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The DMAPS Upgrade of the Belle II Vertex Detector: mechanics and integration

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A major upgrade of the interaction region of Super-KEKB is needed to reach the design luminosity and it has been planned in the years 2026-27. This long shutdown gives the opportunity to install a new vertex detector (VTX) in the Belle II experiment, more robust with respect of the higher level of machine background and more performant, due to improved vertex detector standalone track finding efficiency.

A new DMAPS (TJ-180 nm) CMOS sensor will equip all the barrel-shaped ladders arranged in 5 layers with minimal material budget, ranging from 0.1 % X_0 for the layer 1 and 2 to 0.8 % X_0 of the 70-cm long staves of the layer 5.

A demonstrator has been designed for layer 1 and 2 (iVTX) with a monolithic self-supporting air-cooled structure to yield an all-silicon ladder. A 4-sensor wide module will be cut from the processed wafer and submitted two post-processing techniques: a large size signal redistribution layer (RDL) on top of the sensors and selective backside 50-um thinning.

For oVTX (layers 3, 4 and 5) an evolution of the ladder concept used in the ALICE ITS has been adopted, with a light mechanical structure, supporting a cold plate with liquid coolant hosting the sensors and on top traditional flex circuits to distribute power and for data output. The mechanical structure of the most challenging outer prototype ladder has been realized by a “subtractive method”: the truss structure is obtained by gluing, with a dedicated mask, the 3 planar carbon fiber layers, obtained by a water-jet cut. The mechanical and thermal characterization of the prototypes will be presented.

Primary author: Mr BOSI, filippo (INFN Pisa)

Presenter: Mr BOSI, filippo (INFN Pisa)