Barrel time-of-flight detector for the PANDA experiment at FAIR

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The barrel time-of-flight detector for the PANDA experiment at FAIR in Darmstadt is planned as a Scintillator Tile Hodoscope (SciTil) composed of several thousand plastic scintillator tiles, covering a total area of about 5 m^2 and readout by Silicon Photomultipliers (SiPMs). The system will be needed to identify the time origin of tracks to avoid event mixing at high collision rates with N_{avg} = 20 MHz. It will also provide accurate relative time-of-flight measurements and benefits to the overall particle identification in PANDA. The main requirements for the system are a time resolution better than 100 ps and minimum use of material.

We present the latest results of various studies towards the finalization of the SciTil detector, including basic detector characterization and prototype tests. As photodetectors we consider conventional analog SiPMs as well as the Digital Photon Counter (DPC), recently invented by Philips as the first fully digital SiPM. A prototype SciTil detector has been recently tested in a 2.7 GeV/c proton test beam. In the experiment, a time resolution of about 80 ps has been achieved using SiPMs from Hamamatsu and KETEK with a sensitive area of 3 x 3 mm^2. Employing the DPC from Philips, a time resolution of about 35 ps could be measured. The presented tests represent one of the first studies investigating the applicability of the DPC for a large scale experiment in the field of high energy physics and show the high potential of this new detector technology.