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Towards MAPS based Inner Tracking System of NICA MPD.

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The Multipurpose Detector (MPD) of the NICA complex at JINR will include an Inner Tracking System (ITS) which is a vertex detector meant to complement the Time Projection Chamber of the MPD for the precise tracking, momentum determination and vertex reconstruction for hyperons (Λ, Ξ, Ω) and D-mesons. It will be placed inside the bore of the TPC and it will be composed of 5 layers of silicon Monolithic Active Pixel Sensors (MAPS) grouped in two barrels, with 3 layers on the inner barrel and 2 layers on the outer barrel (Fig. 1), with a spatial resolution of less that 5 μm and a material budget of less than 0.8%X_0. The project is a collaboration between Russian and Chinese institutions lead by the JINR and the Central China Normal University, respectively. The production and assembly of the detector will be shared by both countries, while the mechanics will be designed and manufactured completely at JINR and the readout electronics will be developed and produced in China. The project foresees the construction of the outer barrel on a first stage (2022/2023) based on the same MAPS technology used for the outer barrel of the ALICE-ITS2 1 currently under commissioning at CERN as the first MAPS-only large area ($\sim$ 10 m^2) detector. These are 15 mm x 30 mm x 100 μm silicon sensors (from TowerJazz 180 nm CMOS technology) with 1024 x 512 pixels. The addition of the inner barrel is programmed for a second stage (2025/2026) with the intention of building it based on 280 mm-long and 30 μm-thick bent sensors currently under R&D by the ALICE-ITS3 project at CERN [2]. Nevertheless, the use of the current ALICE-ITS2 inner barrel technology (15 mm x 30 mm x 50 μm) is considered as a backup plan. Figure 1 shows a cut of the MPD-ITS geometry along with a breakdown of one of the 42 Stave structures that compose the outer barrel. Each one of this Staves is segmented into two identical structures (Half Staves) where 2 rows of 7 MAPS are attached to a Flexible Printed Circuit to conform a structure called Hybrid Integrated Circuit (HIC) and 7 of this HICs are glued to a multilayer composite graphite plate with embedded cooling pipes (Cold Plate). According to the current MPDRoot-based simulation results [3, 4] of the MPD tracking system (ITS + TPC) for central Au + Au collisions at $\sqrt{S_{NN}}$= 9 GeV, on the initial stage with only 2 layers (outer barrel) and a beam pipe dimeter of 64 mm the signal extraction of reconstructed hyperons from the invariant mass spectrum of their decay products would be performed with an efficiency of 0.2% which is enough for assessing the identification ability of the system at debugging stage. On the other hand, only with the setup of a 5-layers ITS plus the TPC and a beam pipe diameter of 40 mm would it be possible to achieve a reliable detection efficiency of about 1% for both multi-strange and charmed particles.

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