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Stress Evaluation of ITK Strip Endcap R0 modules in Coldbox Setup Using FEA Simulations for the ATLAS Detector Phase-II Upgrade

Tuesday, 4 June 2019 12:00 (15 minutes)

Planned for the High-Luminosity LHC, the ITK (Inner TracKer) is the upgrade of the current inner detector of the ATLAS apparatus at the Large Hadron Collider (LHC). The ITK is a cylindrically-shaped, all-silicon semi-conductor charged particle tracker, with the ability to run at high rate in a high luminosity and high radiation environment. The ITK is comprised of two different technologies, an inner Pixel detector and an outer Strip detector. To make sure all 20 000 Strip modules are built with a high level of quality, a series of tests are performed for quality control (QC) and quality assurance (QA) of the production. These tests are crucial because once the ITK is installed in the underground cavern it will not be accessible for approximately 10 years. One of the tests performed as part of QA and QC is the thermal cycling, where modules are monitored while being cooled down and heated up in cycles to temperatures relative to potential operating conditions. These tests will occur in an environmentally controlled enclosure able to hold 4-5 modules simultaneously, known as a cold box. The subject of this work is to study the effect of thermal cycling on future ITK Strip R0 detector modules in terms of induced mechanical stress, and thus inform the design of the cold box. This was performed using a Finite Element Analysis simulation of the thermal cycling process. The first result is that the stress created in the module is mostly due to the vacuum applied to keep everything in place. Moreover, the maximum stress felt during thermal cycling is highly dependent on the thickness of the vacuum seal used: A thinner seal causes a lower stress. Finally, the stress in the module in our thermal cycling setup is between $\sim$ 20 MPa and $\sim$ 100 MPa depending on the selected seal thickness, which is consistent with the stress expected in the final detector design. We can then conclude that our proposed design for the cold box is a good candidate to perform the thermal cycling test.

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