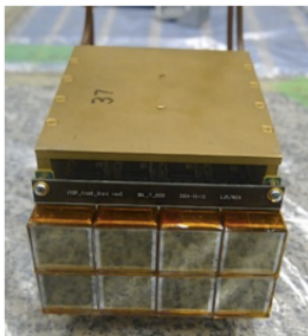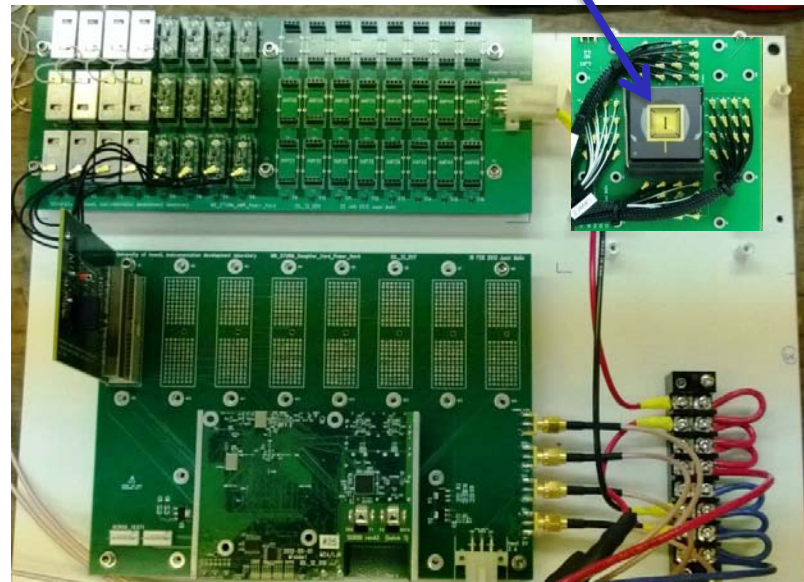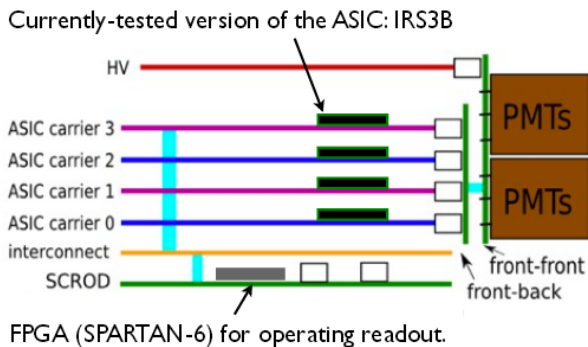# TEDA Detector & DAQ

- Development of new ASICs, amplifiers and readout modules based upon lessons learned from earlier prototypes:

1. 128-channel Micro-channel Plate PMT array based on the IRS3B ASIC

2. 64-channel InGaAs linear array with single x-ray quanta sensitivity based on the STURM2 ASIC and new Giga-bit fiber-optic transceiver

➢Extensive firmware, software developed
➢Deploy and test in TEDA Demonstrator this autumn

TEDA Demonstrator Systems

MCP-PMT

InGaAs detector

Currently-tested version of the ASIC: IRS3B

HV

ASIC carrier 3
ASIC carrier 2
ASIC carrier 1
ASIC carrier 0
interconnect
SCROD

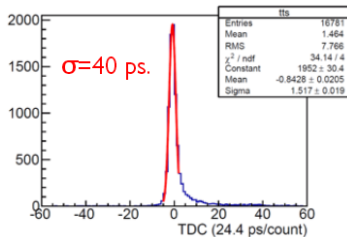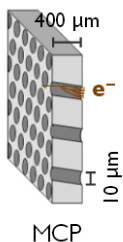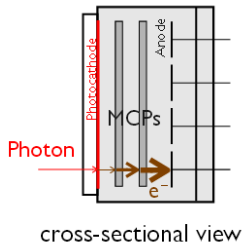PMTs
PMTs

front-front
front-back

FPGA (SPARTAN-6) for operating readout.

4×10^9 samples / sec; chip intrinsic time resolution of <25 psec.

32,256 samples/channel – record full Macropulse

Photocathode
Anode
400 μm
e^-
σ=40 ps.
MCPs
Photon
e^-
10 μm
23mm
square shape
cross-sectional view
MCP

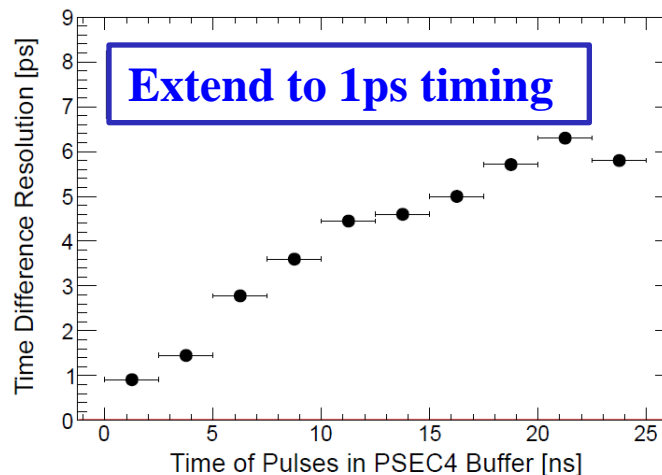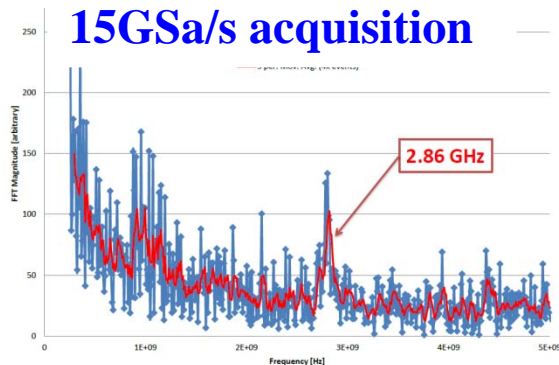| tts	
Entries	16781
Mean	1.464
RMS	7.766
χ^2 / ndf	34.14 / 4
Constant	1952 ± 30.4
Mean	-0.8428 ± 0.0205
Sigma	1.517 ± 0.019

TDC (24.4 ps/count)

1.28 Tera-samples/second burst

Extend to 1ps timing

PSEC4 ASIC @ 15GSa/s acquisition

2.86 GHz

~6us delay from the kicker signal for logging

FFT Magnitude [arbitrary]
Frequency [Hz]

Time Difference Resolution [ps]
Time of Pulses in PSEC4 Buffer [ns]
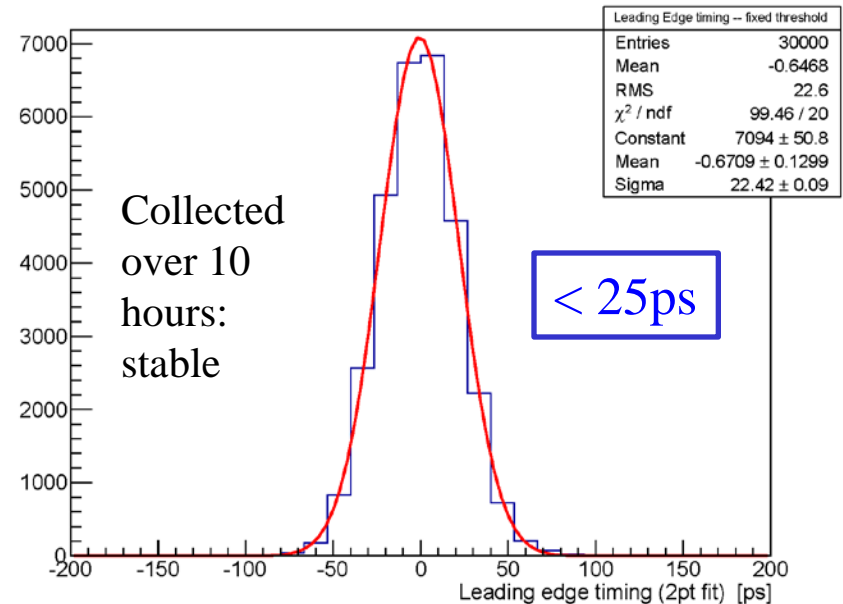
2

Back-up slides
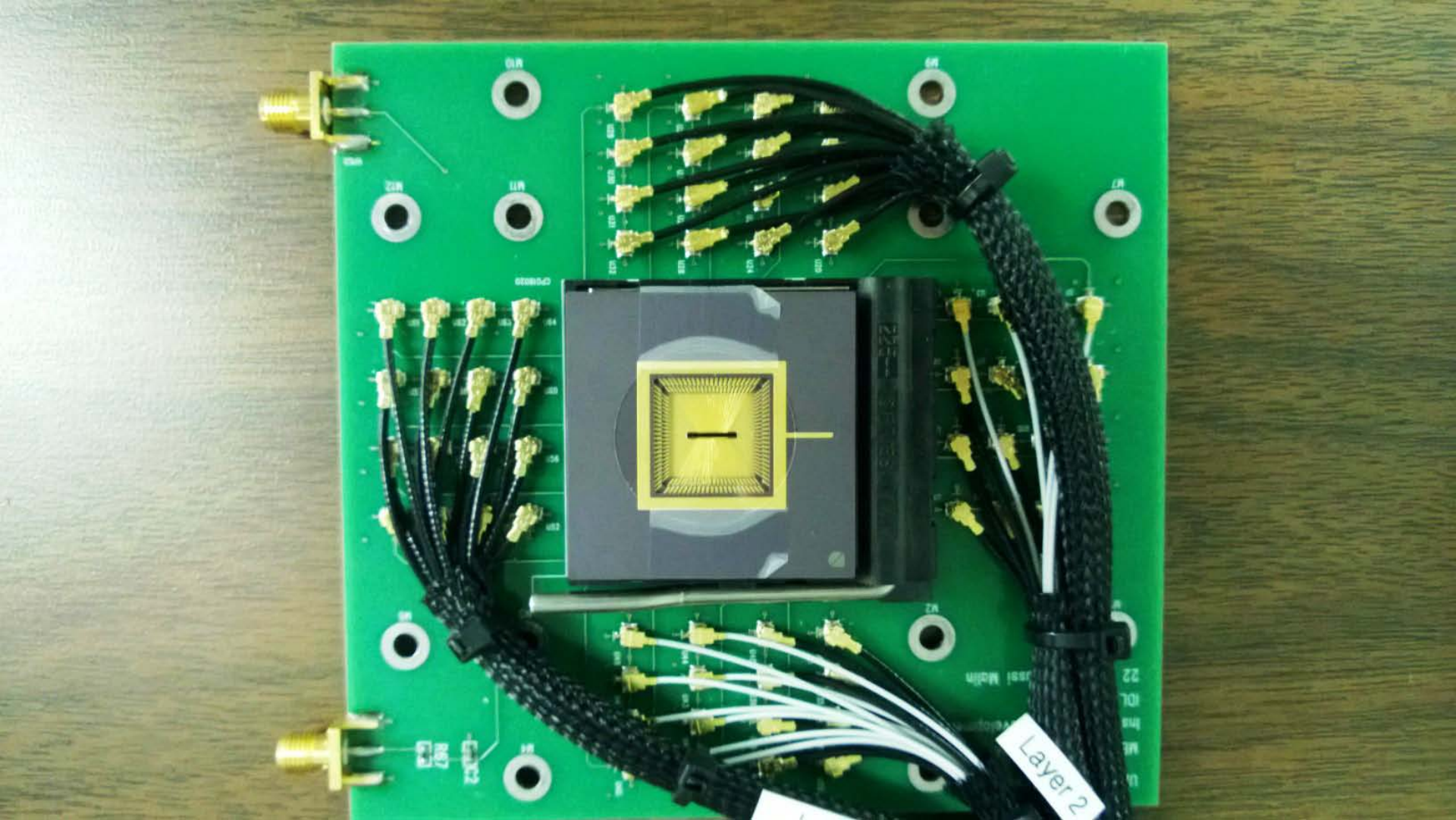
IRS3B and Readout working well

IRS3B on eval board, Cal pulser

Digitized PMT:
Pre-amp output
(timebase uncal.)
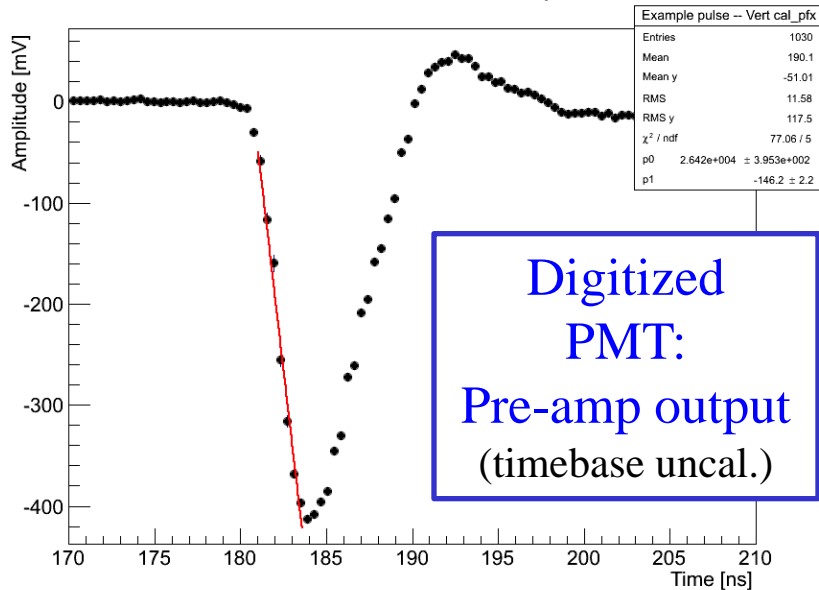
IRS3B on eval board, Timing via on-board Cal pulser

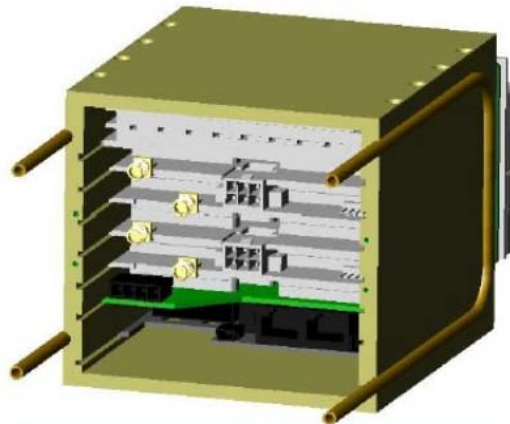

Collected over 10 hours: stable

< 25ps

IRS3B on eval board, with bias2

< 2mV noise
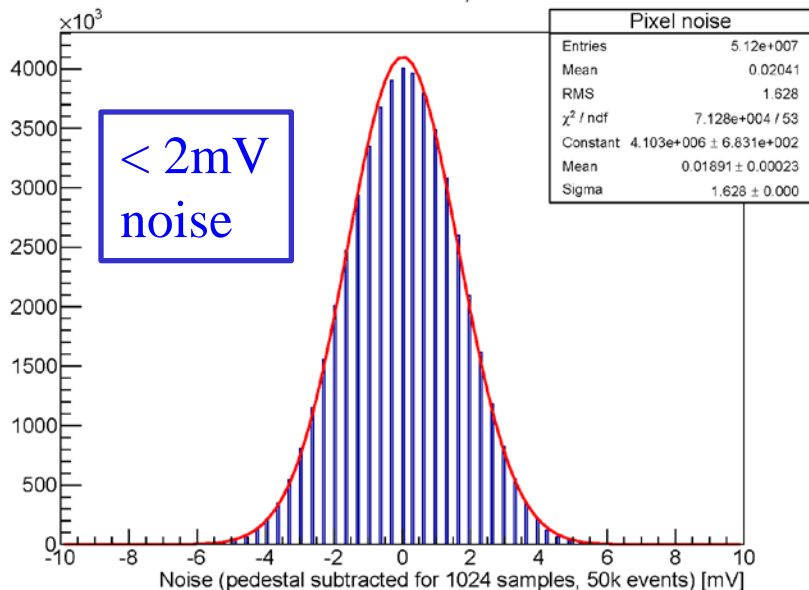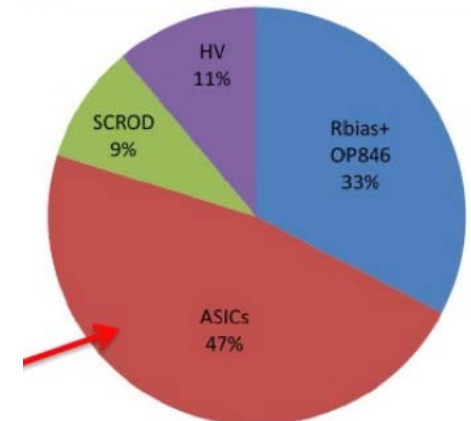
IRS3B on eval board, Cal pulser delay scan

In-situ cal ckt
(10ps steps)

4
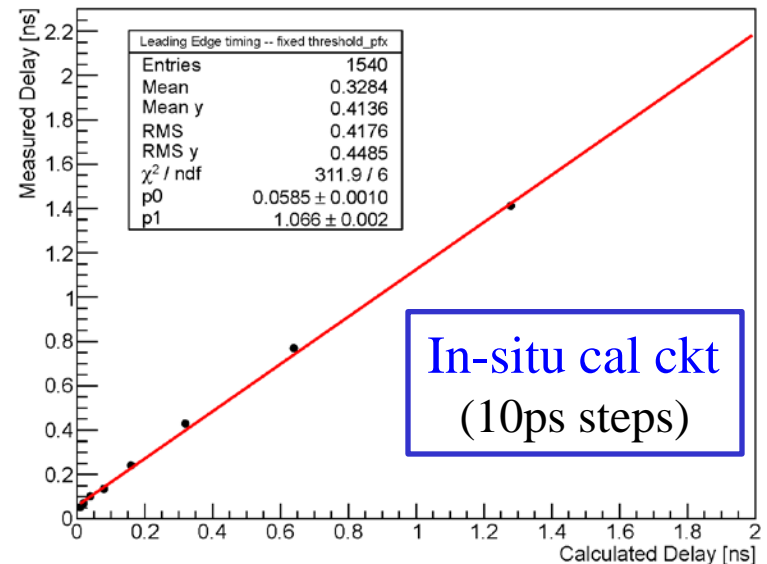
Systems Engineering

- MCP-PMTs, digitizer & cooling!

To include T0, clock distrib, timebase ctrl

σ ~ 38.4ps

σ <~ 10ps

(ideal waveform sampling)

NIM **A602** (2009) 438
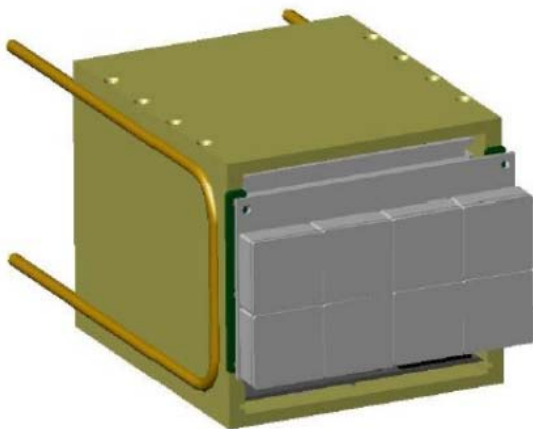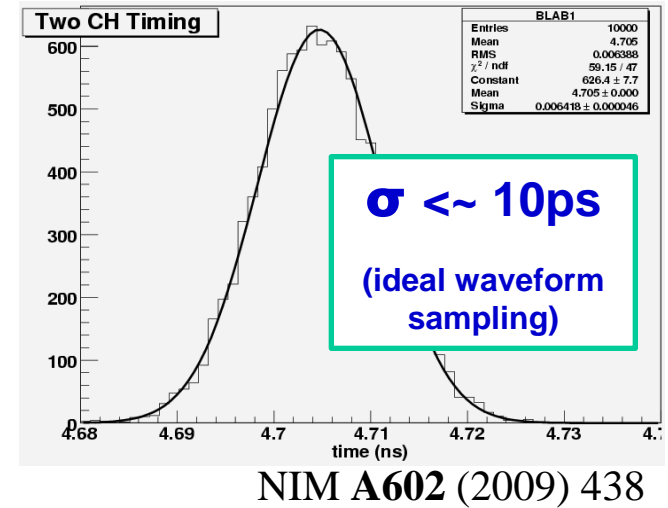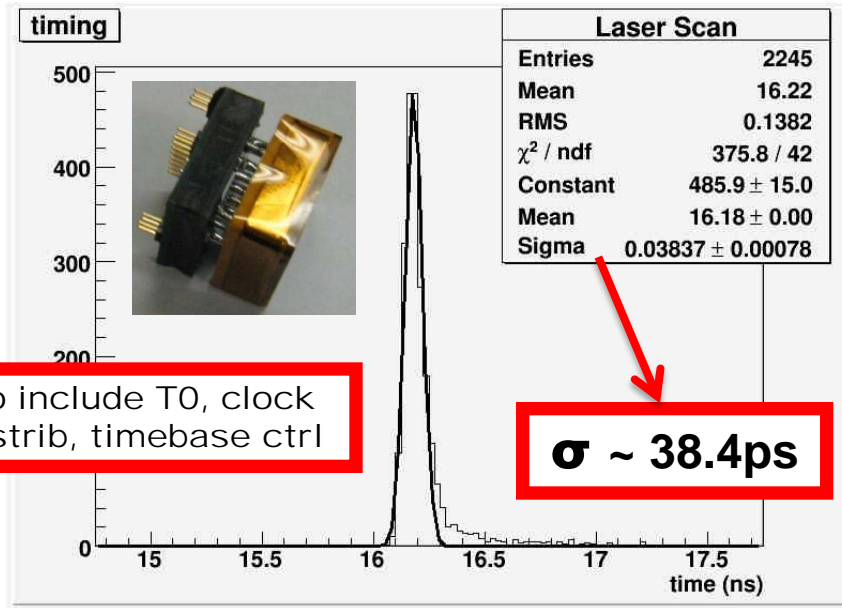
About 31W per board-stack module

Working hard to reduce for large channel counts