Probing ABCStar Front-End Readout ASICs for the new ATLAS Inner Tracker
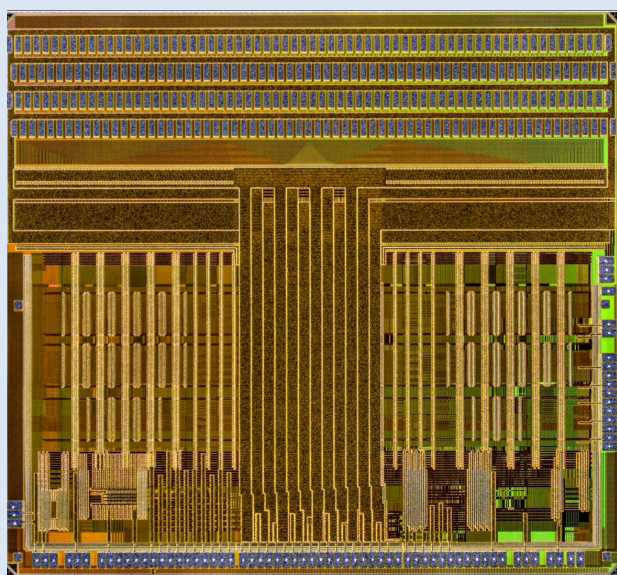
LHCC Poster Session – CERN, November 18, 2021

ABCStar Readout Chip

The ABCStar (ATLAS Binary Chip) provides readout for 256 strips in the Inner Tracker (ITk) strip detector. Each channel has an analog amplifier, shaper, discriminator and masking. Each ASIC needs to be thoroughly tested to ensure it can accurately process the high rate of physics data in the HL-LHC.
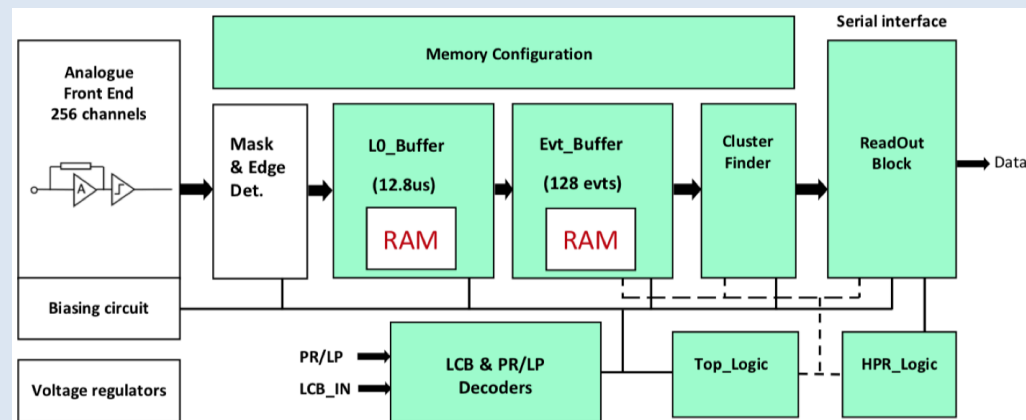

ABCStar Specs

- 8.087 mm x 7.150 mm
- 130 nm CMOS technology
- 256 readout channels
- Built-in analog and digital LDO regulators (1.2 V core)
- 40 MHz bunch crossing clock and 160 MHz readout clock
- Digital logic and clocks are fully triplicated to prevent errors caused by radiation

Wafer Probing Sites

There are two locations for ABCStar wafer probing: Rutherford Appleton Laboratory (RAL):
- Semi-automatic 12" probe station with custom probe card for ABCStar
- Custom interface FMC-1701 is used with a commercial FPGA board. Provides level translation, commercial ADCs and DACs to measure chip voltages
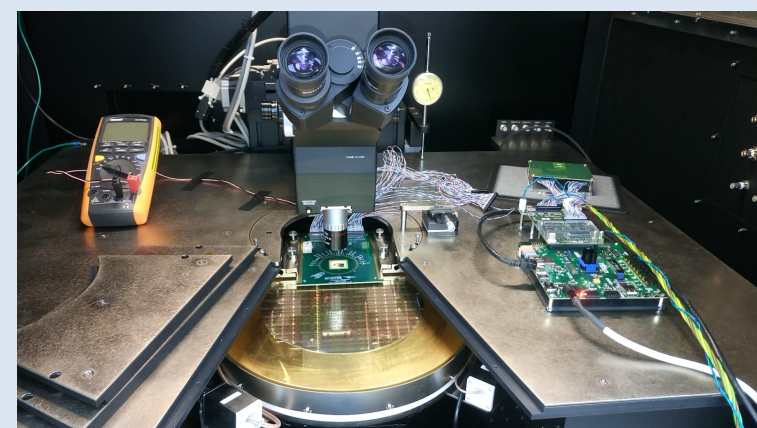
Carleton University/DA-Integrated:
- Carleton University has contracted the services of the private company DA-Integrated to test the wafers
- Electroglas 4090μ Automated Wafer Test System (ATE) with a custom probe card for ABCStar
- The system includes dedicated programmable power supplies and PMUs that can source/sink any voltage or current to/from the pad and have full control over clock frequencies and edge relationships



Die Categorization

Die Categories:
- A: Passes all tests, good for use in detector
- B: Minor defect (e.g. 1-2 noisy channels)
- X: Major defect, chip is rejected
- T: Two category A dice from each lot will be designated category T and used for fast TID (x-ray) testing
- Wafer cross-check showed 99.8% agreement in categorization between RAL and Carleton
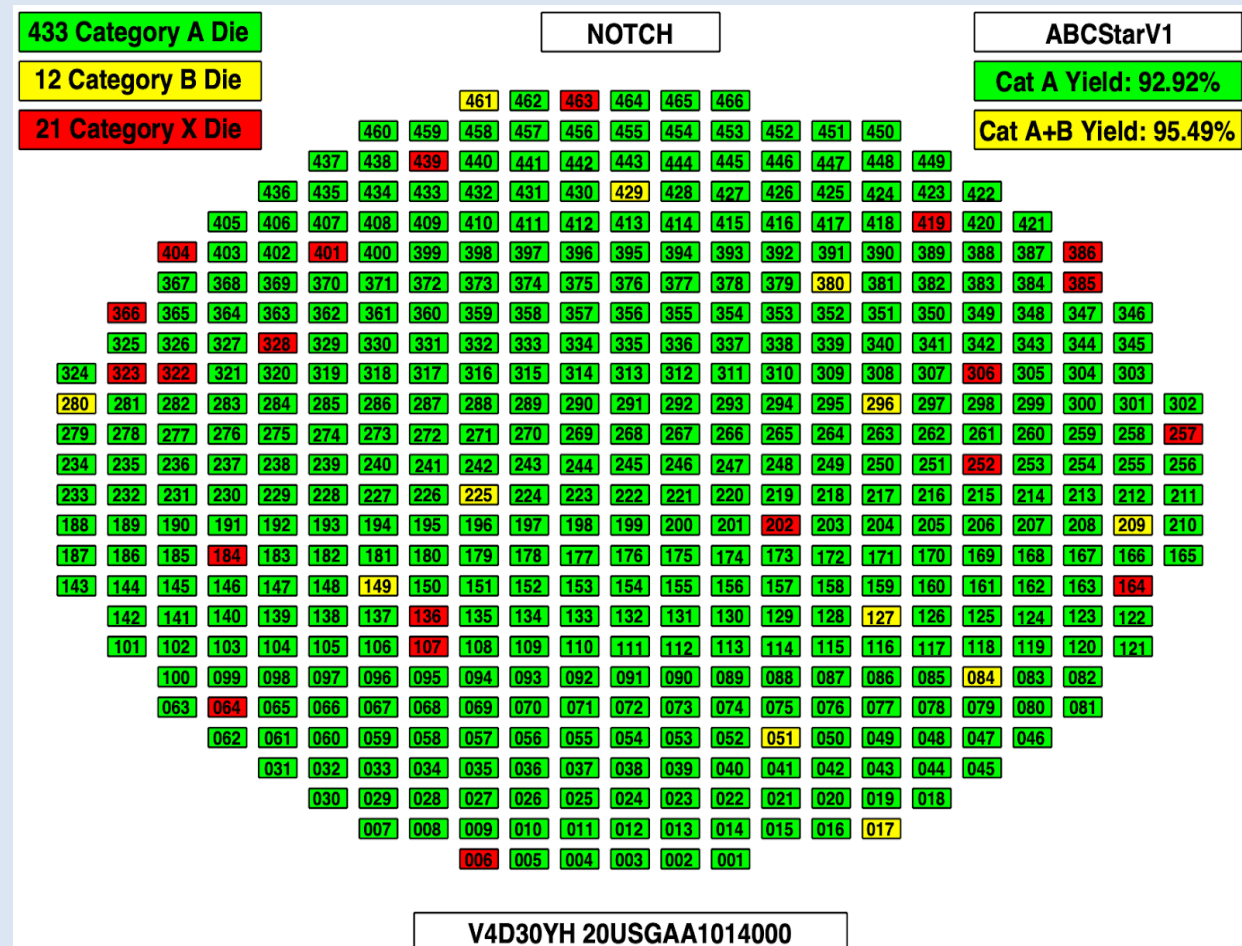
Gain Results

Mean gain and input noise across all 256 channels:
- Gain and Noise are within specification
- Some variation between production lots
- Includes data from both RAL and Carleton (Carleton results are preliminary)
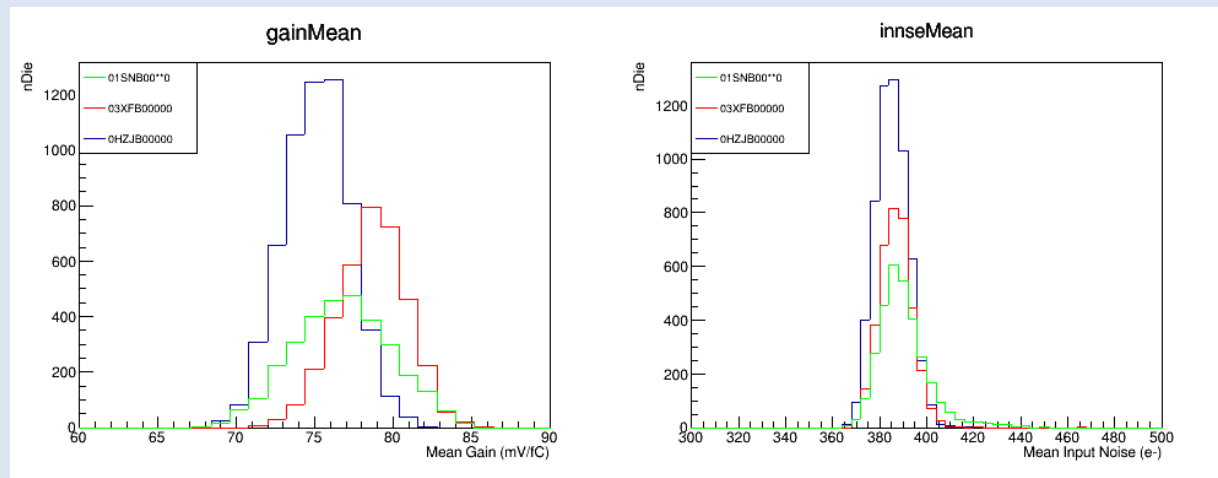
Wafer Yield

- Expected yield is >90% Category A+B
- Currently seeing 94.45% average Category A+B yield
- Yield from dicing wafers will be >98%

Bryce Norman (Carleton University) for the ATLAS Collaboration

Carleton University

ATLAS EXPERIMENT