Contribution ID: **13** Type: **not specified**

High-frequency readout enables unprecedented time-of-flight techniques in high-energy physics and medical applications with SiPMs, scintillators, and SiC detectors

Tuesday, 24 February 2026 09:40 (20 minutes)

The ability to measure the arrival time of particles is important in many applications, including those in high-energy physics, industry, and medicine. For instance, single optical photon detection and time tagging are used in light detection and ranging (LiDAR) systems for the automotive industry, as well as in optical tomography and fluorescence lifetime measurements in medicine. In these fields, silicon photomultipliers (SiPMs) have demonstrated excellent single-photon-counting and time-resolution capabilities. Coupling inorganic scintillators to SiPMs extends this concept to time-tagging gamma and X-ray photons in time-of-flight (TOF) positron emission tomography (PET) and computed tomography (CT), as well as minimum ionizing particles in high-energy physics experiments and particle beams in radiotherapy. The continuous development of SiPMs (e.g., high photon detection efficiency, UV detection, and low dark count rates) has made it possible to explore new and well-established scintillator materials and efficiently utilize various fast emission mechanisms for the first time.

This talk will provide an overview of advancements in high-frequency (HF) readout, which is used to gauge the timing limits of SiPMs for single-photon detection, e.g. in the UV, visible and IR range. Coupling SiPMs to inorganic scintillators enables the detection of minimum ionizing particles with exceptional time resolution and is already being used in the upgrade of the CMS barrel timing layer. Furthermore, HF readout and special cross-luminescence scintillators with ultra-fast sub-nanosecond emission have the potential to enable real-time, high-rate beam monitoring in hadron therapy via PET techniques. We also show that HF readout can be used for fundamental studies of the intrinsic features of novel semiconductor detectors. For example, it is possible to measure the electron and hole saturation drift velocities in silicon carbide (SiC). HF readout can also help to achieve a deeper understanding of radiation damage in such detectors when combined with two-photon absorption (TPA) measurements. The talk will conclude with a summary and an outlook on future research directions.

Author: GUNDACKER, Stefan (Austrian Academy of Sciences (AT))

Co-author: MBI DETECTOR DEVELOPMENT GROUP

Presenter: GUNDACKER, Stefan (Austrian Academy of Sciences (AT))

Session Classification: Talks