# Medipix4
Ferrara, LNS, Napoli, Pisa e Trieste

The proposal is based on the development of a detection system realized assembling of a Timepix4 photon counting chip (energy sensitive; time resolving readout circuits; 4-side buttlable; $\sim$ 7cm^2 area; 512x448 pixels ;$\sim$ 10^6 hits/mm2/s mod-Data driven;$\sim$ 10^9 hits/mm2/s, mode-Frame based); bump-bonded to Si or Cd-Te sensors of various thiknesses.

The spectral capabilities of detection system will be applied to:
*   Dosimetry in mammography
* μ-CT
*   Spectral imaging
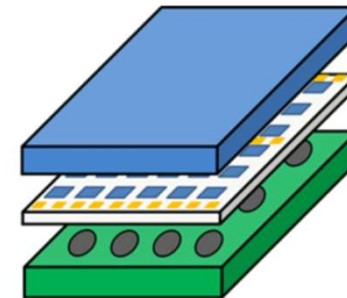
Timepix4 Setup in Pisa

- Timepix4 chipboard equipped with a 300 µm Si sensor <u>delivered on January 2023</u>
- Spidr4 readout system
  - 1 Gb Ethernet connection to PC for slow control
  - 10 Gb Ethernet connection to PC for fast readout
- Timepix4 power supply – 2V, max 3A
- Sensor bias supply – 100 V, max 5µm
- Cooling fan
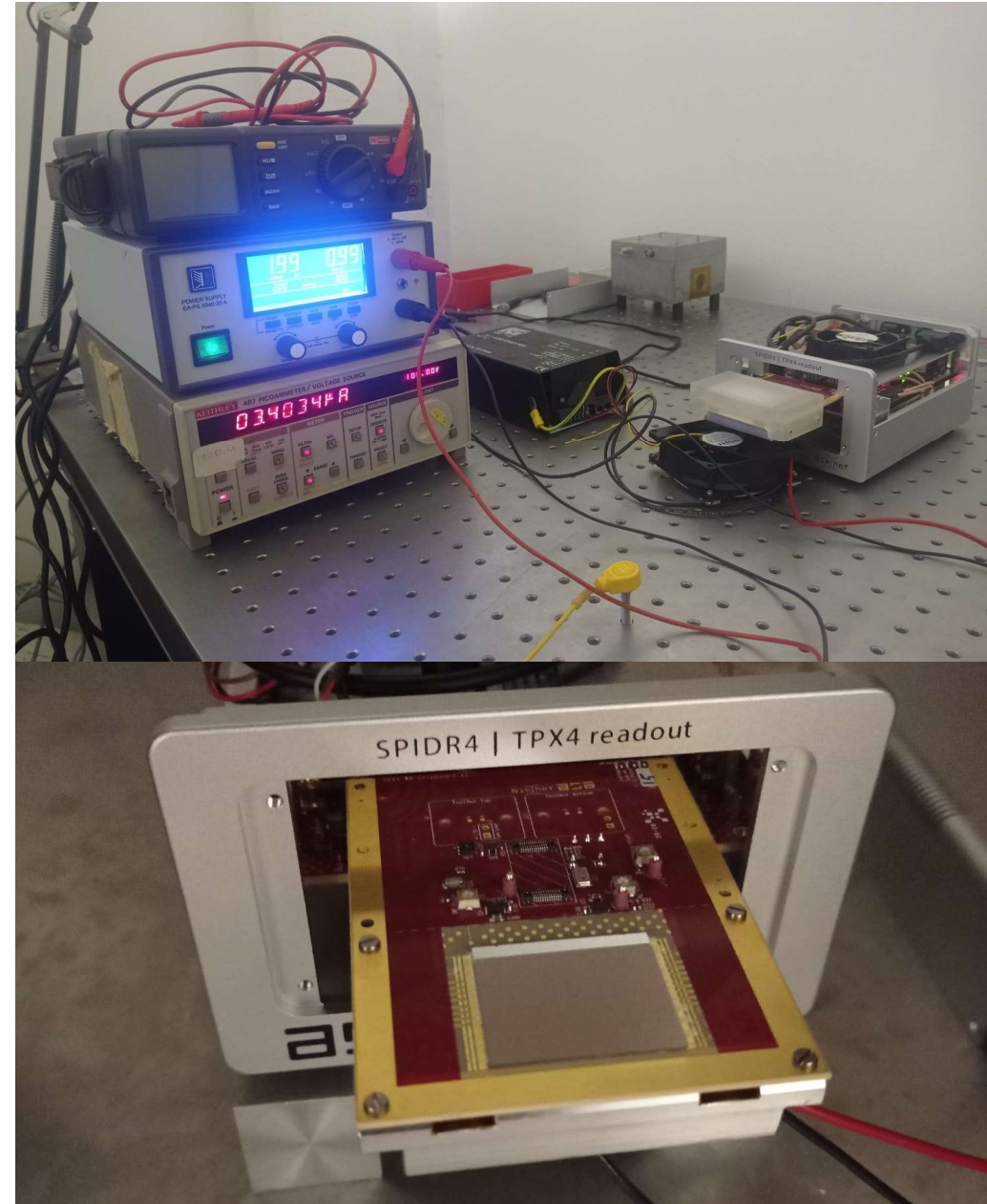
Completed Tasks

- ✓ Installation of the experimental setup
- ✓ Acquisition software debugging
- ✓ Slow control configuration & test acquisitions:
  - ✓ Internal generated test-pulse
  - ✓ Background
- ✓ Fast link configuration & test acquisitions:
  - ✓ Internal generated test-pulse
  - ✓ Background
- ✓ Threshold equalization
- ✓ Detector calibration with internal generated test-pulse

Current Activities

- Detector calibration with external X-ray sources
- Measurements with external X-ray sources:
  - Timepix4 energetic resolution characterization
- Measurements with X-ray tube:
  - Timepix4 energetic resolution characterization
  - Timepix4 dead time evaluation

Future Activities

- Characterization with synchrotron radiation
  - In June, Elettra communicated the assignment of beam-teams: data collection expected in November

- Timepix4 energetic resolution characterization
- Spectral imaging studies

			Timepix3 (2013)	Timepix4 (2019)	
Technology			130nm – 8 metal	65nm – 10 metal	
Pixel Size			55 x 55 µm	55 x 55 µm	
Pixel arrangement			3-side buttable 256 x 256	4-side buttable 512 x 448	3.
Sensitive area			1.98 cm^2	**6.94 cm^2**	
Readout Modes	Data driven (Tracking)	Mode	TOT and TOA		
		Event Packet	48-bit	64-bit	33
		Max rate	0.43x10^6 hits/mm^2/s	**3.58x10^6 hits/mm^2/s**	8x
		Max Pix rate	1.3 KHz/pixel	**10.8 KHz/pixel**	
	Frame based (Imaging)	Mode	PC (10-bit) and iTOT (14-bit)	CRW: PC (8 or 16-bit)	
		Frame	Zero-suppressed (with pixel addr)	Full Frame (without pixel addr)	
		Max count rate	~0.82 x 10^9 hits/mm^2/s	~5 x 10^9 hits/mm^2/s	5x
TOT energy resolution			< 2KeV	**< 1Kev**	2x
TOA binning resolution			1.56ns	**195ps**	8x
TOA dynamic range			409.6 µS (14-bits @ 40MHz)	**1.6384 ms** (16-bits @ 40MHz)	4x
Readout bandwidth			≤5.12Gb (8x SLVS@640 Mbps)	**≤163.84 Gbps** (16x @10.24 Gbps)	32x
Target global minimum threshold			<500 e$^-$	<500 e$^-$	
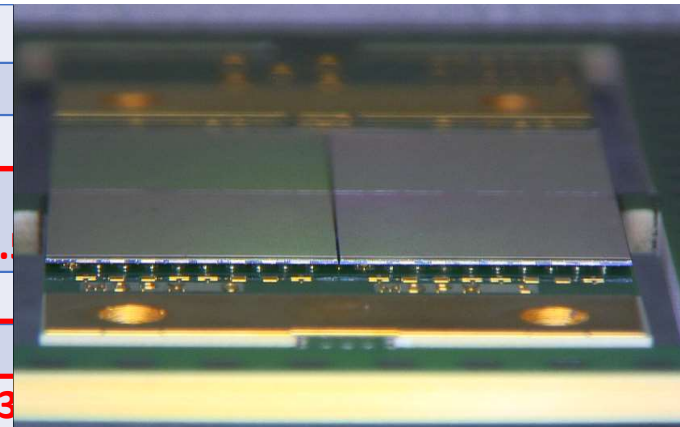
First 2x2 TSV
Medipix3RX
(ESRF)

	Posizione	Medipix4 (%)	
P. Delogu	PA	20	
A. Feruglio	dott	100	
M.E. Fantacci	PA	20	
V. Rosso	**PO**	**40**	**Local coord.**
M.G. Bisogni	PA	20	
G. Sportelli	RTDB	40	
N. Belcari	PA	20	
D. Panetta	Ric. CNR	20	
A.C. Traino	Dirigente AOUP	20	
E. Ciarrocchi	RTDA	20	
		3.0 FTE	