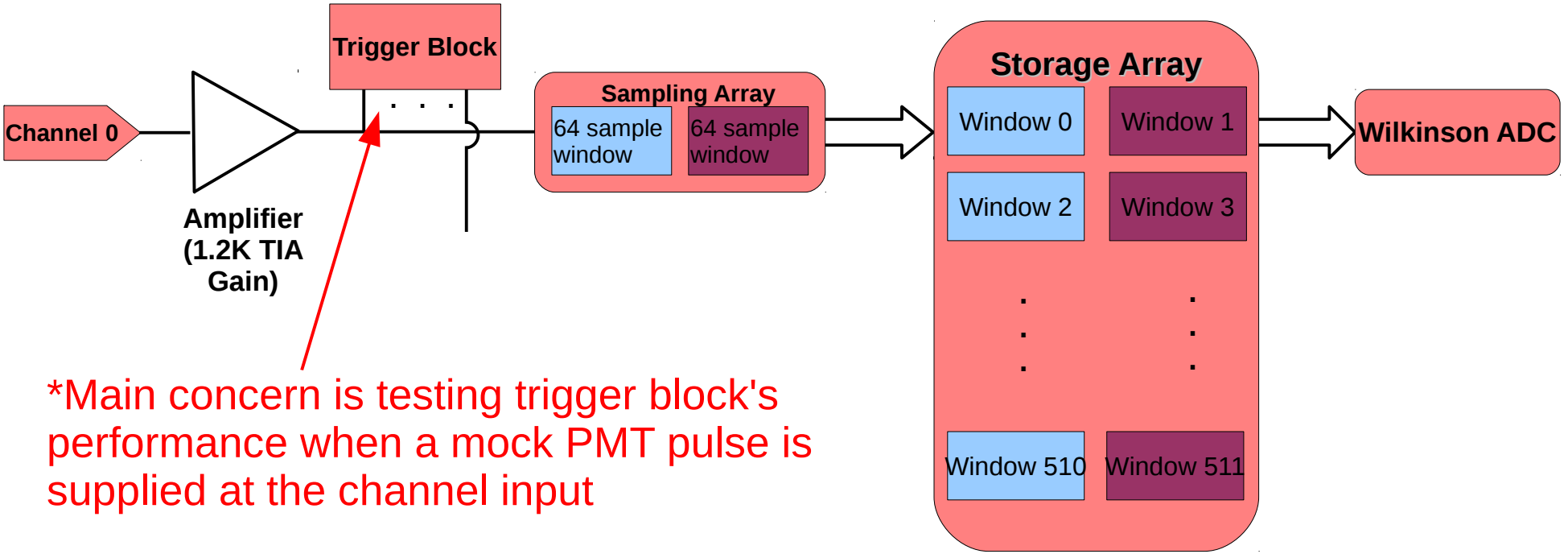




Dimensions:
Scintillating cube - 13cm^3
Populated with PMT's and read-out electronics - ~38cm^3

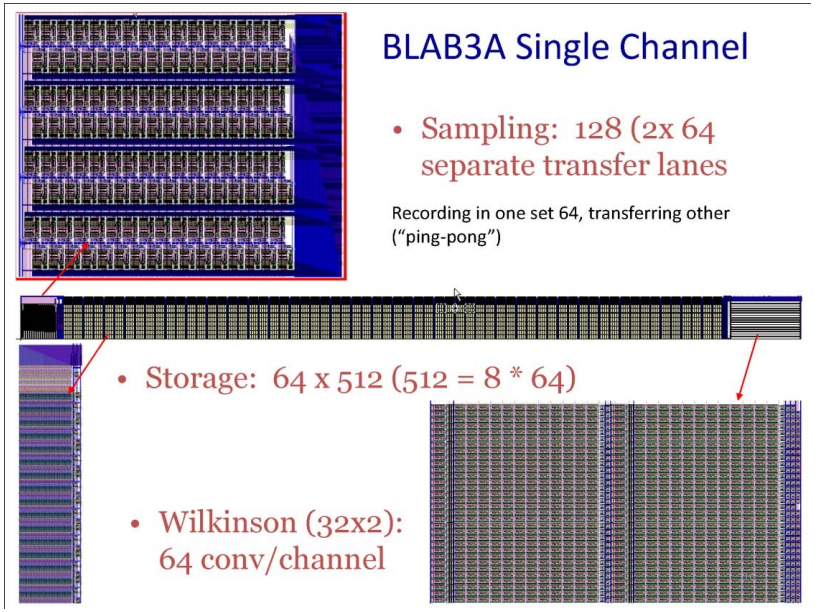
8X8 anode structure
Burle Industries
micro-channel plate photomultipiers.

BLAB3A single channel block diagram

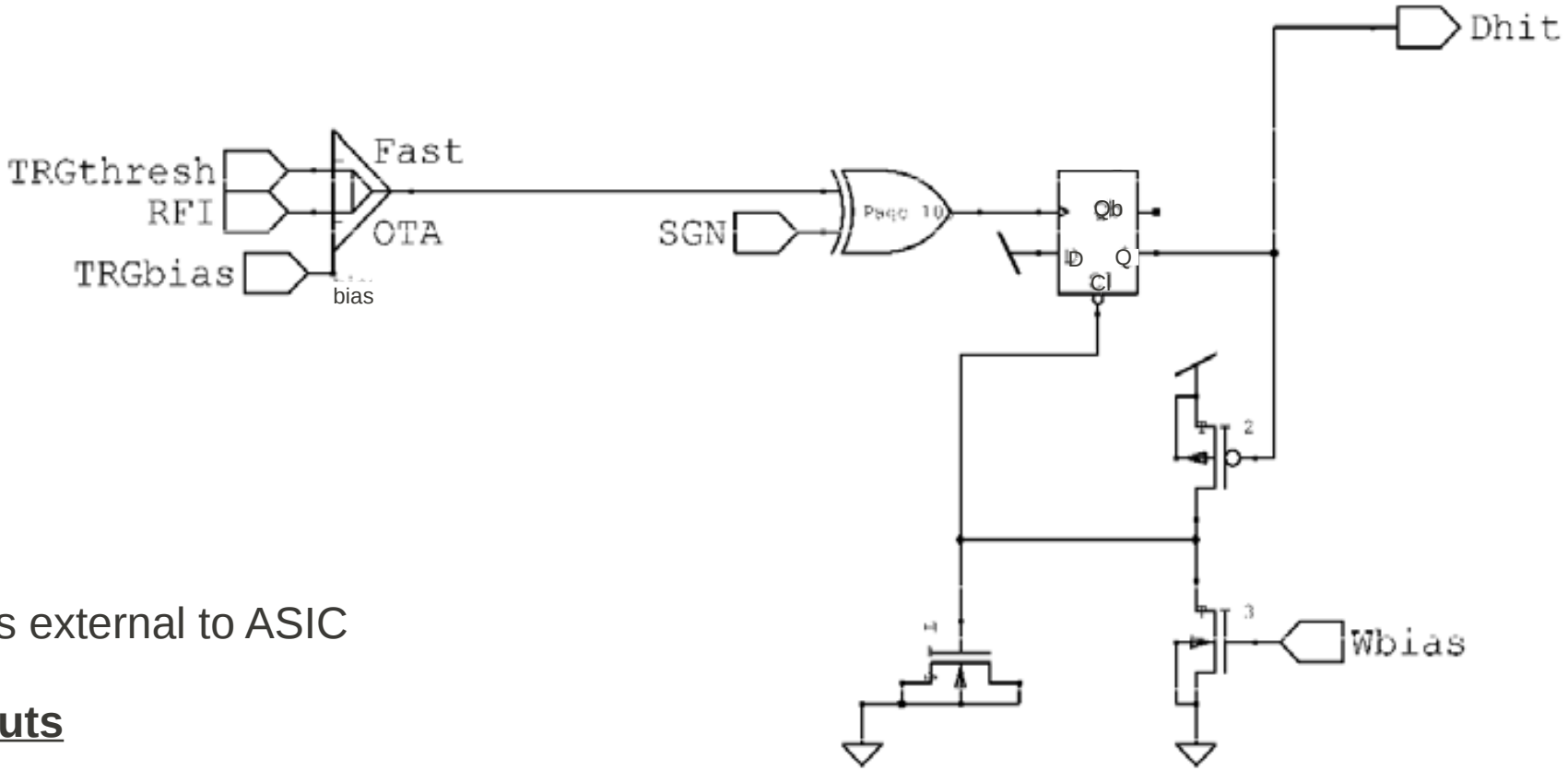


Specifications

- # of channels: 8
- Power: 20mW/channel
- Sampling Speed.: 2~4 Giga-samples per second
- Readout rate: up to 100kHz
- Amplification: ~1.2kOhm (measured) TIA on each channel



Trigger Schematic



Pins external to ASIC

Inputs

TGRthresh Trigger threshold (global)

TRGbias Bias current for Comparator

SGN Select signal polarity (0 = neg. signal; 1 = positive)

Wbias 1-shot width adjustment

Output

Dhit Trigger output 1-shot

Preliminary Outcomes

- What we were able to do
  - Make mock pulse is negative: width 50-100ns, height ~20mV.
  - Identify channel 1 of 0~7 channels, row 0 of 0~3 rows, column 0 of 0~3 columns, via Chipscope.
  - Adjust trigger values (TRGthresh, TRGbias, SGN, Wbias) via Chipscope using virtual input output (VIO) core or simply set nominal values in VHDL code.

Demonstration

Outlook

- This project was a great way to “get our feet wet” and we both learned a substantial amount about:
    1) BLAB3A, as well as the workings of the board stack (SROD, carrier boards, DAC's)
    2) VHDL code and ISE
    3) Generating cores via Chipscope for debugging

- Our testing of the BLAB3A was not conclusive in identifying whether or not this ASIC will work for the mTC project.

    This work will continue in spring semester.