EIEM GA Project – Some Results

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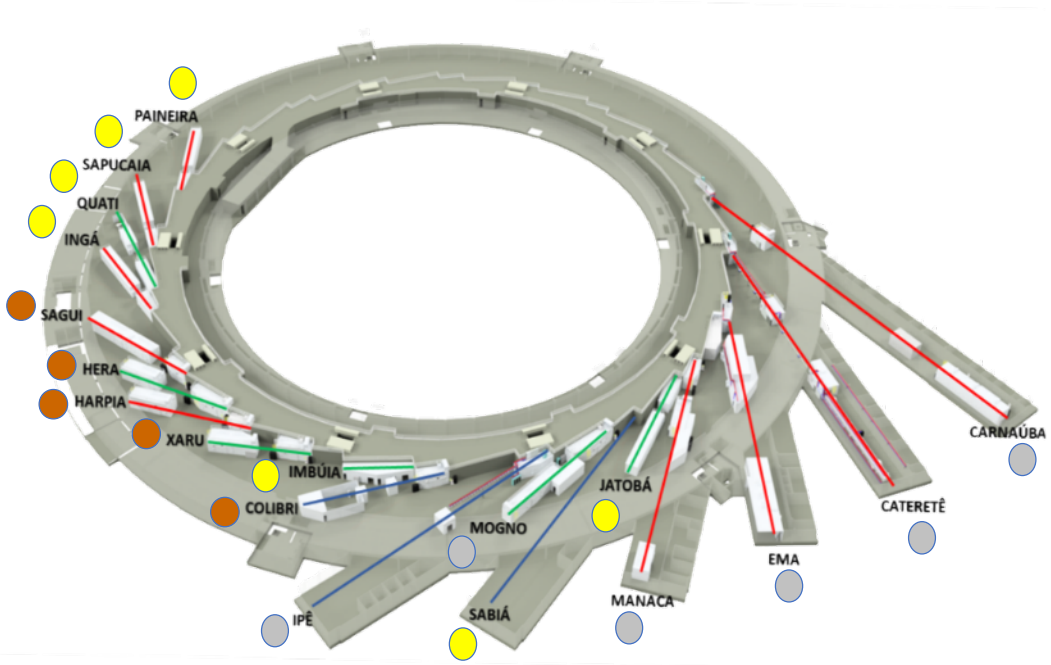
Outline

- Detector needs at Sirius
- Detectors current status
- Detectors upcoming plan
- Detectors long-term expectations

Detector needs at Sirius



Phase	Number of beamlines	Status
1-A	6	Construction
2*	5	Funding
1-B	7	Design

* Mainly refurbished beamlines from the UVX machine

PHASE	BEAMLINE	ENERGY (keV)	TECHNIQUES	DETECTORS
I – A	MANACÁ	5 – 20	Serial micro and nano MX	1 Construction
I – A	EMA	3 – 35	Extreme Conditions	1 Construction + 1 project
I – A	MOGNO	20/40/70	Cone beam Tomography	2 Delivered
I – A	CATERETÊ	3 – 12	CDI, XPCS	1 Delivered
I – A	CARNAÚBA	2 – 15	spectro-ptychography	2 Delivered + 2 construction
I – A	IPÊ	0.08 – 2	AP-RIXS; ARPES	1 ccd Delivered
I – B	SABIÁ	0.25 – 2.5	AP-XPS; XMCD	
I – B	JATOBÁ	30 – 200	XRD-CT	
I – B	INGÁ	4 – 24	IXS	
I – B	QUATI	4 – 45	Quick-EXAFS	
I – B	SAPUCAIA	4 – 24	High-Throughput SAXS	1 Test
I – B	PAINEIRA	4 – 24	XPD	1 project
II	COLIBRI	0.1 – 1.5	PEEM, CDI	
II	IMBÚIA	0.001 – 1 eV	nano-FTIR	
II	XARU	4 – 45	EXAFS	
II	HARPIA	5 – 30	TR-XPD	1 project
II	HERA	30 – 120	XTMS	
II	SAGUI	4 – 24	SAXS	

Detector current status

Detectors from ΠM3GA Project

There are five X-ray imaging cameras models Medipix3RX[1].



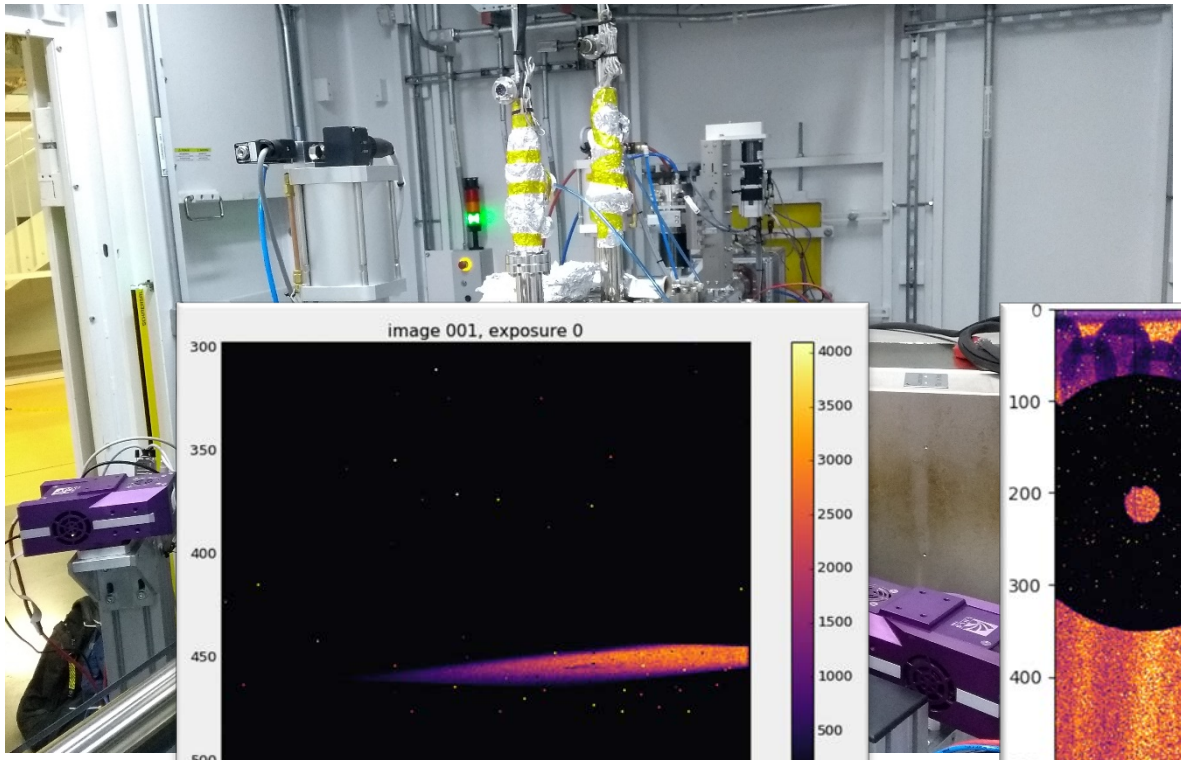

	MOBIPIX 15D	PIMEGA 45D	PIMEGA 135D	PIMEGA 450D	PIMEGA 540D
Sensors (µm type)	300 Si / 1000 CdTe	300 Si	300 Si / 675 Si	300 Si / 675 Si	300 Si / 675 Si
Pixels (number / arrangement)	262,144 / 512 x 512	786,432 / 512 x 1536	2,359,296 / 1536 x 1536	1,310,720 / 256x5120	9,437,284 / 3072 x 3072
Pixel size (µm²)	55 x 55	55 x 55	55 x 55	55 x 55	55 x 55
Detection area (mm²)	≈28 x 28	≈28 x 85	≈ 85 x 85	≈14.2 x 1710	≈170 x 170
Active area (%)	≈99.7	≈99.6	≈100 (minimal gaps)	≈100	≈99 (minimal gaps)
Incident Flux (counts/px/s)	3 x 10^5	3 x 10^5	3 x 10^5	3 x 10^5	3 x 10^5
Max Dynamics range	24 bits	24 bits	24 bits	24 bits	24 bits
Frame rate @ 12/24bits (fps)	2000 / 1000	600 / 300	2000 / 1000	1000 / 500	2000 / 1000
Throughput @ 12bits (Gb/s)	6.3	5.7	56.6	87.9	226.5
Vacuum (10^{-3} mbar)	No	No	Yes	No	Yes

Detector current status

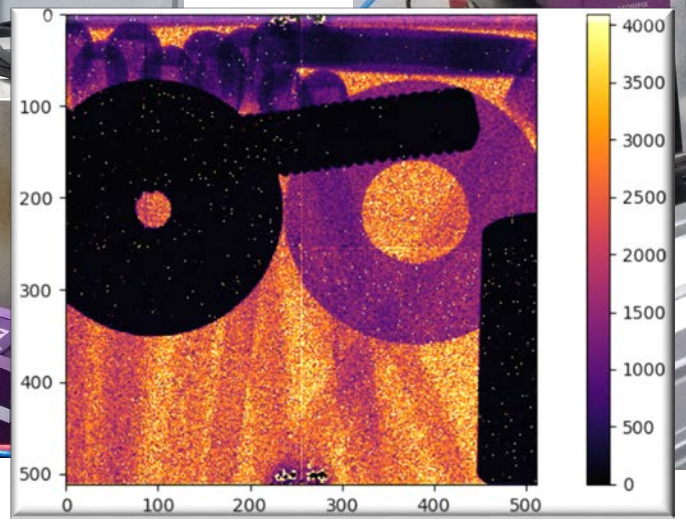
Three PIMEGA 15D (MOBIPIX) delivered

Two silicon MOBIPIX installed in the Carnaúba Beamline.

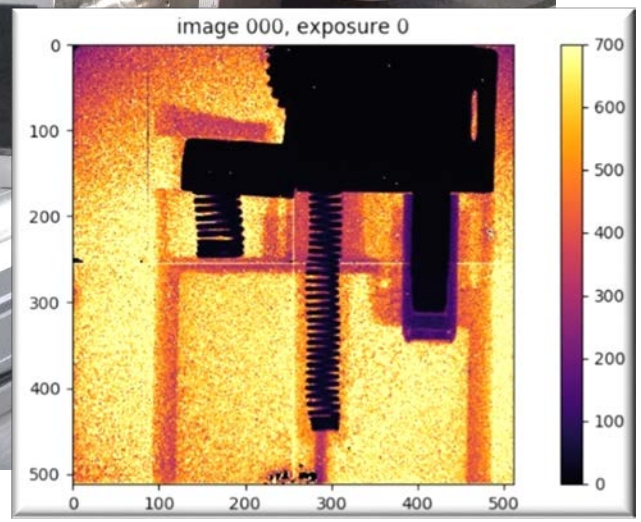
One CdTe MOBIPIX under tests i



Example of raw image diffracted by a silicon crystal to check the beam coherence in the CARNAÚBA beamline.



Cdte Raw image of a matchbox with screws and washers under polychromatic x-rays.

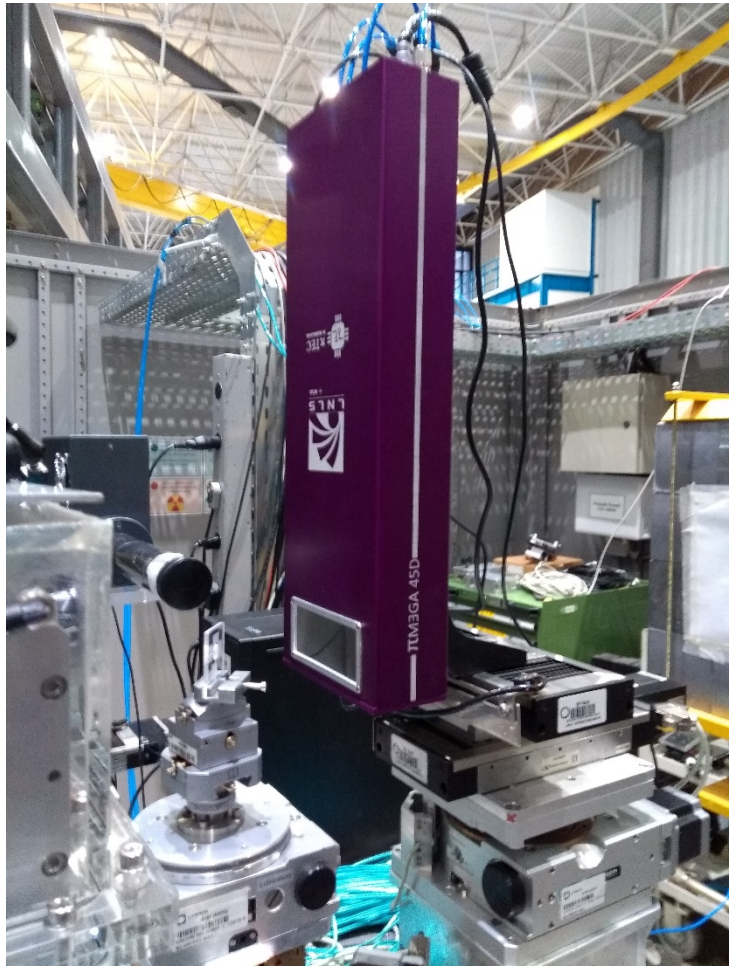


Cdte Raw image of a lighter under polychromatic x-rays.

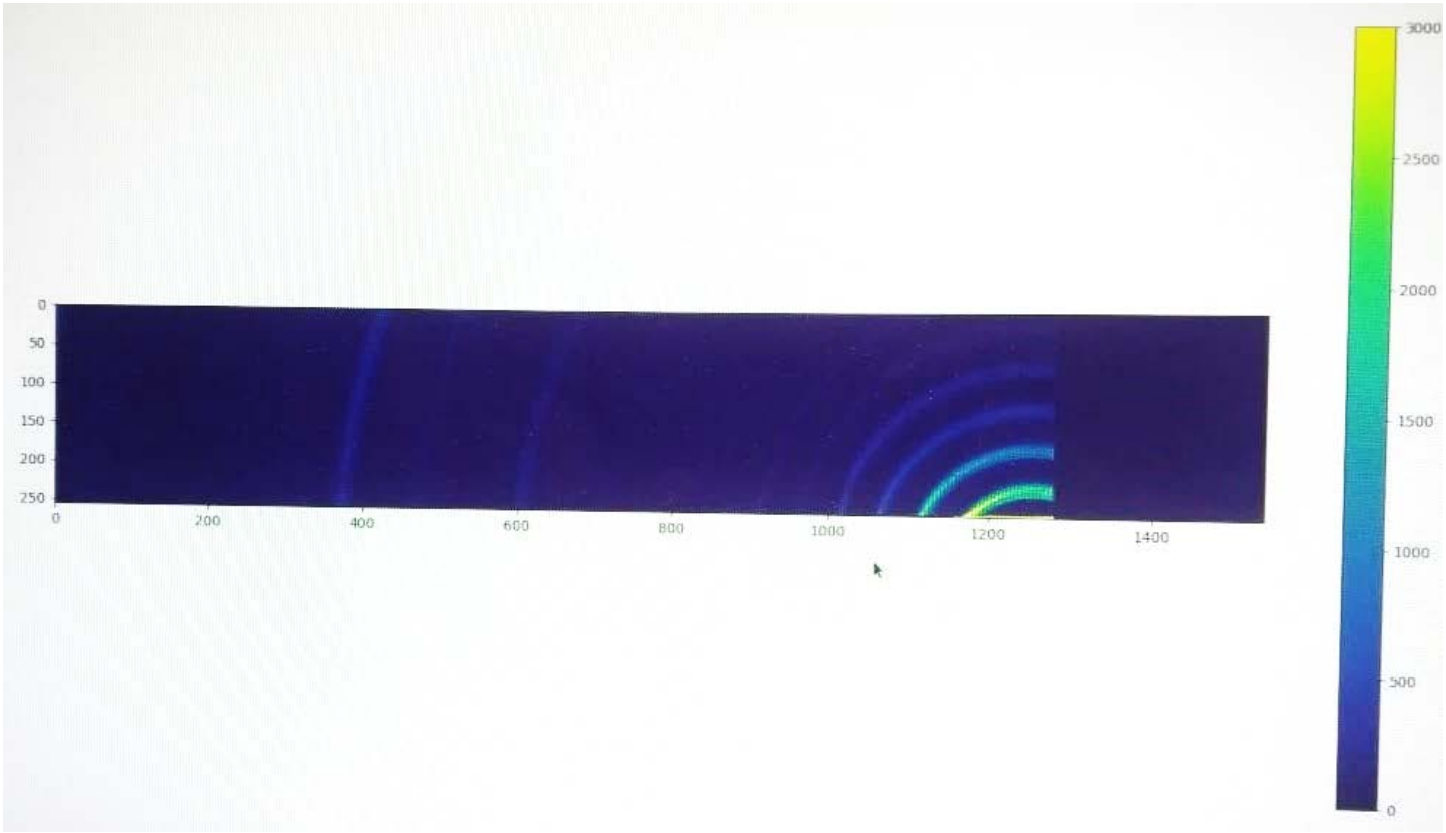
Detector current status

Two PIMEGA 45D Si prototypes delivered

One Silicon Pimega 45D installed in UVX Beamline for tests.



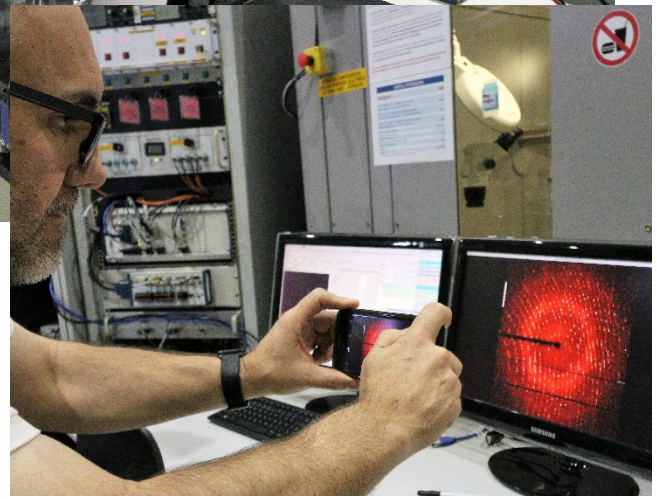
First AgBe diffractogram got using one PIMEGA 45D with silicon 300um HEXA sensor.



Detector current status

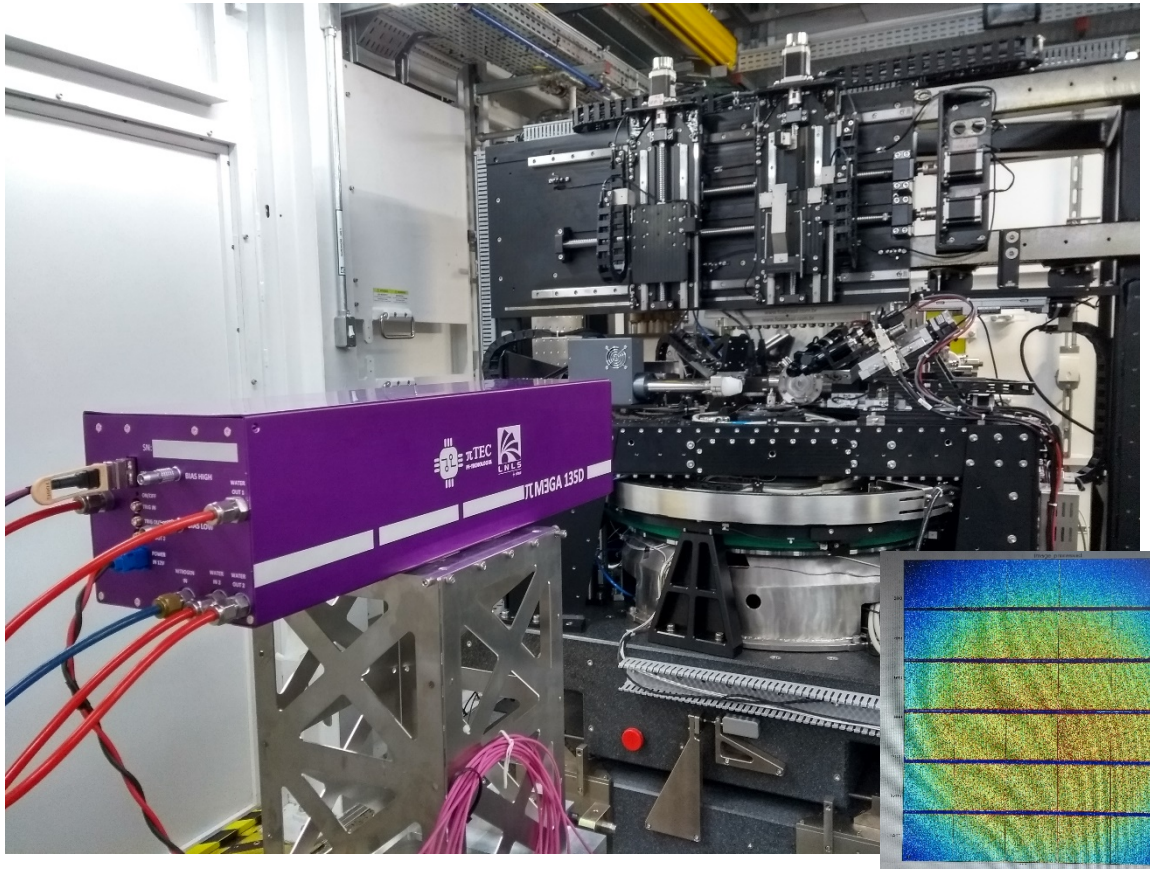
Two PIMEGA 135D delivered – prototype and Mogno beamline

Testing PIMEGA 135D in the MX2 (UVX Beamline)



and a lisozyme cristallography test.

PIMEGA 135D Si 675um testing Carnaúba beamline



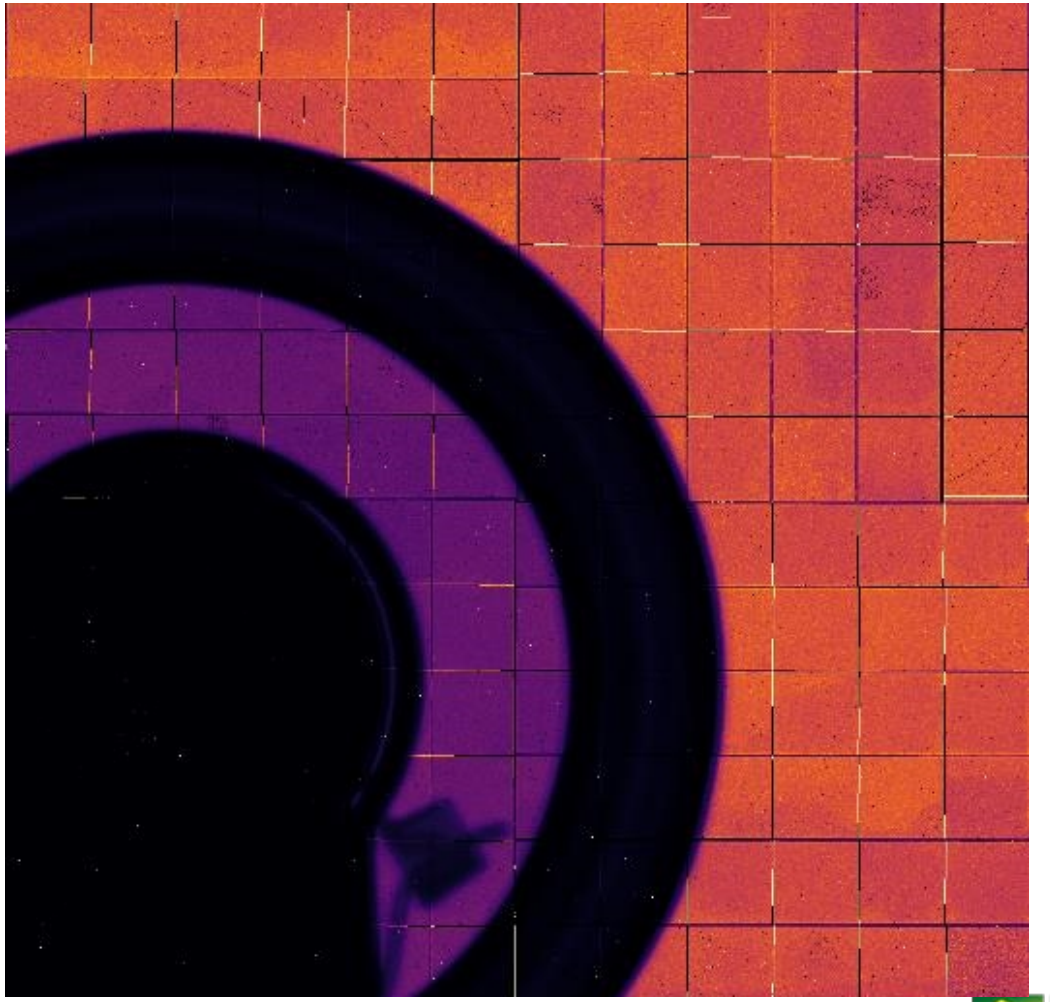
Pimega 135D-675 under tests (image of ^{55}Fe radioactive source).

Detector current status

First PIMEGA 540D Si delivered

Pimega 540D mounted in the vacuum chamber tunnel of CATERETÊ beamline.

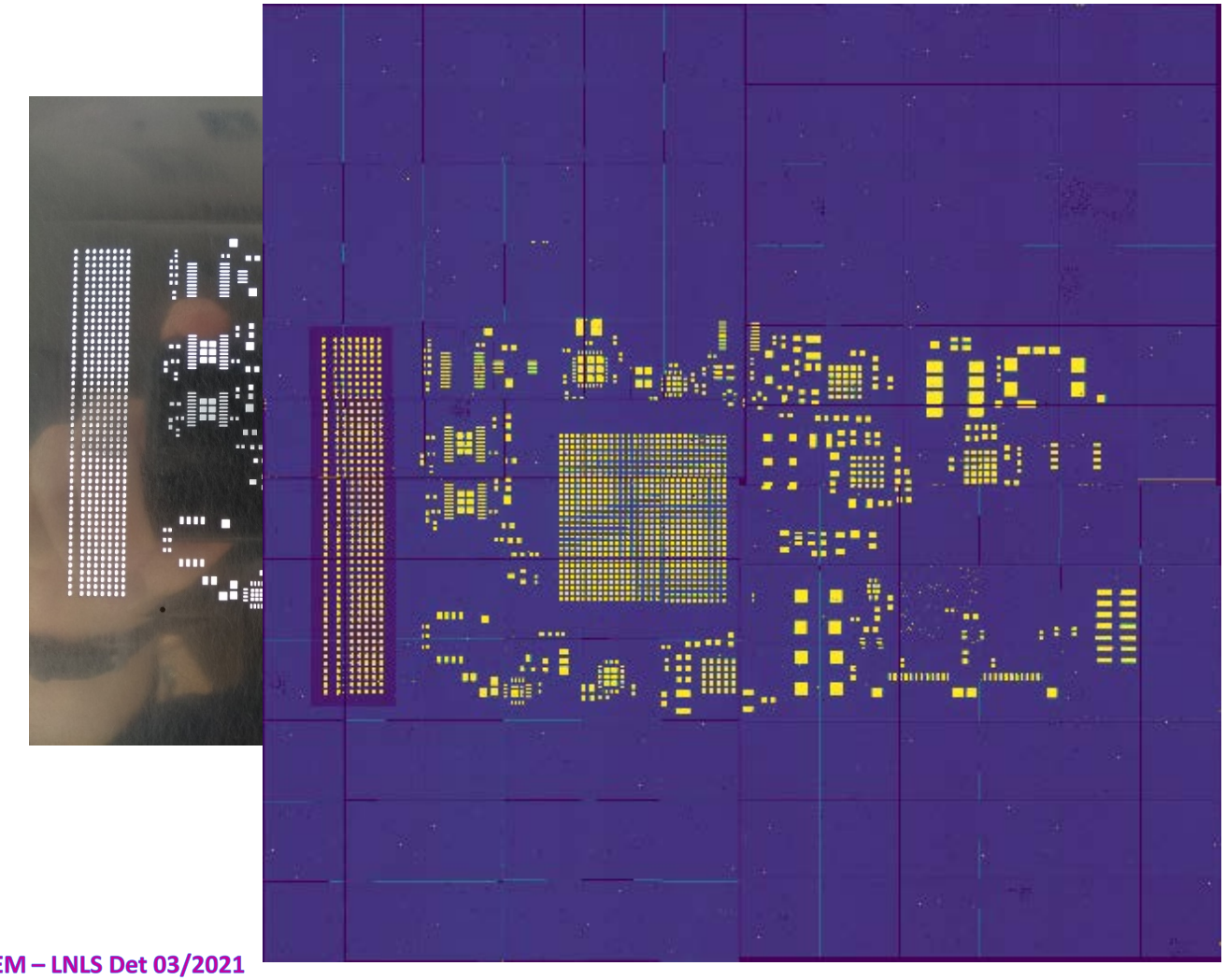
Frame Rate Test: 1848 images per second with a metallic disk running at approx. 570RPM acquire time = 50us



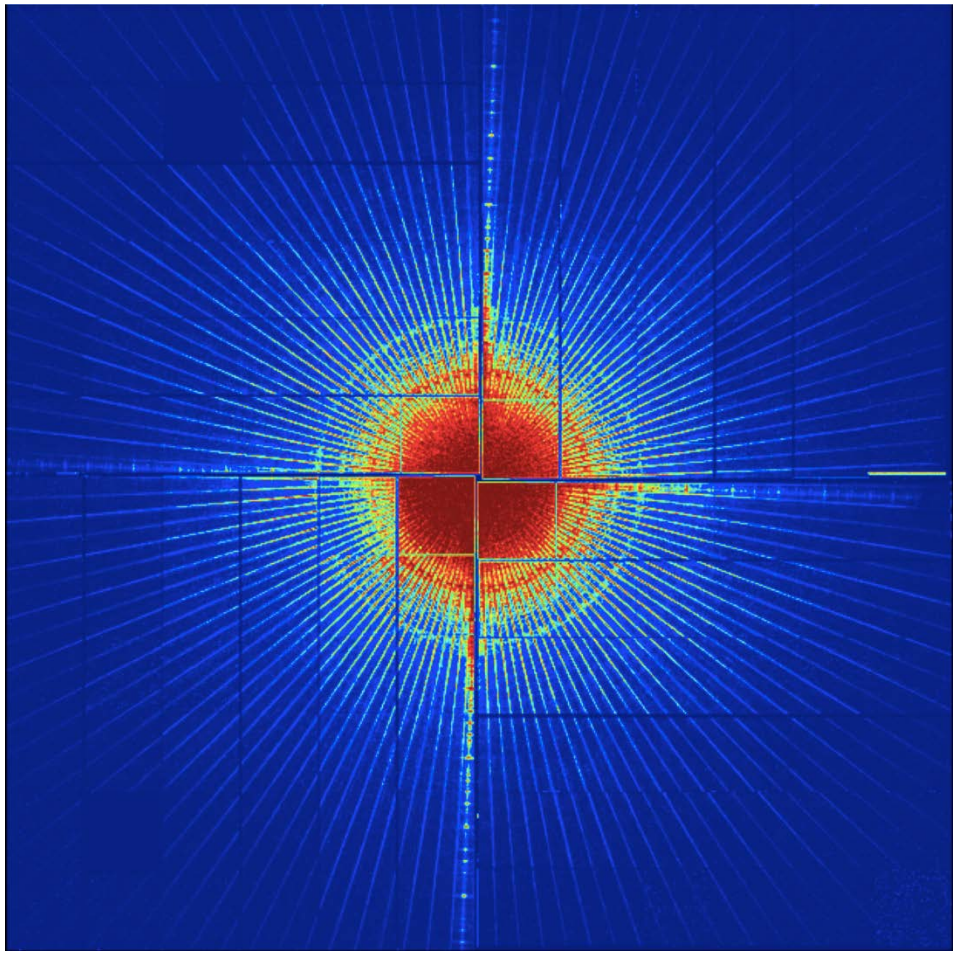
Detector current status

First PIMEGA 540D Si delivered

Electronic board Stencil Radiography in the CATERETÊ Beamline



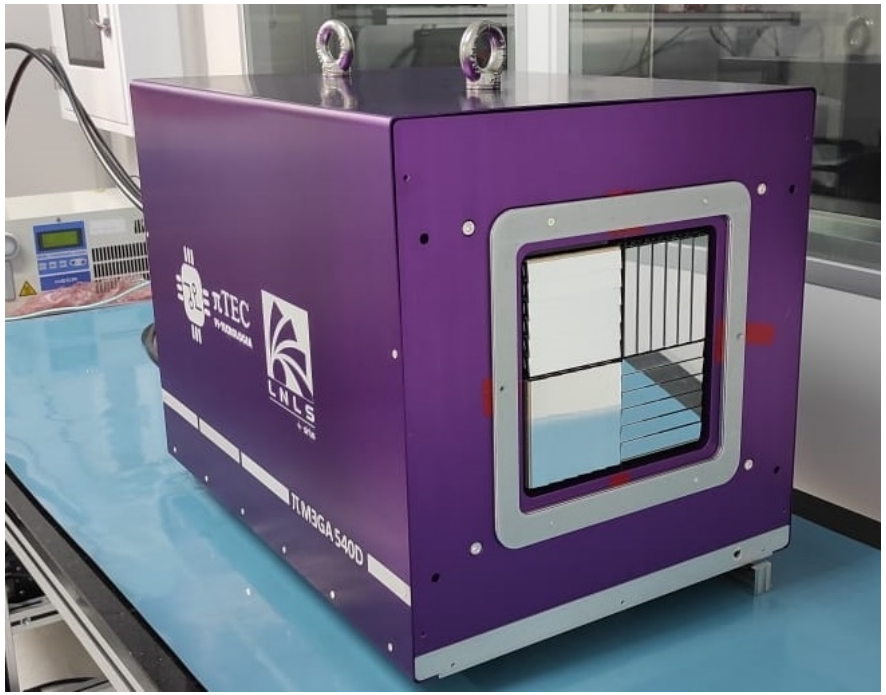
Cateretê (**C**oherent **A**nd **T**im**E** **RE**solved scat**TE**ring)
Experiment goal: alignment purposes Setup: Distance: 12000 mm; Diffraction Patterr
Credits: Aline Passos, Eduardo Miqueles, Florian Meneau, Jean Polli, Carla Polo



Detector current status

Second PIMEGA 540D Si under testing

Assembling PIMEGA 540D #2 detector for SAPUCAIA beamline



PIMEGA 540D #2 mounted for SAPUCAIA beamline

Detectors upcoming plan

PIM3GA Project – Delivery Plan for Next Detectors

	PIMEGA Model	SIRIUS BeamLines	Sensor Thickness (µm)	2021				
				Apr	May	Sep	Oct	Dez
1	PIMEGA 540D	Ema	Si 675	1				
2	PIMEGA 135D	Carnaúba	Si 300		1	1		
3	MOBIPIX 15D	Carnaúba	Si 300		3			
1	PIMEGA 450D	Ema	Si 675				1	
1	PIMEGA 450D	Paineira	Si 675				1	
1	PIMEGA 540D	Manacá	Si 300					1

Detectors long-term expectations

The ideal detector

Should have:

- 10^9 pixels
- 1um spatial resolution
- 1eV energy resolution
- 1 fs time resolution
- count rates up to 10^9 / pixel
- Efficient from 100eV out to 100keV
- ~~And it should be free!~~

Shamelessly stolen from Peter Siddons

Cornell University
Physics Department & CHESS

Detector Capabilities XDL-2011

Source: X-ray Detectors: State-of-the-art & Future Possibilities. Sol M. Gruner. Physics Dept. & Cornell High Energy Synchrotron Source (CHESS)

About Hybrid imaging detectors for SIRUS synchrotron:

Well, nowadays it is possible with the same Frame rate (2000 fps) but conflicts with last desire.

Microelectronics needs to be smaller.

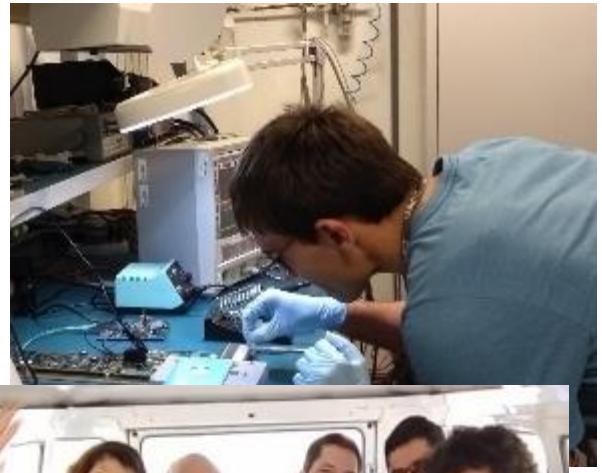
New sensors materials and microelectronics improvements.

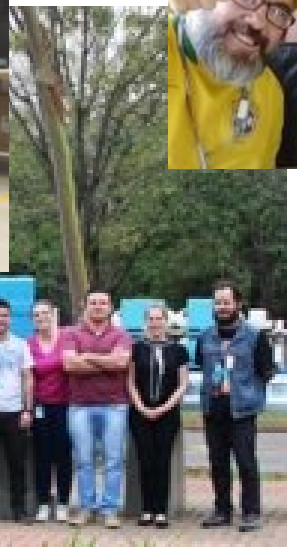
We reach us with larger areas as you want (or can pay).

Dynamic range needs improvements in sensors and analog circuits.

New sensors materials to cover larger energy ranges.

Thanks for invitation and to everyone worked in this project!





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Acknowledgment

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