Timing resolution performance of the $\bar{P}$ANDA time-of-flight (TOF) detector using Silicon Photomultiplier (SiPM)

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The $\bar{P}$ANDA experiment at FAIR situated in Darmstadt, Germany will use proton-antiproton annihilation with a momentum range from 1.5 GeV/c to 15 GeV/c for strong interaction studies. The detector is currently under construction. It will be in operation in 2022-. In order to identify the charged particles accurately and differentiate between subsequent events the detector will need several advanced particle identification systems.

We are working on the development of a barrel time of flight (TOF) detector, which is located in the central region (20º-140º) and covers ~5.7 m^2 area. It is constituted of 1920 scintillator tiles, each of which has a dimension of 90x30x5 mm^3, readout by Silicon Photomultipliers (SiPM). The barrel-TOF detector will be capable of providing a fast and highly accurate event timing. The requirements for the barrel-TOF detector are an intrinsic time resolution below σ = 100 ps and a geometry which fits along 2 cm in radial direction.

Development of a single tile is in a final phase. After optimizing scintillator material, sensor, wrapping etc., we achieved the best time resolution of $\sigma \sim 50$ ps with 4 Hamamatsu SiPMs S13360-3050-PE connected in series. In this presentation, the final design and its performance of a single tile will be presented.