turing institute [13]. The first step in integrating the module into the system test is to repeat this standard characterisation on an *electrical test bench* to verify that the module has not suffered in transit. The electrical test bench is considerably simpler than the full system test as it bypasses the optical communication, employs only very short power and signal cables, and has well controlled grounding and shielding since the module is mounted in a metallic box. Therefore a module running stand-alone on the test bench tends to give its best performance. The noise figures from the calibration scans are used as bench marks when analysing similar data from multi-module runs on the sector.

Once the module is verified to be in good working order, it is mounted on the system test sector with all grounding and shielding connections made, and the standard characterisation sequence is repeated, powering only that one module, and this performance is compared to its performance on the bench. Any differences are noted, and investigated if possible. When this comparison is complete, the module is considered ready to be included in multi-module tests. `Shall we add a list of all our modules here?`

Part of the characterisation sequence applied during these individual test are a full trimming and a calibration run [13]. The results of these are used to initialise and calibrate all modules in all subsequent multi-module runs.

5 Tests with several modules

`The following lists measurements I would like to see in this section. Those marked with (?) should probably not be in this paper (in particular those in 5.4), but those are at least tests we did`

5.1 Tests in default set-up

`3-pt gain results + comp. to elec stand;`
`average occupancy at 1fC + comp.`

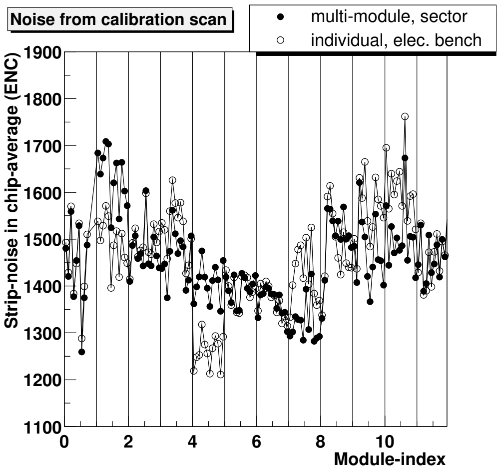

Fig. 4. ENC-noise multi-module vs electrical stand.

`to elec stand;`
`stability (gain, noise, occupancy);`
`noise occupancy vs Qthr scans;`
`correlated noise results;`
`noise injection;`
`cross talk (if we get this done);`
`row-of-12 -- full+half-row --`
`3-half-rows (if we have 18 modules).`

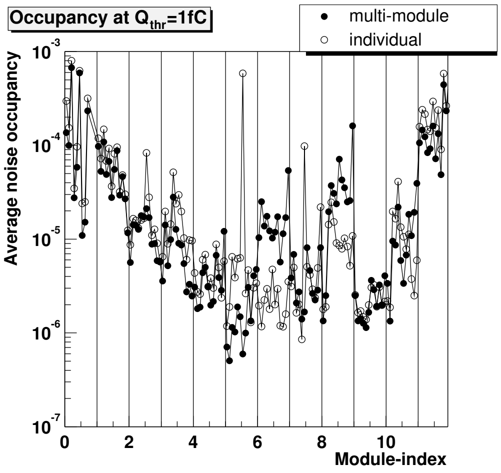

Fig. 5. Average noise occupancy: multi-module vs electrical stand.

5.2 Shielding studies

Ned vs Tony (ie shunt shields in/out, (un-)split pipes);
other "optional" parts in the shield like dummy-radial heat spreader plates, PP1/choke filtering(?);
effect of bad connections (?).

5.3 Cold running and irradiated system test

as in the title

5.4 Misc.

redundancy links in operation (requires extra explanation in 2.2)(?);
tests with Heinz' PP1-PP2 cables(?);
LV2-LV3 comparison(?);
stability degradation with reduced bias voltage(?).

6 Summary

All's well that ends well.

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References

[1] ATLAS Technical Proposal for a General-Purpose pp Experiment at the LHC at CERN, CERN/LHCC/94-43 (1994).

[2] ATLAS Collaboration, ATLAS Technical Design Report - Inner Detector, CERN/LHCC/97-16 and CERN/LHCC/97-17 (1997).

[3] M. Turala for the ATLAS SCT collaboration, Nuclear Instr. Meth. **A 466** (2001) 243.

[4] T. Kondo for the ATLAS SCT collaboration, 5th International Conference on Large Scale Applications and Radiation Hardness of Semiconductor Detectors, Firenze, Italy (2001).