



Istituto Nazionale di Fisica Nucleare
LABORATORI NAZIONALI DI LEGNARO

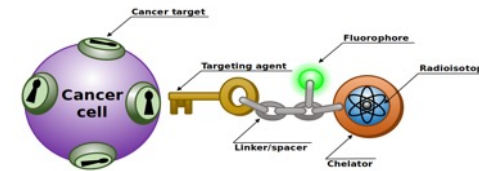
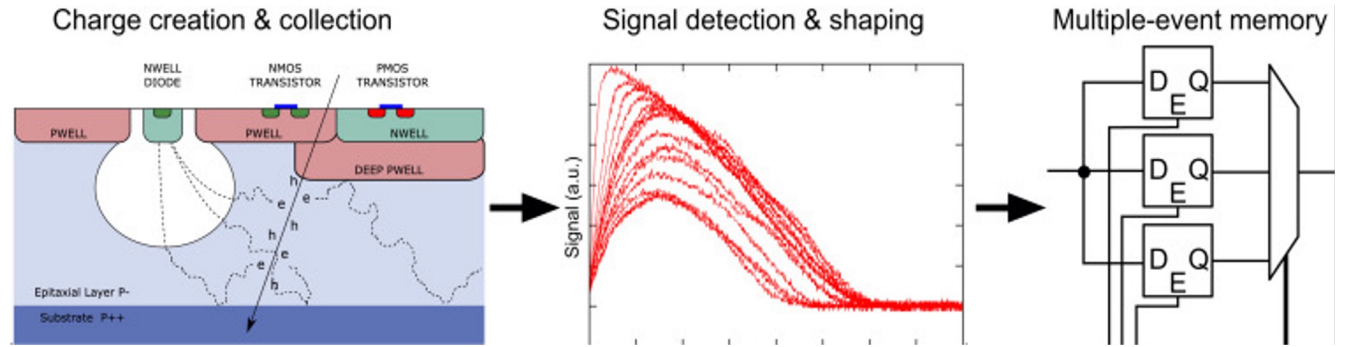
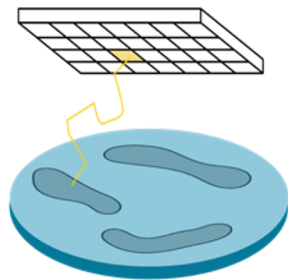


Work Package 2

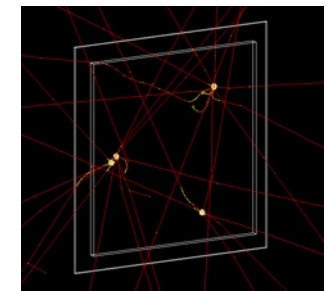
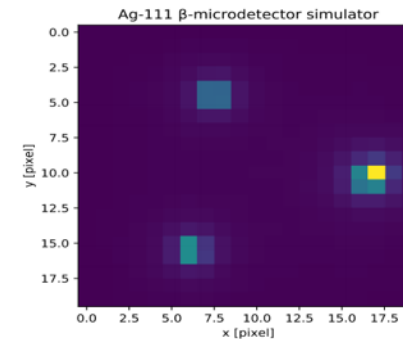
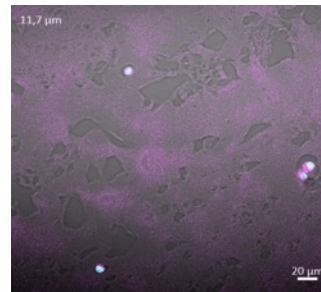
The Beta Imaging Detector

Pavia, June 20th, 2024

- **ALPIDE chips:** technology from HEP
- 15 mm x 30 mm active area with 512 x 1024 pixels (typical size about 28 μm)
- low-cost readout electronics using commercial FPGA + custom PCB + dedicated Firmware
- modular system, scalable size, compact, easy to use. With 8 chips an active plate of 60 mm x 60 mm can be easily assembled.



Schematic concept of a bivalent fluorescent radiopharmaceutical.



Cell culture in 3D scaffold slice administered with a pharmaceutical: fluorescence confocal microscopy (unlabeled) vs β -microdetector simulation using Geant4 (labeled with ^{111}Ag ; pixel size 20 μm , noise 12%, 10^6 CCK2 receptors [26], detector distance 10 μm).

ADMIRAL WP2

		Year 1				Year 2				Year 3				Notes
		M3	M6	M9	M12	M15	M18	M21	M24	M27	M30	M33	M36	Required for
WP2 - β-Imaging														
MS2.0	Development of the detector control firmware prototype	→			•									MS2.3
MS2.1	Electronics and mechanics design	→			○		○		•					MS2.3
MS2.2	Preliminary Monte Carlo simulations for mechanics and detector design	→		○					•					MS2.3
MS2.3	Detector characterization and test with fluorescence						→	○					•	MS4.4

we are here

Milestone MS2.1 :

- work ongoing, design for electronic board and mechanics expected on time

Milestone MS2.2:

- MC code already implemented and working. To be updated according with final E+M design

Milestone MS2.3 (2025):

- some first experimental test already done!

→ more details in the Jessica's talk

ADMIRAL WP2

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MS2.3	Detector characterization and test with fluorescence							→	○				●	MS4.4

we are here

Activity planned for second semester 2024:

- finalize the design of board and FW for a 2 chips module (30 mm x 30 mm) and start the realization. This module can be easily duplicated to allow for a 2 x N chip configuration
- finalize the design of the final mechanics and start the realization
- finalize the MC tool
- more experimental test with the currently working prototype

Activity proposed for 2025:

- complete the realization of the prototype detector and the mechanics
- test and characterization of the prototype

INFN-PD – budget for 2nd year

		Required	Granted	Used
		[k€]	[k€]	[k€]
Consumables	Mechanical and Ancillary components:			
	- Thorlabs precision XY movements (or equivalent) - other components	5		0 (exp. 2-3k)
Consumables	Electronics		9	
	- Xilinx FPGA development kit (or equivalent)	3		
	- PCB production	1		
	- other components	1		0 (exp. 1-2k)
Shipping	Shipping of detectors from PD to test sites in Italy	2	0	0
Travels	Travels for experimental activity	4	2.5	1.6
TOTAL INFN-PD		16	11.5	1.6

Richieste servizi: 1 M.U. officina elettronica per chip bonding e altre operazioni di assemblaggio. Qui potrebbe esserci una maggiore disponibilità per velocizzare la realizzazione della scheda elettronica (TBV)

INFN-PD – budget for 3rd year

		Current bud.	Realistic bud.
		[k€]	[k€]
Consumables	Mechanics	5	maybe 1
	Electronics	5	maybe 1
Shipping	Shipping of detectors from PD to test sites in Italy	2	?
Travels	Travels for experimental activity	4	4
TOTAL INFN-PD		16	6

Anagrafica 2024: M. Lunardon **0.6**, S. Moretto **0.1** , P.Lotti **0.3**, L. Zangrando **0.2**, Chiara Bonini (PhD) **0.5**, Daiyuan Chen (PhD) **1.0**, Jessica Delgado Alvarez (Assegno) **1.0**

TOT = 3.7 FTE

Collaborano inoltre: Piero Giubilato, Rubens Raffagnato, Michele Giorato

Anagrafica 2025: M. Lunardon **0.5** (0.2 in SPES_MED), S. Moretto **0.1** (0.5 in SPES_MED) , Jessica Delgado Alvarez (Assegno) **1.0** + possibile percentuale parziale di dottorando elettronica nel corso del 2025

TOT = 1.6 FTE

Collaborano inoltre: Piero Giubilato, Michele Giorato

Richieste servizi: 2 M.U. officina elettronica per realizzazione scheda, chip bonding e altre operazioni

- next experimental tests with Ag-111 to determine intrinsic efficiency
 - key point to detect low activity in cell cultures
 - identify best source and detector geometry
- tests with scaffolds
 - minimum requirements (geometry, mechanics, activity...)
 - Ag-111 only or not?
- final geometry
 - keep into account practical needs
- final tests
 - possible setup to compare beta-imaging and fluorescence measurement?

