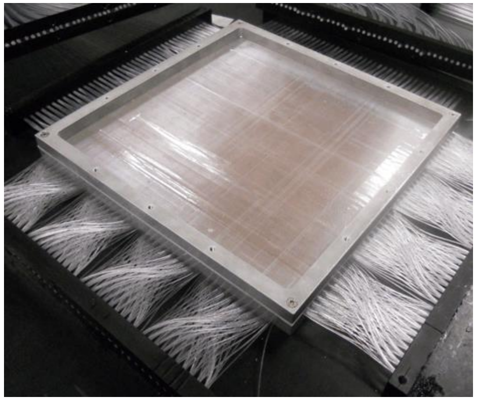
SE^{2}D

Sensor with Embedded Electronic Development

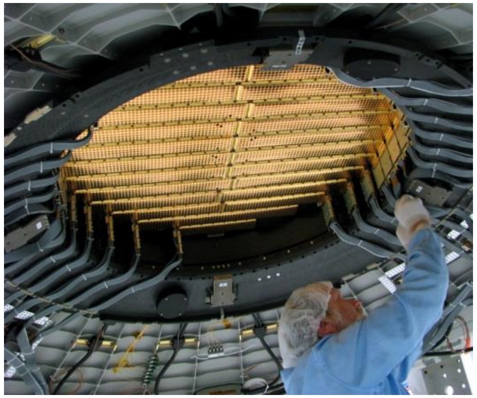
Piero Giubilato – Padova University

SE^2D

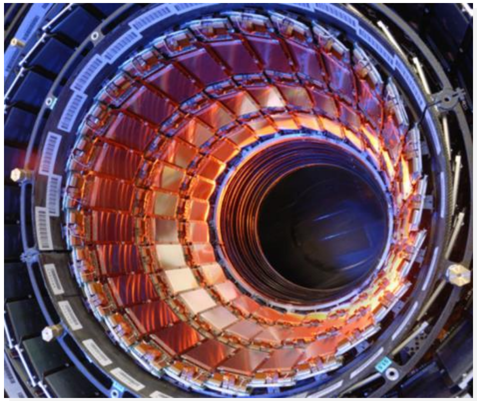
Employ monolithic sensors in experiments to extend their scientific performance.



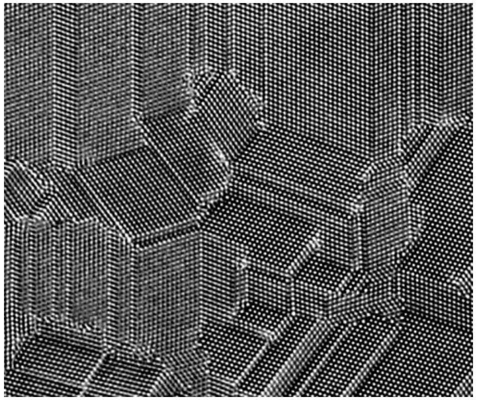
Solid state detectors for medical applications



Space-born trackers and telescopes



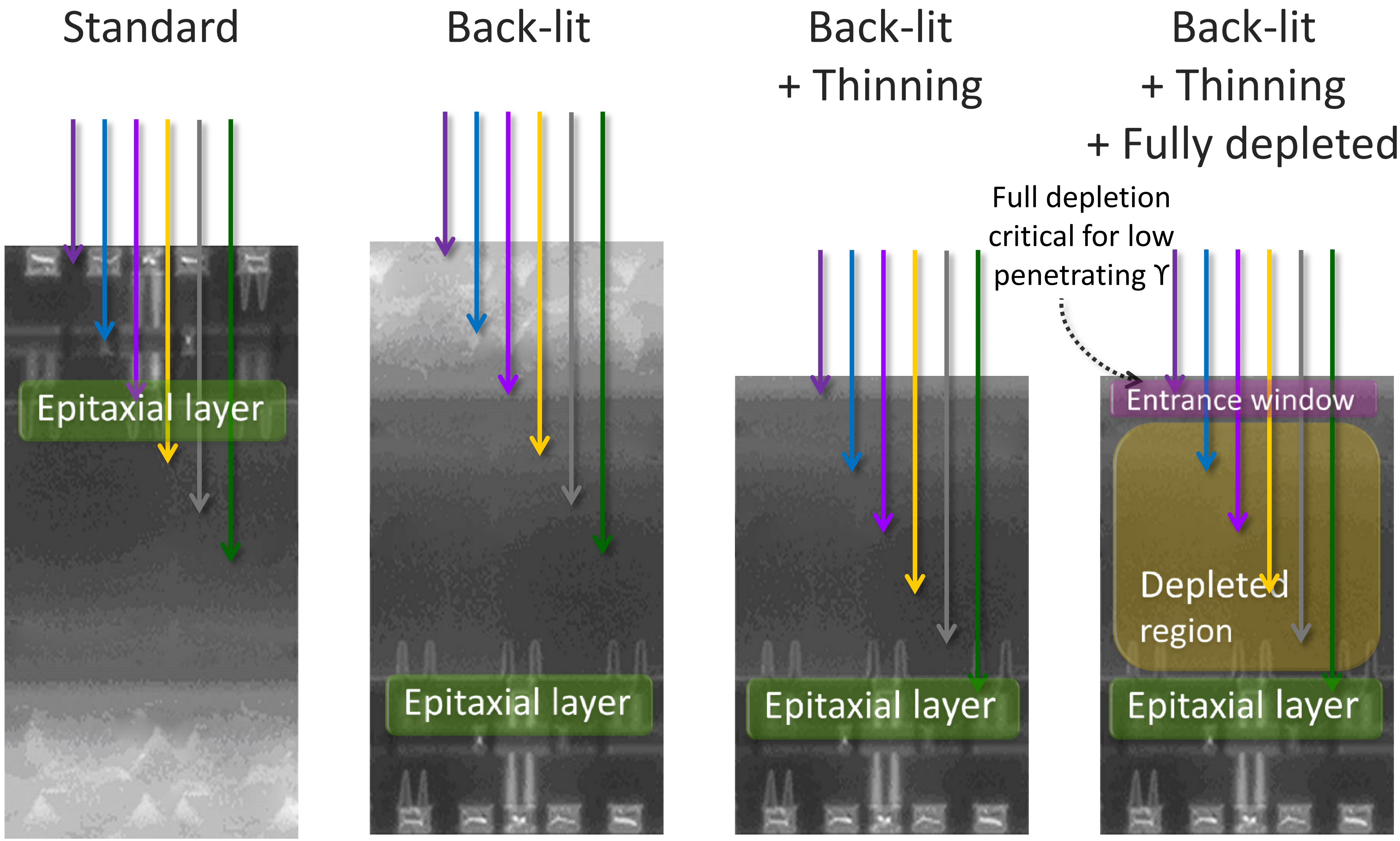
HEP trackers and calorimeters



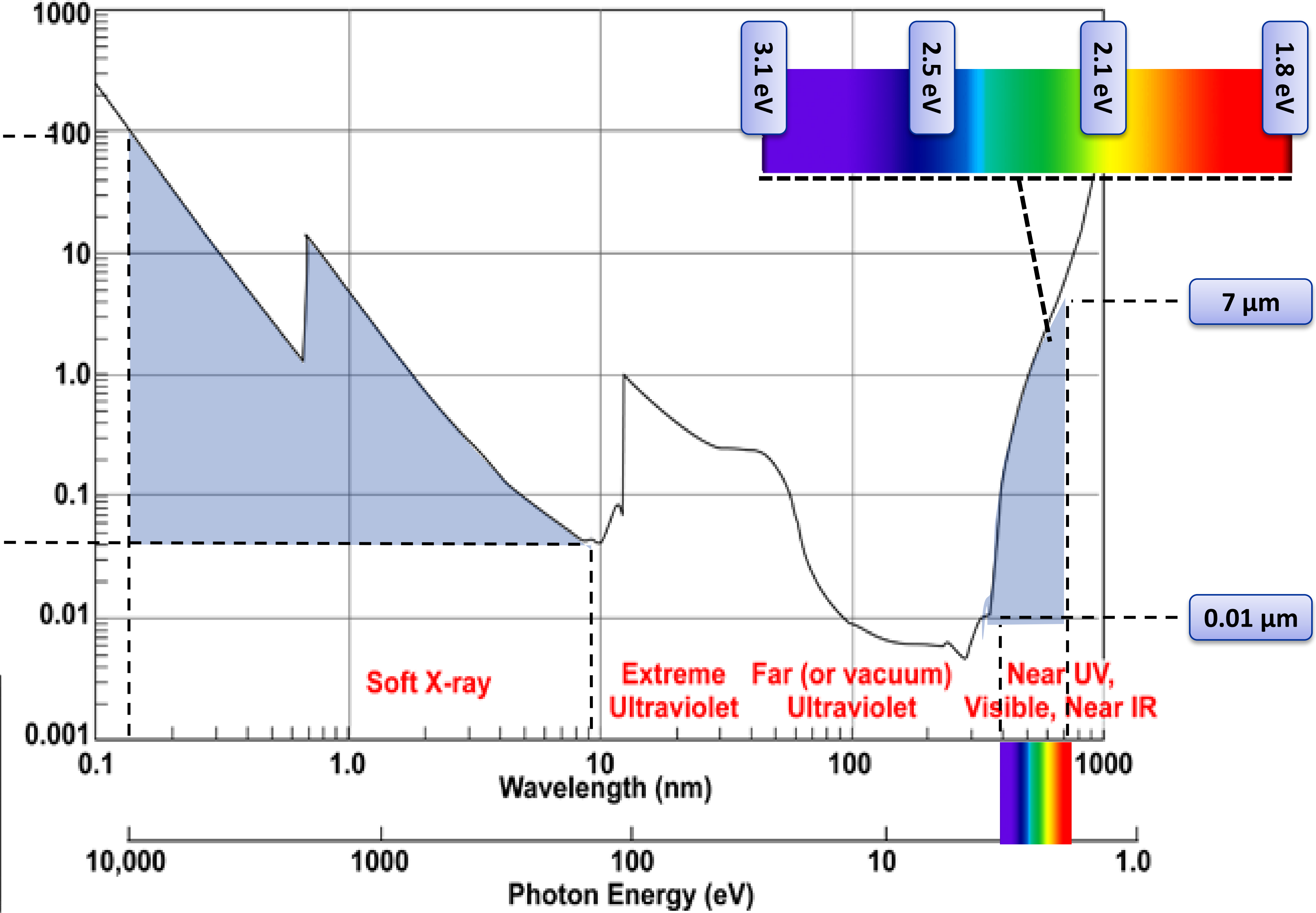
Electron microscopy sensors

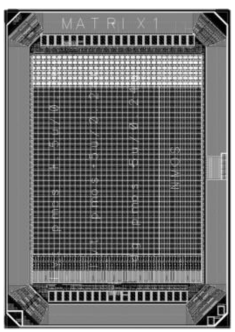
Less power consumption, higher granularity, lower assembly cost. Cannot address every issue in present solid state pixel physics detectors, but definitely most of them.

SE²D – depleted, thinned, processed sensor



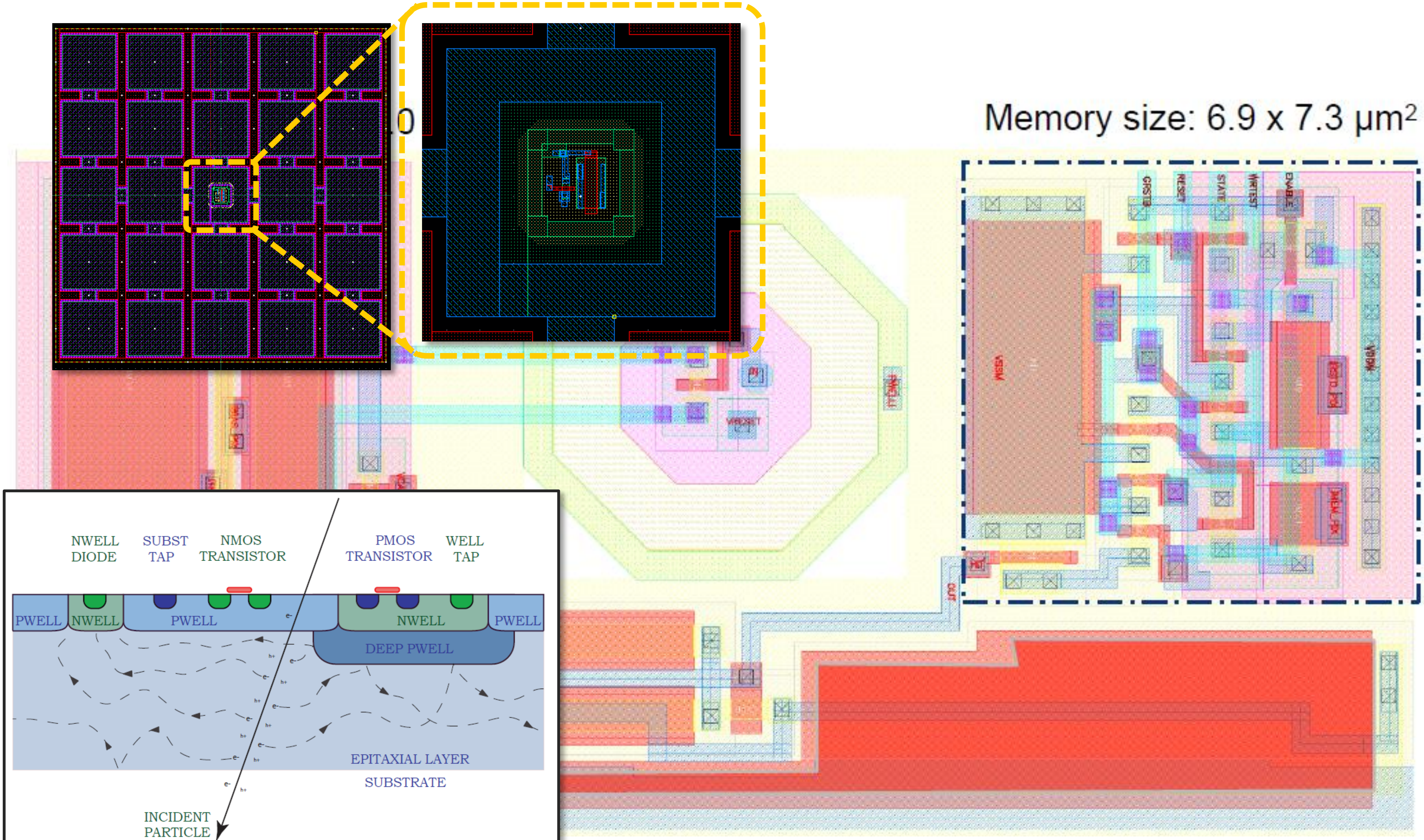
SE^{2}D – full spectrum (1 eV – 10 keV) with a single device



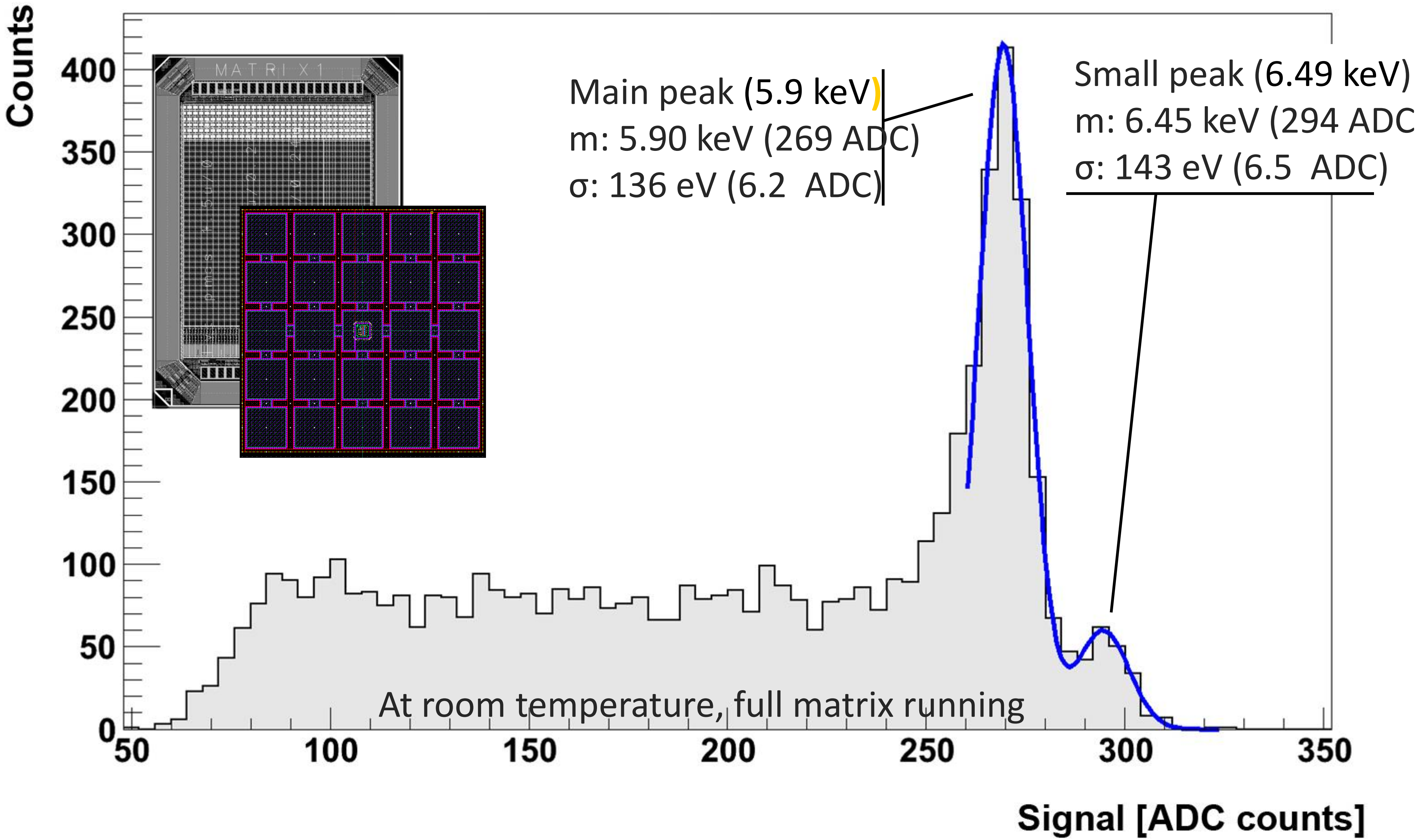


SE^{2}D – electronic in depleted sensor for low power and noise

Memory size: 6.9 x 7.3 µm^2



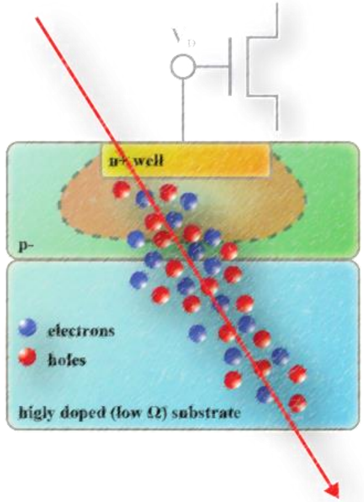
SE^{2}D – low noise, integrated electronic performance

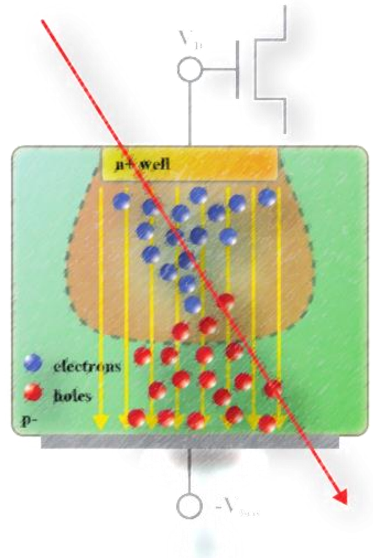


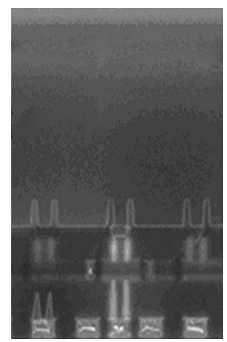
Reason for a Technology Transfer driven project – 1

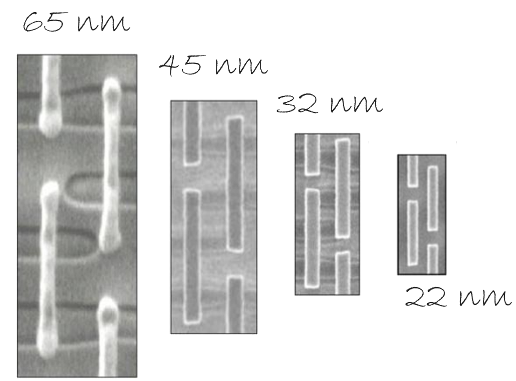
SE^{2}D

Monolithic sensors are mass-produced: advanced technology at cheap prize.









The scientific community lacks both the funding and know-how to get where SE^{2}D aims to go. The big HEP experiments (the only with substantial funding) are ineffective in focusing the resources for any very innovative R&D in that sector.

Reason for a Technology Transfer driven project – 2

Trying to address the previous slide issues, a technology transfer driven project could set the base for a different future modus operandi (hence the name SE^2D).

Collaborate with industrial/private partners who can benefit from direct or indirect outcomes of our research to obtain “special prices” in exchange for know-how.

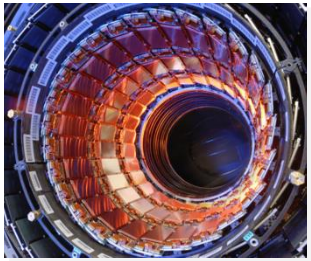
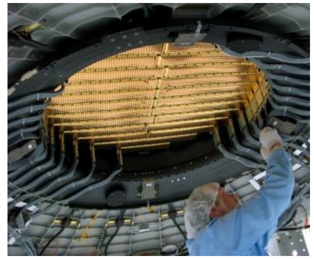
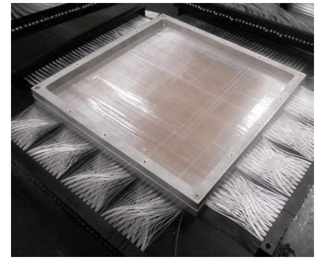
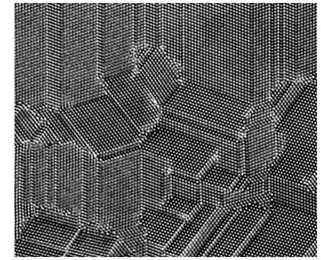
Find among our own scientific targets what part could be shared in market-oriented applications as a mean of financing ourselves.

Take the challenge of a different “metric” for success measurement and competition drive: beating other team supporting different industrial/private partners could be way more challenging than being cheered at the usual conference where everyone knows everybody!

LFoundry

In Avezzano there is an European medium-sized specialty foundry dedicated to microelectronic circuits production (11.000 m^2 clean room, down to 90 nm processes), employing about 1600 people.

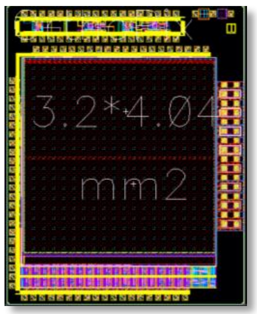
SE^{2}D – shared interests

Our scientific interest	 GHz tracking capability, ns timing.	 < 20 mW cm^{-2} power, fine pitch (< 10 µm).	 Sparsification and digital conversion.	 Ultra-thin, very large area sensors
Enabling technology (INFN has the know-how)	Medium/high resistive epi layer (≥ 500 Ω cm), quadruple well technology.	Low capacitance node, high routing density, minimal in-pixel cell electronics.	IPs blocks embedded to perform timing, sparsification and digital conversion.	Back illuminated, fully depleted and back-processed device.
Commercial interest	Better signal for IR applications, low light vision. Low-energy monolithic panels for X-rays.	Movie and medium large format camera market. Niche space-born camera market.	Fully digital output sensor for prosumer and consumer imaging applications.	Better signal on all visible wavelengths. <u>Blue/violet S/N much better</u> than current state of the art.

SE^{2}D – workgroups

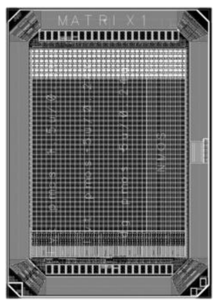
National responsible: A. Rivetti (TO) & P. Giubilato (PD)

WP1 Torino



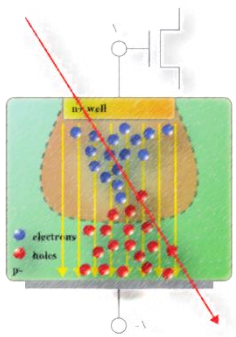
Chip and IPs design, production cycle management, interface with the foundry. Long experience and expertise in pixel ICs design.

WP2 Padova



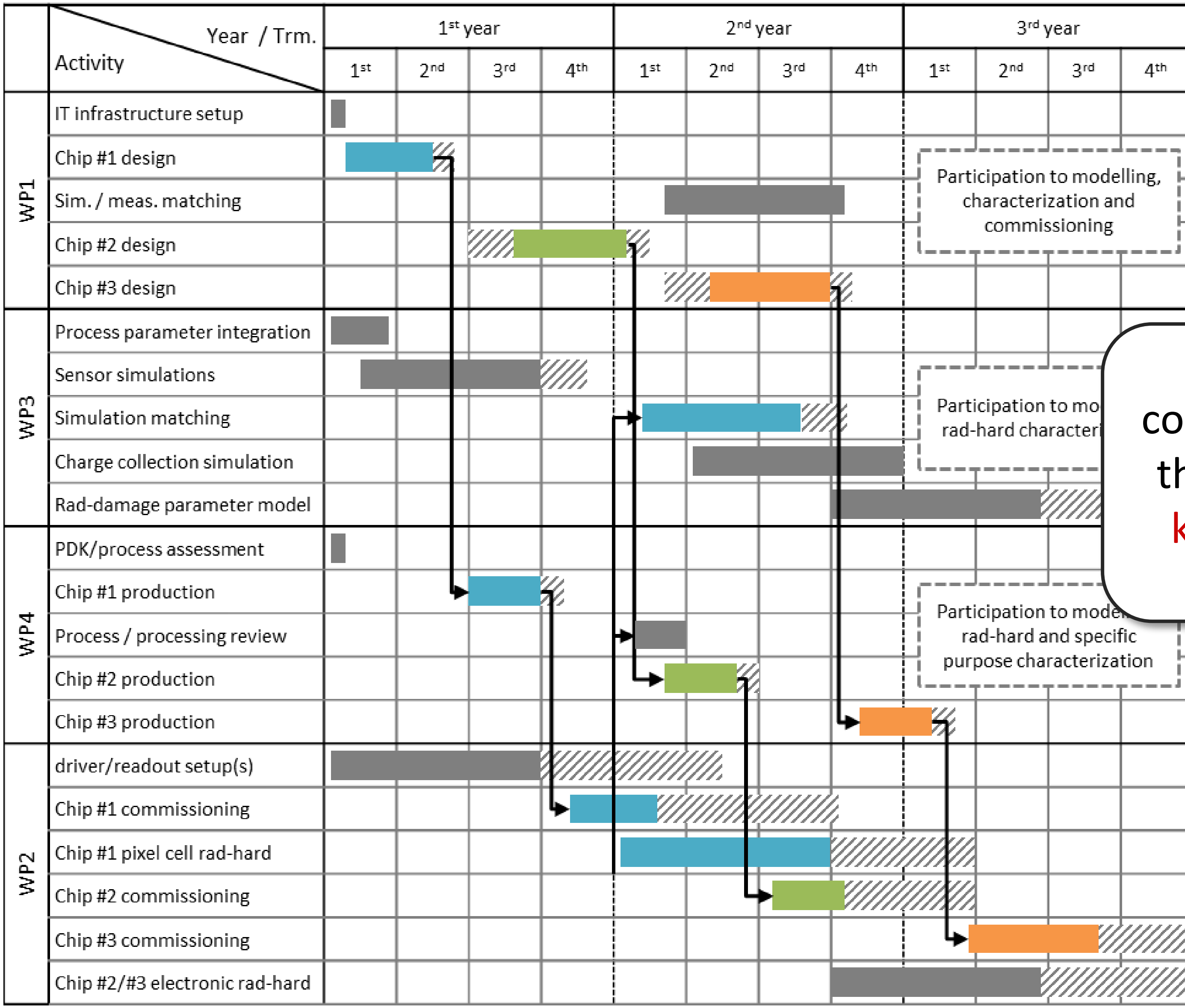
Commissioning, measurement and radiation hardness studies, plus help in design and simulation in collaboration with other working groups.

WP3 FBK



Device sensor simulation and process development in close collaboration with the foundry (a quite unique opportunity in the Ics world).

SE²D – timeline of the 3 years project



Thanks to collaboration with the foundry, 150 keuro/year will suffice

SE^2D – Padova group

	1^{st} year	2^{nd} year	3^{rd} year
Goals	• Chip readout development (mostly reuse of previous projects equipment). • First chip commissioning, table top measurements. • Some IP blocks design (under Torino guidance).	• Chip rad-hard assessment for both ionizing and non ionizing radiation. • Single Event Effect characterization. • Efficiency measurements at test beams.	• Multi-layer odoscope for tracking efficiency assessment. • Multi-chip systems for high-bandwidth data acquisition and sparsification assessment.
Resources	• 1 assegnista/ricercatore 12 mesi (setup/measurements). • 1 tecnologo eqv. 6 mesi (design). • 1 tecnico elettronico 6 mesi • 6 mesi uomo di officina elettronica. • IT support for design toools installation/maintenance.	• 1 assegnista/ricercatore 12 mesi (setup/measurements). • 1 tecnologo eqv. 6 mesi (design). • 1 tecnico elettronico 6 mesi • 3 mesi uomo di officina elettronica. • IT support for design toools installation/maintenance.	• 1 assegnista/ricercatore 12 mesi (setup/measurements). • 1 tecnologo eqv. 6 mesi (design). • 1 tecnico elettronico 6 mesi • 3 mesi uomo di officina elettronica.

SE^{2}D – final remarks

- Push state-of-the-art in detection for future experiments needs.
- Consolidate INFN position in sensors & microelectronic technology.
- Develop an effective collaboration model between INFN and the industry.
- Use INFN know-how to support national strategic infrastructures (i.e. microelectronics companies) into the worldwide market competition.