1. Motivation and the ATLAS ITk Strips Sensors

- ATLAS Inner Tracker (ITk) fully silicon upgrade comprises pixel and strip sensors
- Strips comprises 22000 sensors of 8 types (2 barrel and 6 endcap)
- Each sensor to be evaluated for quality control (QC) at various institutes with various test setups
- For this, developed common framework with common algorithms to objectively assign pass/fail, interface with common database, and do reporting

2. Workflow

3. Treatment of Current-Voltage (IV) Tests

Method A: (modified from tech spec.)

\[ V_{bd} = \text{earliest} \, V_{b, \text{sat}} < -100 \text{ V} \text{that satisfies} \]

\[ \frac{1}{V_{bd}} = \frac{1}{V_{b, \text{sat}}} + \frac{1}{V_{b, \text{sat}}^*} - \frac{1}{V_{b, \text{sat}}^*} \]

\[ \frac{1}{V_{bd}} > 5 \text{ i.e. avg of 3 local slopes along point divided by min local slope} \]

Method B: (modified from [3])

\[ V_{bd} = \text{earliest} \, V_{b, \text{sat}} < -100 \text{ V} \text{that satisfies} \]

\[ \frac{1}{V_{bd}} = \frac{1}{V_{b, \text{sat}}} + \frac{1}{V_{b, \text{sat}}^*} - \frac{1}{V_{b, \text{sat}}^*} \]

\[ \frac{1}{V_{bd}} > 5 \text{ i.e. local slope at point divided by slope of line from origin to point ("total derivative") > 5.} \]

Method C: (modified from B)

\[ V_{bd} = \text{earliest} \, V_{b, \text{sat}} < -100 \text{ V} \text{that satisfies} \]

\[ \frac{1}{V_{bd}} = \frac{1}{V_{b, \text{sat}}} + \frac{1}{V_{b, \text{sat}}^*} - \frac{1}{V_{b, \text{sat}}^*} \]

\[ \frac{1}{V_{bd}} > 5 \text{ i.e. B but with averaging, and running threshold to compensate for gradually decreasing total derivative} \]

4. Treatment of Individual Strip ICR Tests

- AC-coupled metal strips probed automatically to characterize strip RC network and AC current
- Combinations of this info lets scripts distinguish different failure modes (metal short, implant break, short, pinhole, Ibias defect), and measurement issues

5. Batch Reporting

- QC approval done on batch-by-batch basis
- Reports show interactive diagnostic histograms and plots by batch
- Allows humans to visually detect batch issues and outliers not immediately obvious to an algorithm
- Reporting tool designed to provide a concise table summary and plots of all tests in a batch in a single place for monitoring
- Scripts allow for direct interactive access to database data in python for studies

6. Current Status

- Scripts have proven a robust, reliable, and intuitive interface for reporting and monitoring, and have already been instrumental in helping catch subtle issues with sensors and testing
- Have already processed 2500 sensors through preproduction and production in 7 institutes in 5 countries
- Undergoing continuous development to add new features useful to QC sites as we enter production

References & Acknowledgements

[2] 10.1016/S0168-9002(00)01207-0

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