Radiation-Current Effect in ABC130 Chip

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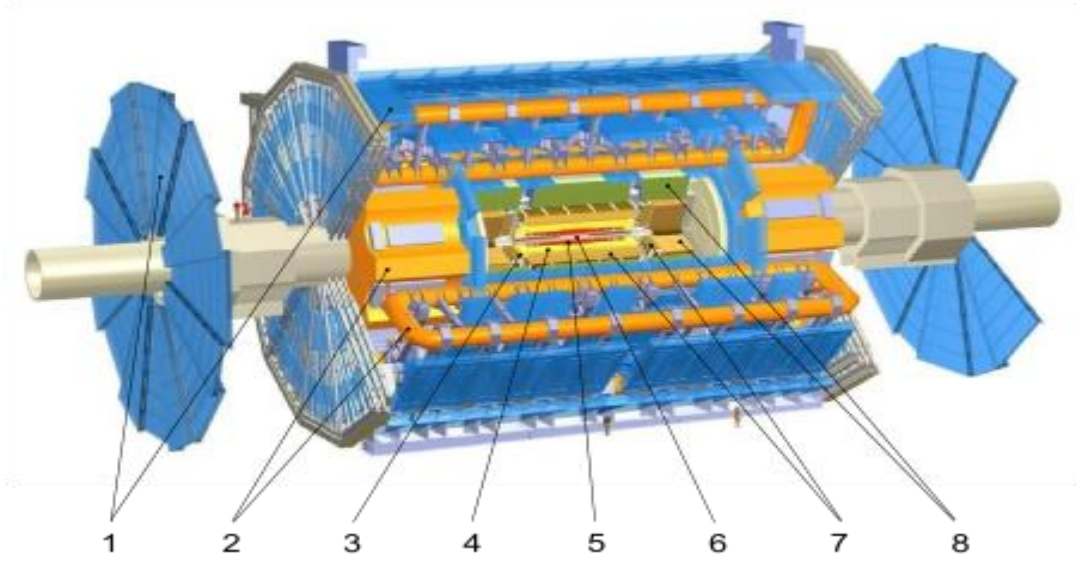
ATLAS

One of four major experiments utilizing CERN's LHC

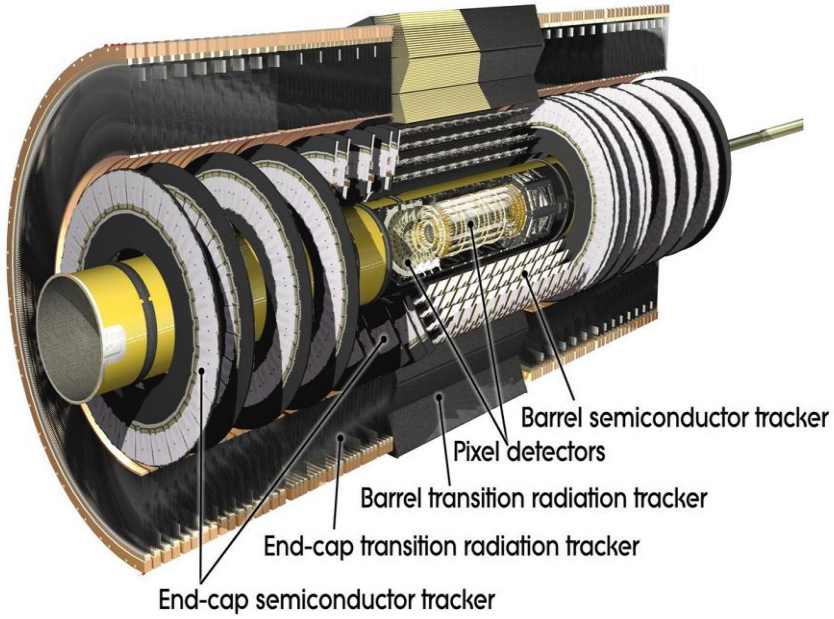
Largest particle collider detector constructed to date

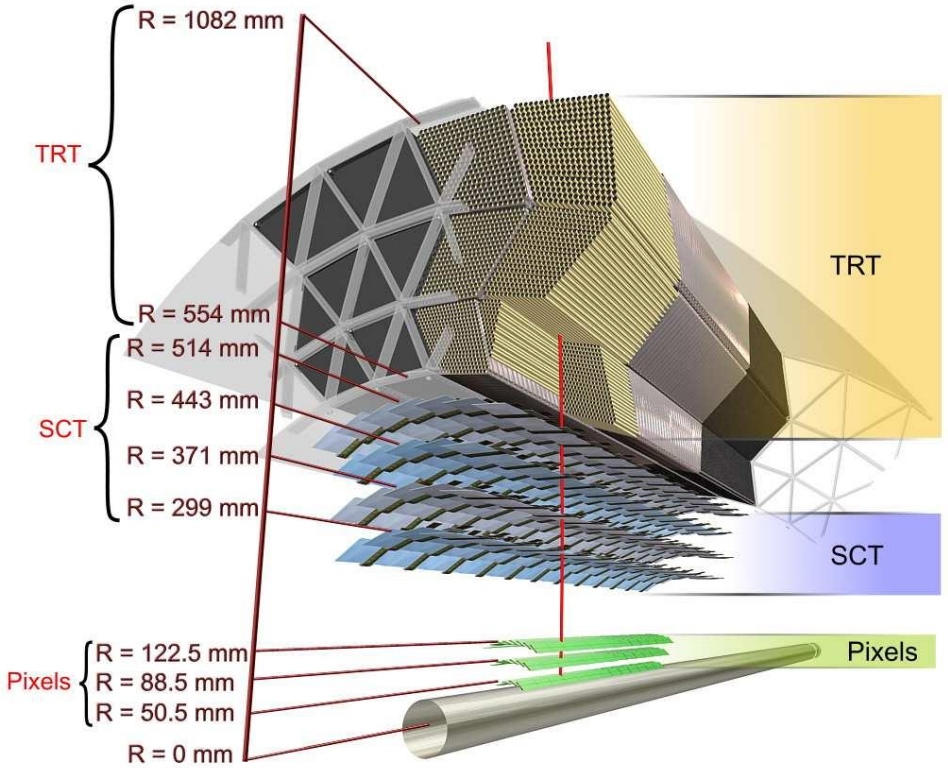
Consists of four major components

- Muon Detectors (1)
- Magnet System
  - Toroid Magnets (2)
  - Solenoid Magnet (3)
- Inner Detector
  - Transition Radiation Tracker (4)
  - Semi-Conductor Tracker (5)
  - Pixel Detector (6)
- Calorimetry
  - Liquid Argon Calorimeter (7)
  - Tile Calorimeter (8)



Inner Detector



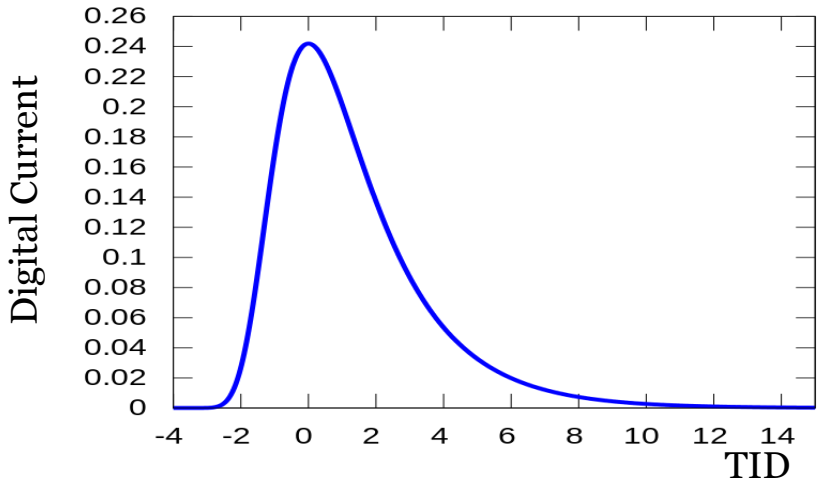


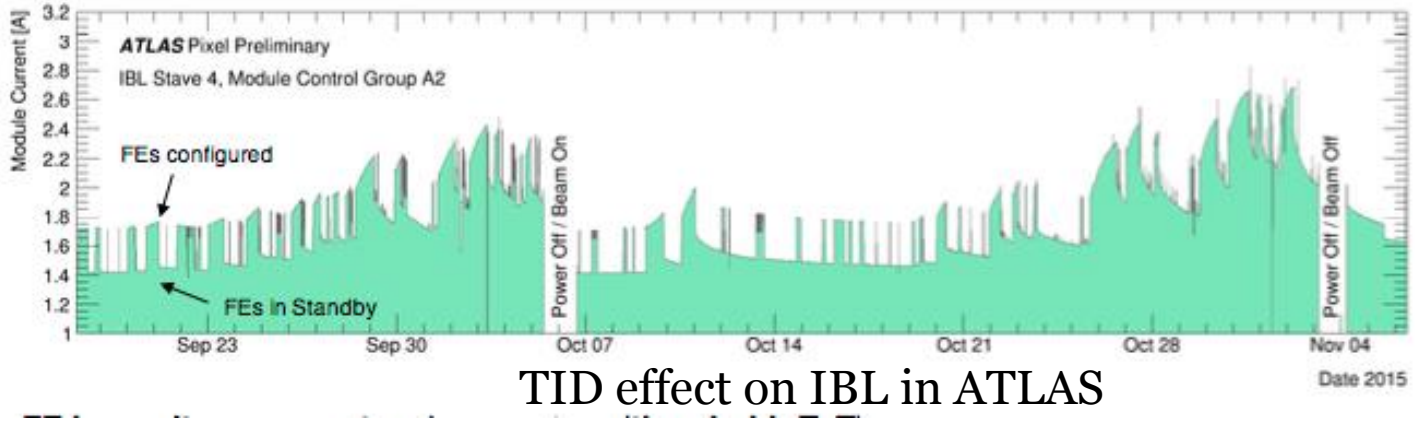
Mid-life Radiation Effects

A year ago, single radiation-hardness test on proposed chip showed drastic jump in power consumption

Simultaneously, IBL power consumption jumped unexpectedly a year after installation, causing operational overhead and also temporary inactivation of IBL

Although this phenomenon was known as early as 2002, no predictive model currently exists, thus requiring experimental analysis of the individual system





TID effect on IBL in ATLAS

Experiments and Analysis

Test chips irradiated under controlled conditions:

- Temperature: low temperatures inhibit annealing, thus exacerbating mid-life current bump
- Dose rate (distance from source): actual chips will be placed at different distances from collisions, thus resulting in current fluctuations at different times throughout the system.

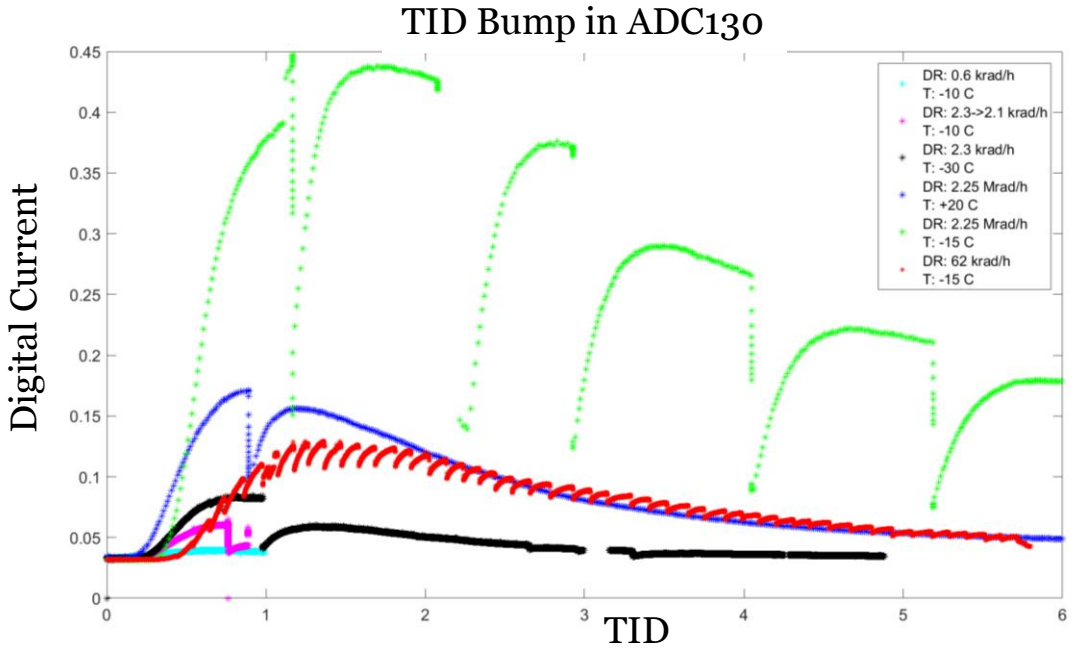
Initial tests done locally using X-Rays

- Limited accessibility
- Excessively high dose-rate

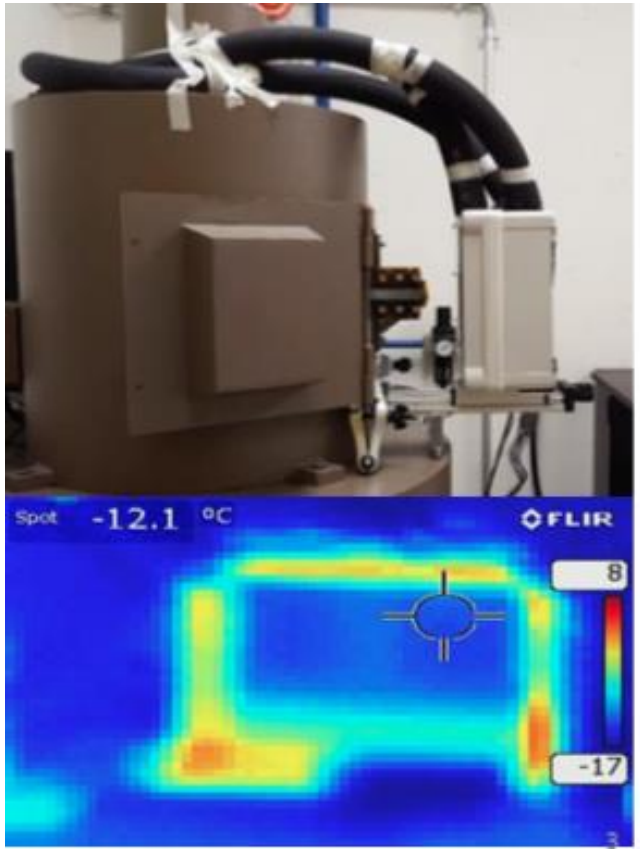
Current tests off-site with natural cobalt source

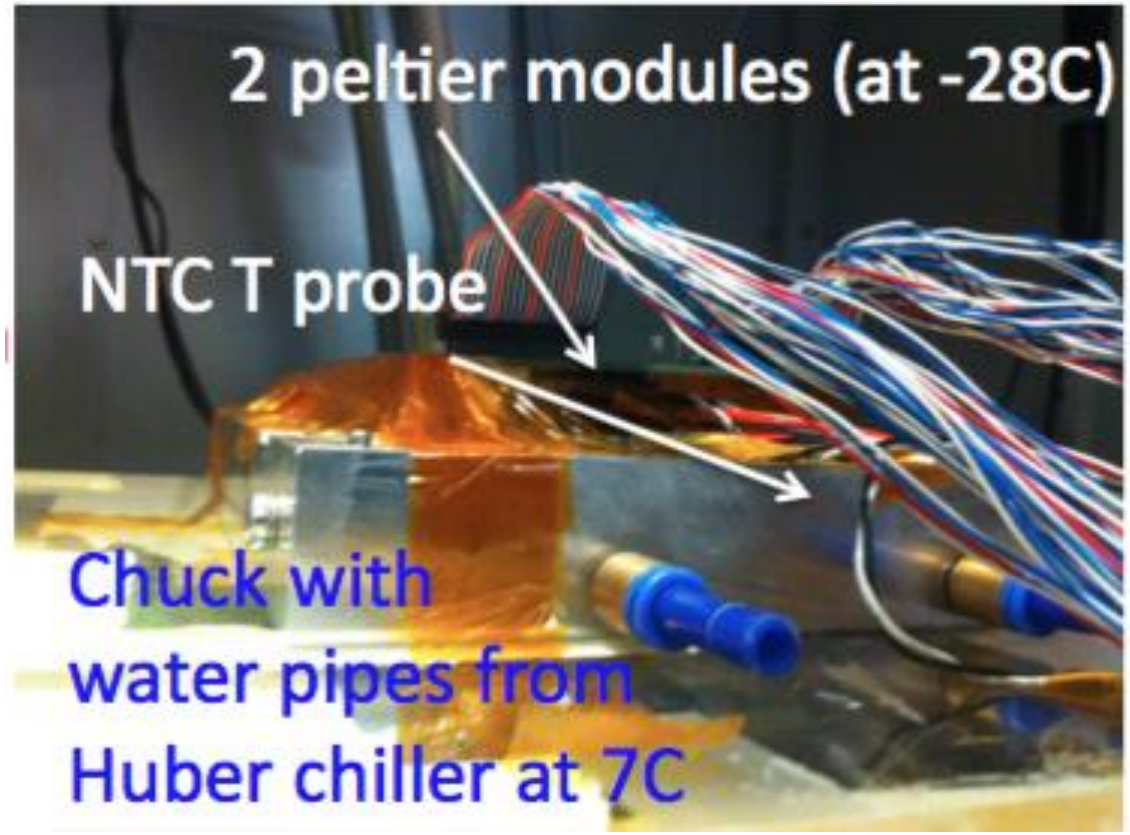
- Occasionally power outages and computer restarts allow annealing in chip, thus interfering with representative data collection

Approaching critical point where data sufficient to attempt modeling



Experiments at Co60 source





Next Steps

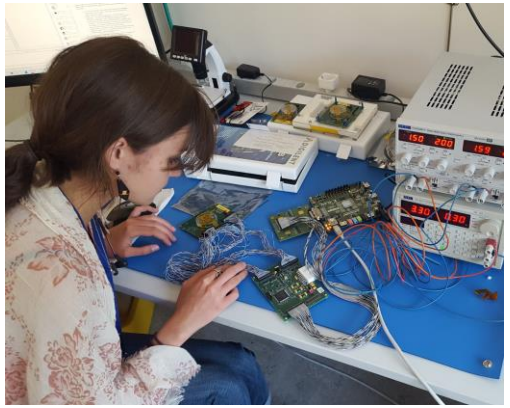
Further automate data collection and analysis process

Complete analysis of newest results

- Investigate suitability of proposed Landau model

Verify integrity of new test chips and begin tests under new conditions

Develop model correlating TID effects with temperature and dose rate



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