PetVision Newsletter; 5th edition
October 2025

Welcome to the 5th edition of the PetVision Newsletter!

Welcome to the **5th edition of the PetVision Newsletter**! This issue celebrates key milestones across the project, from partner innovations in detector design and system integration to the successful PhD defence of our colleague **Michele Penna**, whose research on SiPM timing performance strengthens PetVision's technological foundations.

We're also excited to share upcoming opportunities to meet the team at major international conferences. Thank you for following our journey as we push the boundaries of medical imaging for better cancer detection and care.

About the project

Over 2.7 million people in the EU were diagnosed with cancer in 2020, while 1.3 million people lost their lives to it. Cancer cases are predicted to increase by 24% by 2035, making it the leading cause of death in the EU. The current leading imaging diagnostic technique sensitive to cancer is Positron Emission Tomography (PET). Due to the high implementation cost of PET, this highly sensitive diagnostics is only available in less than 0,5 % of the medical centers in the world. One of the main components of the overall cost is the cost of PET scanners. The main objective of PetVision EIC Pathfinder project is to develop a flexible, modular PET scanner, based on planar detector panels with exquisite time-of-flight (TOF) resolution and sensitivity. It will enable affordable, fast and precise dynamic scanning, and hence improve access to early cancer detection and therapy follow-up, paving the way for personalized medicine.

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Presentation of selected project partners

The Institute of Cosmos Sciences of the University of Barcelona: We are committed to leveraging our expertise in particle physics and fundamental science to advance medical imaging technologies and contribute positively to society.
Our core expertise lies in the design and development of front-end ASICs for photosensor readout and ultra-fast timing applications, which constitutes our primary contribution to the project. This specialization complements the roles and capabilities of our project partners, fostering a collaborative and multidisciplinary approach essential for achieving the project's ambitious goals.
With our current developments, we aim to match the intrinsic timing performance of LSO/LYSO scintillation crystals, which represent the state of the art in time-of-flight PET. Importantly, our technology is designed to be forward-compatible and will immediately benefit from ongoing advancements in scintillator materials. Notably, there are promising R&D efforts in the field of meta-scintillators, which leverage principles from quantum optics to push the boundaries of light yield and timing resolution. We are also developing readout microelectronics technologies to fully exploit these new domains. These innovations have the potential to further enhance the performance of our system and open new frontiers in medical imaging.

Oncovision: Oncovision decided to join the PETVision project because of our shared commitment to advancing cancer diagnosis and treatment. As a medical technology company specializing in creating innovative imaging devices for oncology, this project aligns perfectly with our mission. The opportunity to collaborate with leading partners and contribute our expertise in building and integrating complex systems is a vital step in developing the next generation of medical imaging technology.
Our main role in the PETVision project is multifaceted, focusing on the core technical components of the device. Our team is responsible for the construction of the mechanical device itself. Additionally, we are in charge of the crucial task of integrating the entire system, from the detector to the final data acquisition. This includes the development of the data acquisition framework, ensuring all components work together seamlessly to capture and process high-quality imaging data.
This new PET imager will significantly improve brain diagnosis by offering unprecedented clarity and precision. The device, which uses two large panels to cover the patient's head, is being engineered with a very high timing performance. This superior timing resolution will allow for the detection of subtle changes in brain activity, which is crucial for the early diagnosis of neurological diseases, including certain types of brain tumors. The improved signal-to-noise ratio and reduced imaging time will provide clinicians with more accurate and reliable data, leading to better-informed treatment decisions and, ultimately, improved patient outcomes.

Michele Penna successfully defended his PhD thesis

*PetVision team-member **Michele Penna** of Fondazione Bruno Kessler (FBK) has successfully defended his PhD thesis at Politecnico di Torino on September 2, 2025. We are proud to celebrate this achievement and the valuable contributions Michele has made to the PetVision project. Below are some highlights of his research, which not only advances the understanding of SiPM technology but also strengthens the foundation for future innovations in medical imaging and cancer detection.*

I am very glad to announce the completion and defence of the doctoral dissertation of the Electrical, Electronics and Communications Engineering PhD programme at Politecnico di Torino in collaboration with Fondazione Bruno Kessler. The research activity is focused on a comprehensive characterization of Silicon PhotoMultipliers (SiPMs), with a particular emphasis on the Near Ultra Violet- High Density with Metal-filled Deep Trench Isolation (NUV-HD-MT) technology fabricated by Fondazione Bruno Kessler (FBK), focusing on its timing performance.

From the fundamental principles governing SiPM operation to the detailed experimental characterization and analysis of the factors that ultimately limit time resolution, this research provides valuable insights, which will be useful for future technology developments. Owing to their exceptional characteristics, particularly their excellent time resolution, SiPMs have become highly relevant in fields such as large-scale physics experiments and in particularly in medical imaging applications.

A critical parameter defining SiPM timing performance is the Single Photon Time Resolution (SPTR), which measures the uncertainty in the time of arrival of a single photon impinging on the detector surface. SPTR is a key parameter affecting the Coincidence Time Resolution (CTR) of a Time-of-Flight Positron Emission Tomography (ToF-PET) scanner. Since SiPMs are core components in modern ToF-PET machines, optimizing their timing performance is crucial to enhance the performance of the entire system, to obtain better image quality and, ultimately, to improve the accuracy of cancer detection.

The primary focus of the research activity was the analysis of the SPTR of (i) Single-Photon Avalanche Diodes (SPADs), which are the building block of SiPMs, with different sizes of their active area and (ii) of SiPMs with different active areas. The analysis was carried out by studying the different contributions to the SPTR, including the fundamental limits of the avalanche build-up statistics and of the time jitter due to the electronic noise. Furthermore, the performance improvement provided by a timing-optimized microcell layout, featuring a metal mask around each microcell, has been evaluated, along with its impact on time resolution. Finally, the CTR of a ToF-PET-like system has been measured in the laboratory, outlining the potential of this SiPM technology for real medical applications.

The insights on timing performance achieved with this research will help the development and continuous optimization of FBK SiPM technology, providing significant innovations for fast timing applications in medical

imaging, with a relevant impact on society. Specifically, these findings are directly applicable to the ongoing research within the PetVison project, in which FBK is an active partner, involved in the development and production of the SiPMs. I am proud to be part of this fruitful collaboration that aims at providing the necessary context to translate these technological advancements into a tangible impact on next-generation medical diagnostics.

You can meet us here:

- FATA "FAst Timing Applications for nuclear physics and medical imaging" (Catania, Italy, October 2025)
- IEEE Medical Imaging Conference 2025 (Yokohama, Japan, November 2025)

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101099896. You have received this email because you have subscribed to our newsletter. If you wish to unsubscribe, please send a feedback e-mail.

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Funded by the European Union