

Long-term humidity exposure of ATLAS18 ITk strip sensors

The ATLAS collaboration is upgrading its detector for High-Luminosity LHC operations scheduled to start in 2029. This involves making a new all-silicon tracker, called Inner Tracker (ITk), with instrumented strip area of 165 m².

The strip sensor type is n-on-p, chosen because of its radiation hardness and a relative fabrication simplicity. So far it has not been used in large-scale experiments. Many years of R&D investigations and pre-production experience showed that it works well, with the specification of the maximum operational voltage of 500 V. The sensors, however, show sensitivity to ambient humidity, e.g. reduced breakdown voltage at relative humidity (RH) values of about 40% and above. This is an issue for testability, but not real operations, where RH is very low. Therefore, the collaboration adopted the strategy of dry storage, testing, and shipment for sensors and related assembled components: modules, staves, and petals. A few days long exposure to ambient air during assembly was shown to be tolerable.

The dry handling strategy becomes much more difficult to implement during the tracker integration, when barrels and disks are put together in large-size cleanrooms with RH range between 50 and 70%. The duration of each of numerous integration steps is several weeks, followed by testing. The effect of such long humidity exposures on the sensor properties was unknown. Therefore, we commenced a study of repeat sensor exposures to 75% RH. We chose 32 sensors for the study from different deliveries, and with different pedigrees in terms of initial performance on reception and recovery procedures used. Progressively longer exposures ranged between 4 and 266 days in duration. The cumulative exposure time was up to 2 years. No performance deterioration was seen, as evaluated by the visual inspection, IV characteristics, and other checks. We report the details of the tests, results, and implications.

Submission declaration

Original and unpublished

Author: FADEYEV, Vitaliy (University of California, Santa Cruz (US))

Co-author: ON BEHALF OF ATLAS ITK STRIP SENSOR COLLABORATION

Presenter: FADEYEV, Vitaliy (University of California, Santa Cruz (US))

Track Classification: Strip sensors