

# Qualification of the bump-bonding process in the ATLAS ITk pixel modules

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The ATLAS experiment at CERN is getting more and more ready to face the High-Luminosity era of the Large Hadron Collider, that will set harsher conditions in terms of radiation, luminosity and data stream for the ATLAS Detector. One of the key detector upgrade is the new all-silicon Inner Tracker, the ITk, that the ATLAS Collaboration is building to replace the ATLAS Inner Detector for the High-Luminosity phase. The ITk is made by a pixel detector at smaller radius and a strip detector surrounding it. The ITk Pixel detector innermost layer will be exposed at unprecedented radiation levels: highly radiation hard 3D hybrid pixel sensors have been selected to instrument it, while all the other layers will use planar sensors.

Hybridization of 3D sensors plays a key role in the project and presents several challenges, given the natural mechanical fragility of 3D sensors. The Institutes involved in the assembly of the module for the innermost layer together with two hybridization companies (Leonardo SPA and The Fraunhofer Institute for Reliability and Microintegration IZM) have undergone a long process of qualification to study and improve the quality of the process.

In this talk, we will focus on the qualification procedure that has been adopted to test the quality of the bump bonding connection of both vendors. We will present several ways for investigating the bump connectivity based on cross-talk, x-ray scan or electrical noise. Finally we will present the effects on bumps due to thermal cycles, where we are investigating any possibility of delamination between the 3D sensors and the electronics.

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