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The ultra low mass cooling system of the Belle II DEPFET detector

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The new e^+e^- colliders impose unprecedented demands to the performance of the vertex detectors. To achieve the required resolution in the vertex reconstruction, besides highly segmented pixel detectors, the material budget has to be kept at very low levels to reduce the multiple Coulomb scattering. These requirements are even more challenging in the case of the new Japanese Super Flavour Factory (SuperKEKB) where the very low momentum of the particles in the final state requires a vertex detector with less than 0.2%~X_0 per layer, together with 50x50~μm^2 pixels, to achieve the aimed resolution of 8.5~μm.

As a consequence, there is an obvious impact on the cooling system, that has to be carefully designed, not allowing active cooling pipes inside the acceptance region. Due to the low power dissipation of the DEPFET sensor and the special geometry of the detectors (with the front end electronics placed at both ends of the ladder), the system can be chilled using 2-phase CO_2 cooling through the massive support structures outside of the acceptance, while the sensitive area relies on forced convection with cold dry air.

In the talk not only full thermal simulations will be presented but also measurements done with a real mock up, showing that a proper cooling of the vertex detector can be made using this approach.

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