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## Performance of the HADES T0 and beam tracking system based on Ultra Fast Silicon Detectors

*Tuesday, 18 February 2020 15:00 (20 minutes)*

The recently developed sensors based on the Low Gain Avalanche Diodes (LGAD) sensors [1,2], aka Ultra Fast Silicon Detectors (UFSD), provide excellent position measurement capabilities and additionally provide fast signal response with a precision better than 100ps [3]. These unique properties combined with high radiation hardness [4] and low production costs are very attractive for tracking applications and place the UFSD technology ahead of diamond based scCVD sensors.

The HADES experiment [5] at GSI Darmstadt, Germany, in cooperation with INFN, Torino, Italy, prepared a demonstration system realized as a beam telescope consisting of two UFSD strip sensors. The sensors, manufactured by FBK [1], have a size of about 5mm x 5mm, 50  $\mu\text{m}$  active thickness and the strip structure with a 140  $\mu\text{m}$  pitch. They are equipped with multi-stage analog amplifying circuits [6] connected to discriminators whose outputs were digitized by a TDC system based on the FPGA-TDC concept [7].

In a series of experiments carried out at the COSY Synchrotron at Jülich we have demonstrated a timing precision of 56 ps for protons of 1.92 GeV kinetic energy. To our knowledge, these are the best results obtained so far using this type of sensors integrated in a complete detection system.

In this presentation, the construction of the experimental setup, the data readout system and details of the analysis will be presented with particular emphasis on the final results obtained with the UFSD sensors.

[1] First FBK production of 50  $\mu\text{m}$  ultra-fast silicon detectors - Sola, V. et al. Nucl. Instrum. Meth. A924 (2019)

[2] Design optimization of ultra-fast silicon detectors - Cartiglia, N. et al. Nucl. Instrum. Meth. A796 (2015) 141-148

[3] Beam test results of a 16 ps timing system based on UFSD - Cartiglia, N. et al. Nucl.Instrum.Meth. A850 (2017) 83-88

[4] Radiation Hardness of Thin Low Gain Avalanche Detectors - Kramberger, G. et al. Nucl.Instrum.Meth. A891 (2018) 68-77

[5] The High-Acceptance Dielectron Spectrometer HADES - G. Agakishiev et al. Eur. Phys. J. A41:243-277, 2009

[6] Diamonds as timing detectors ···, J. Pietraszko et al. Nucl. Instrum. Meth. A 618 (2010) 121-123

[7] A compact system for high precision time measurements (< 14 ps RMS) ···, M Traxler et al 2011 JINST 6 C12004

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