

XRO - X-Ray Observatories

Richiesta servizi 2026

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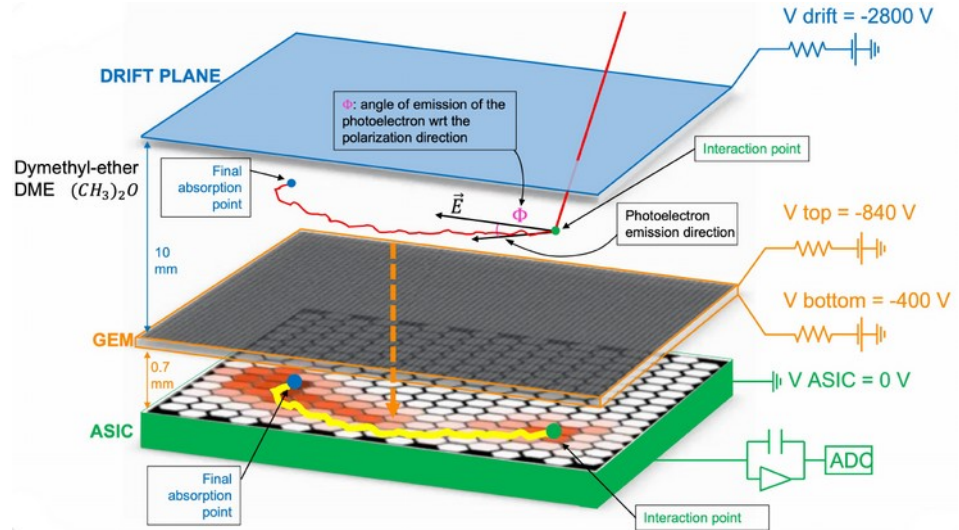
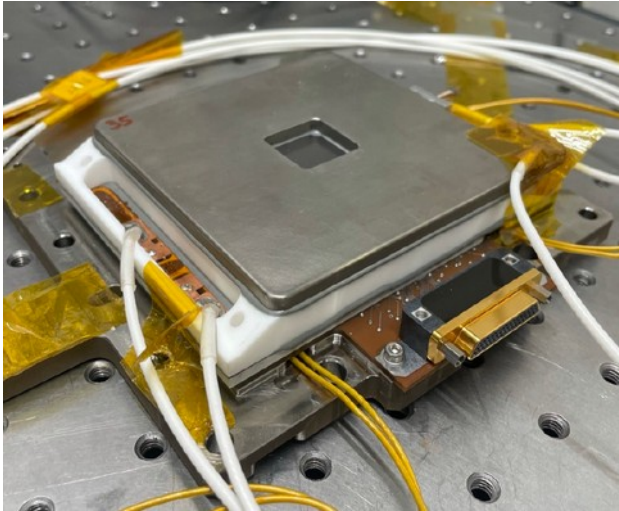
X-Ray Observatories:

XRO in CSN2

GPD detectors for x-ray polarimetry

SDD detector for timing / imaging

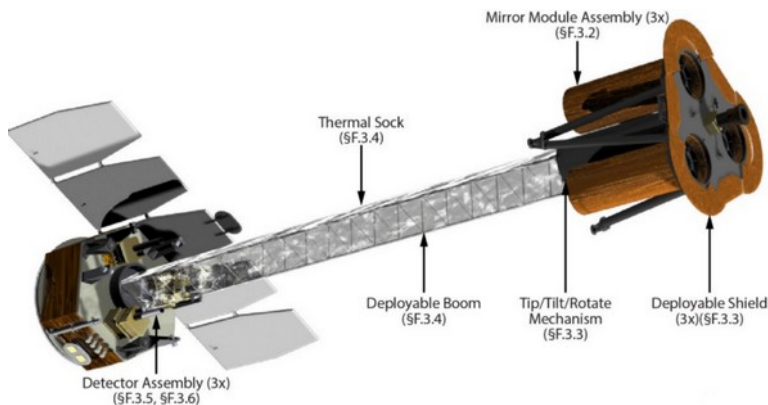
GPD: Gas Pixel Detector



3 GPD are currently flying on the IXPE mission

IXPE: Imaging X-ray Polarimetry Explorer

NASA smex mission

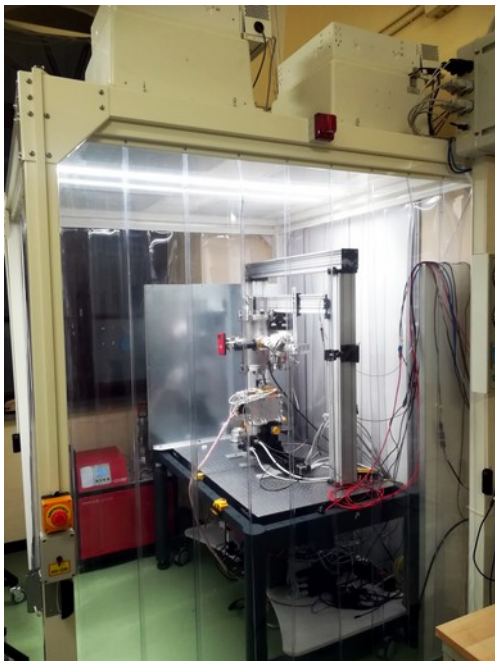


X-ray polarimetry in the band 2-8 keV

- December 9, 2021: launched on December 9, 2021
- After the first 2 years of operations, extended to September 2025 with a General Observer program most of observing time dedicated to external proposals
- Will be evaluated at the next NASA Senior Review of Operating Missions, for extension beyond that date.
- ~120 source observed so far
- Significant polarization detected for ~half of them
- New ASI/INFN contract to support IXPE mission for the next three

XCF: X-rays Calibration Facility @Torino

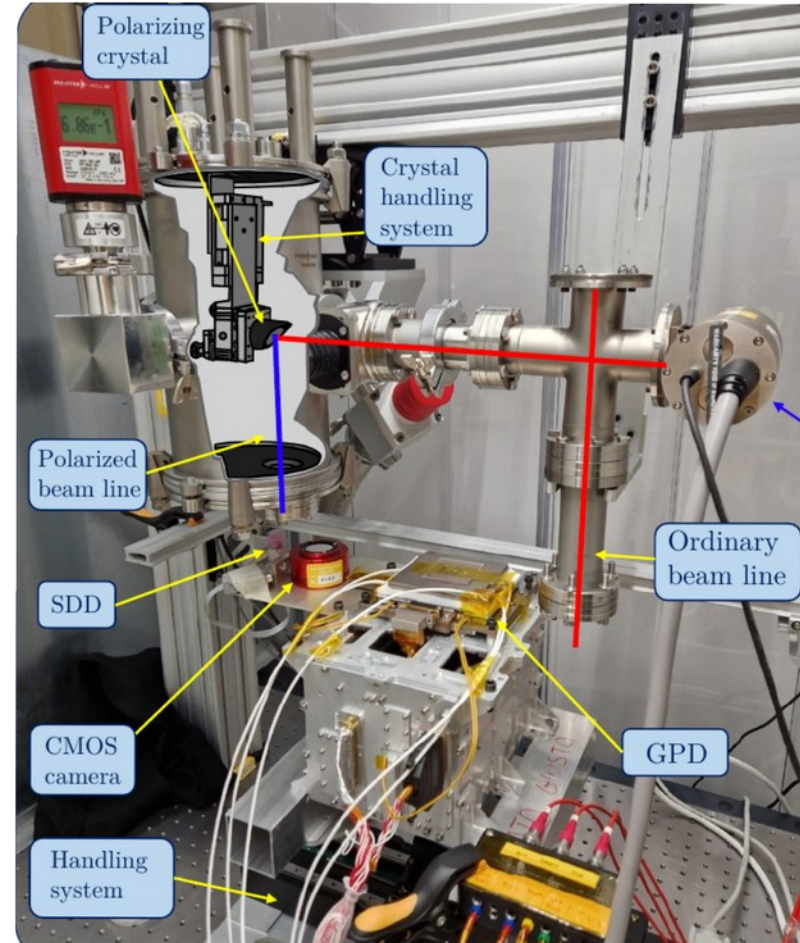
Irradiation setup in Torino, to test, characterize and qualify X-ray sensors (1-10 keV range)



- Long term studies of the IXPE GPDs on the ground
(we have 4 control GPDs, identical to the flight ones)
- Characterization/calibration of:
 - new generations of Gas Pixel Detector
 - innovative X-ray sensors (SPACEITUP. ASIX)

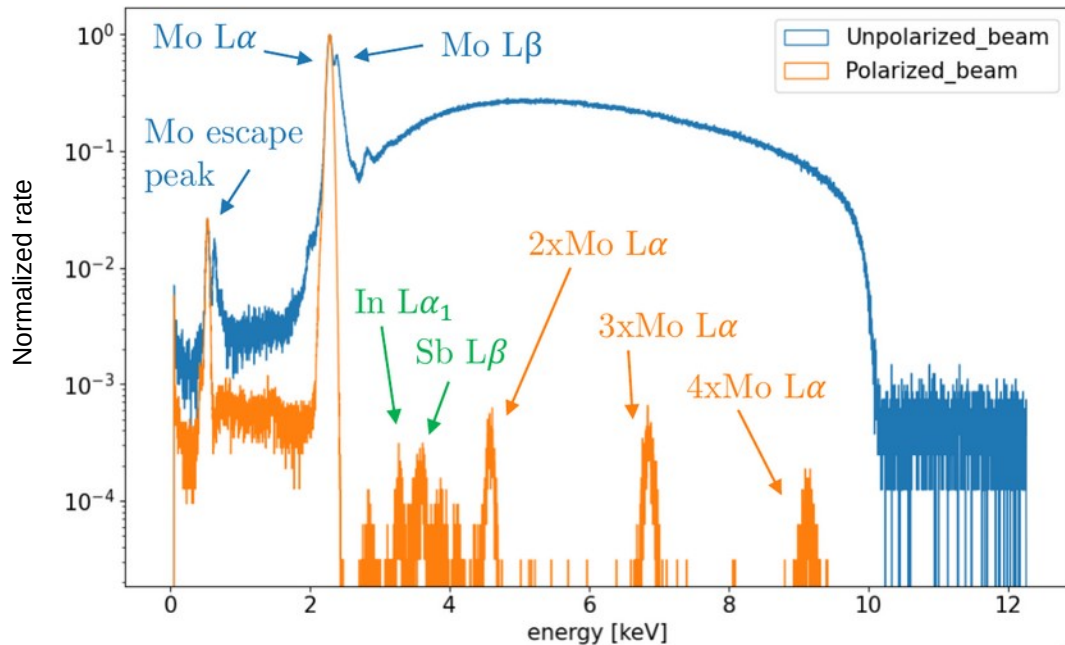
XCF: Main Characteristics

- Two X-ray tubes:
 - McPherson Multi-anode source
 - **MXR single anode (Mo)**
- ^{55}Fe source (37MBq)
- two output beams: one beam polarized by Bragg diffraction @~45deg
- Positioning stages to control the position of polarizer crystal and items under test
- Source and polarizer cylinder in vacuum ($\sim 10^{-6}$ hPa)

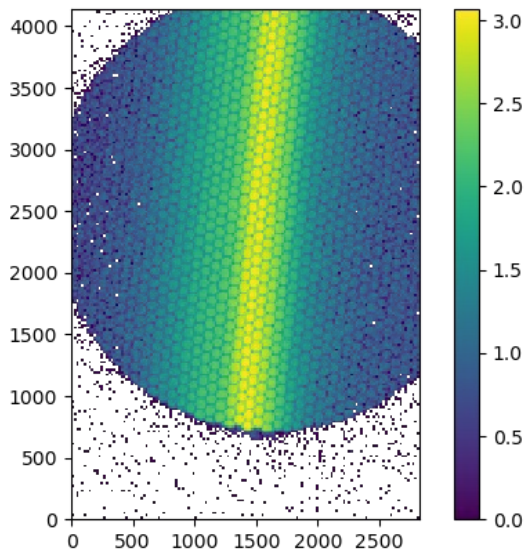


XCF: example of pol./unpolarized beams (Mo anode, InSb111 xtal)

Energy spectra

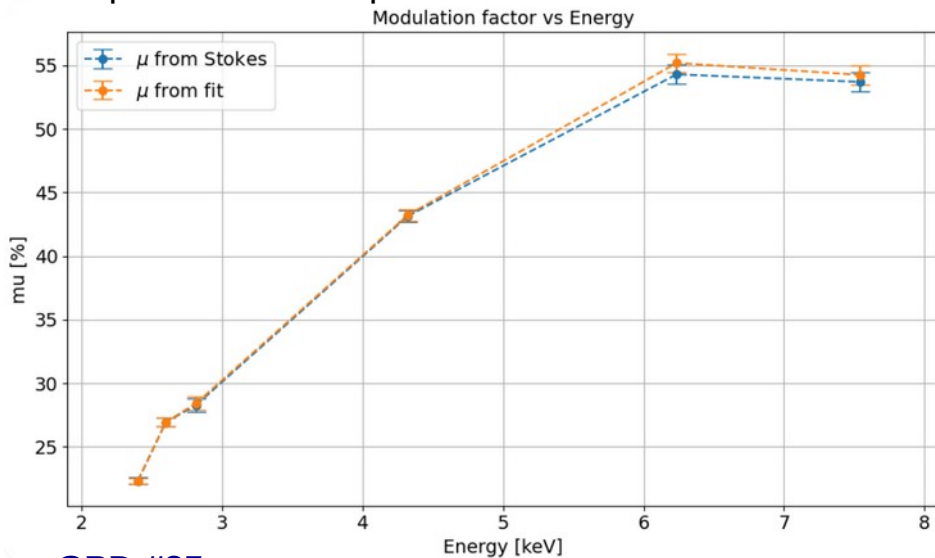


Polarized beam image



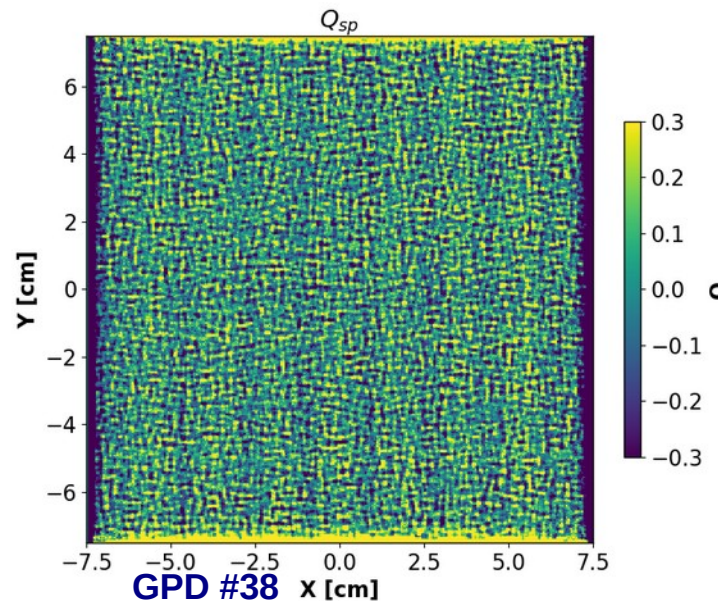
XCF: polarization measurement

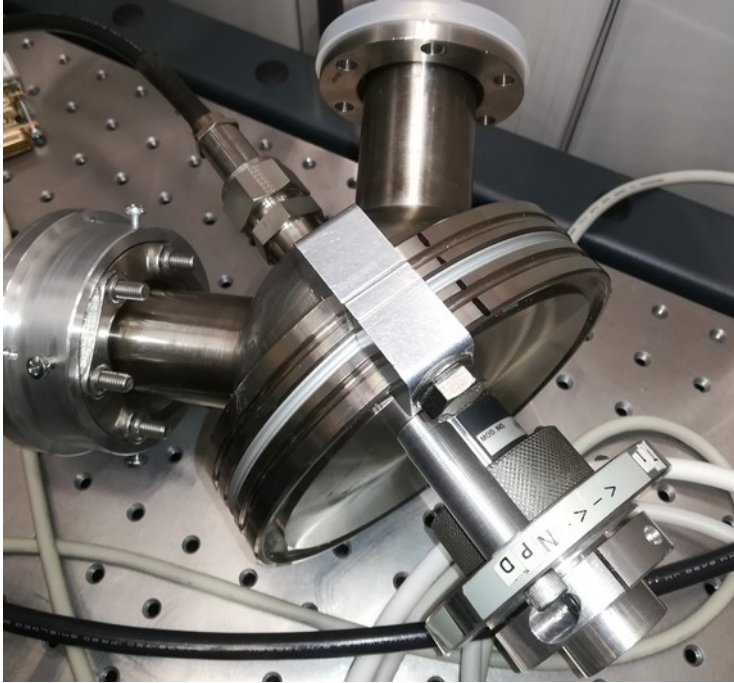
Modulation factor:
response to 100% polarized beam



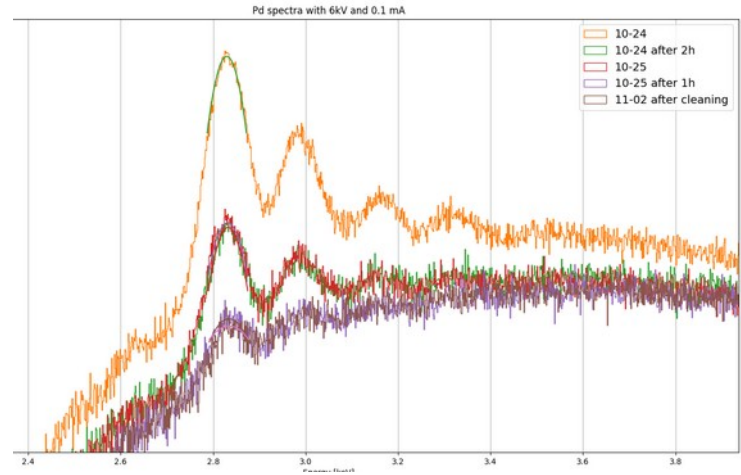
GPD #35

Spurious modulation:
response to un-polarized beam





Multi-anode x-rays source



- Anodes characteristic lines fading away
- need to improve the vacuum level reached

- **Progettazione Meccanica** – (3 mesi/persona)
 - Upgrade del sistema di vuoto, in particolare per il tubo radiogeno McPherson
 - eventuale disegno fornitura tramite officine (interna o esterna) di parti di meccaniche per interfaccia tra i rivelatori e i fasci di test

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 - Non chiediamo tempo al Laboratorio di elettronica, ma potremmo aver bisogno di qualche piccolo aiuto (saldature etc)



XCF: X-rays beams monitors

- Amptec fast SDD

25 mm² active area

Resolution of 122 eV FWHM at 5.9 keV ~2%

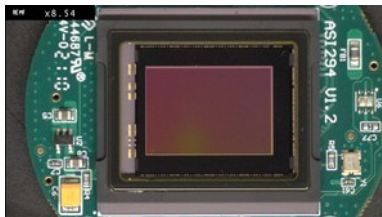
Count rates > 1,000,000 CPS

Windows: Be 12.5 μm



- Modified* optical sensor (sony IMX294)

*glass cover removed

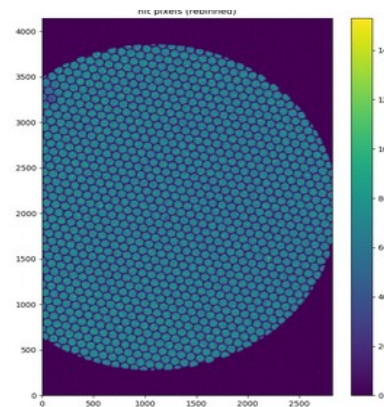
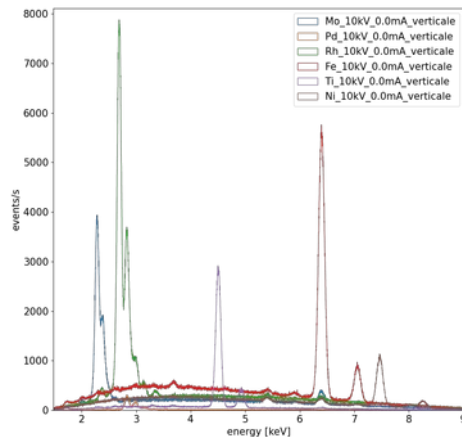


4144x2822 pixels (4.63 μm)

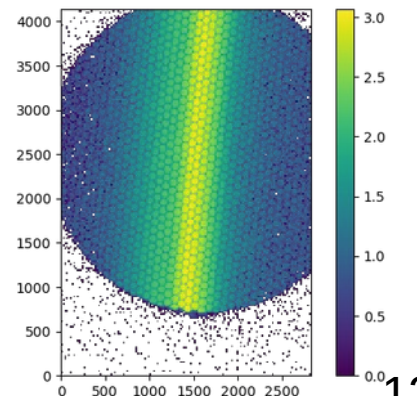
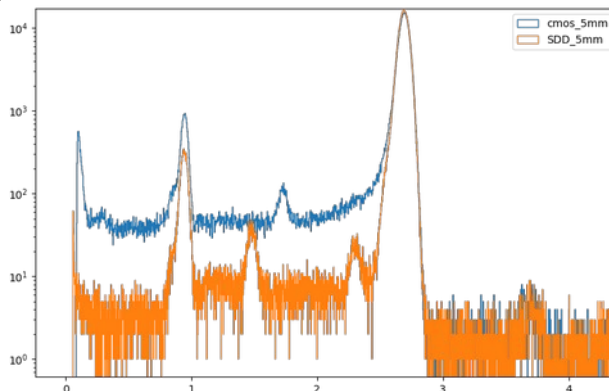
Energy resolution (FWHM) ~2.2% @6keV

Efficiency ~10% @6keV w.r.t SDD

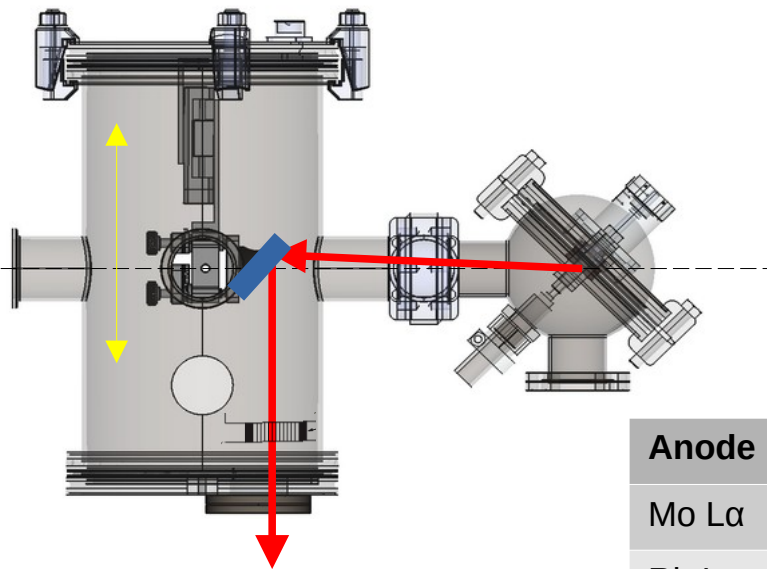
Unpolazided beam



Polazided beam Rh (2.7KeV - Ge111)



XCF: Polarized beam



Emission lines and crystals chosen in order to have:
 $\theta_{\text{Bragg}} \sim 45^\circ$

Polarization by Bragg diffraction at 45°

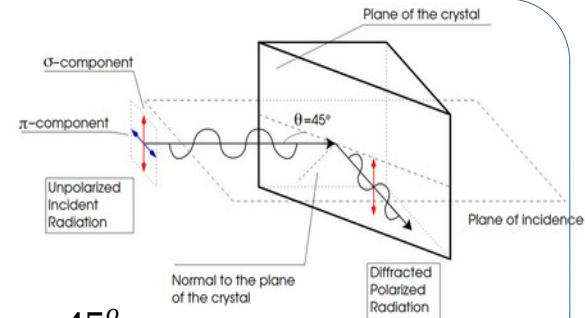
$$\sin(\theta_{\text{Bragg}}) = \frac{nhc}{2dE}$$

Polarization degree:

$$P = \frac{1 - k}{1 + k}$$

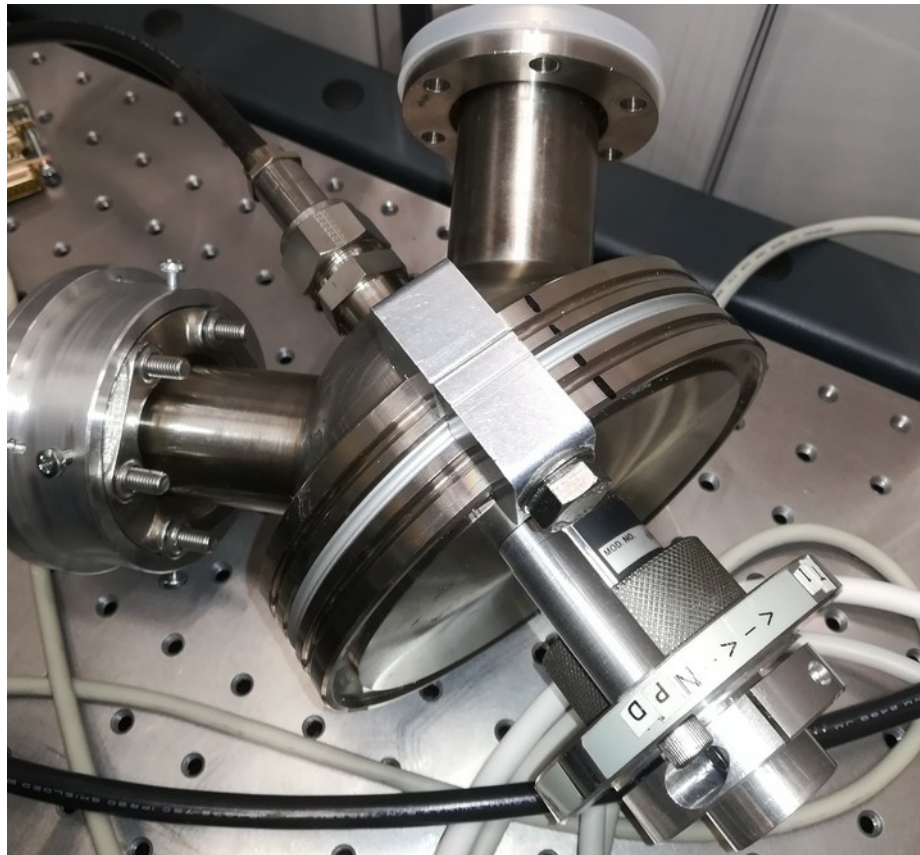
With:

$$k = \frac{R^\pi}{R^\sigma} \approx 0 \quad \text{for} \quad \theta_{\text{Bragg}} \approx 45^\circ$$



Anode line	E [KeV]	Xtal	2d (Å)	θ_{Bragg}	P
Mo $L\alpha$	2.2932	InSb111	7.481	46.28	99.32%
Rh $L\alpha$	2.697	Ge111	6.532	44.87	99.28%
Pd $L\alpha$	2.839	Si111	6.271	44.12	>95.08%
Ti $K\alpha$	4.511	Si 220	3.840	45.71	99.51%
Fe $K\alpha$	6.404	Si 400	2.7142	45.5	99.7% (from MC)
Ni $K\alpha$	7.478	Ge 422	2.31	45.86	99.04%

McPherson 642-1



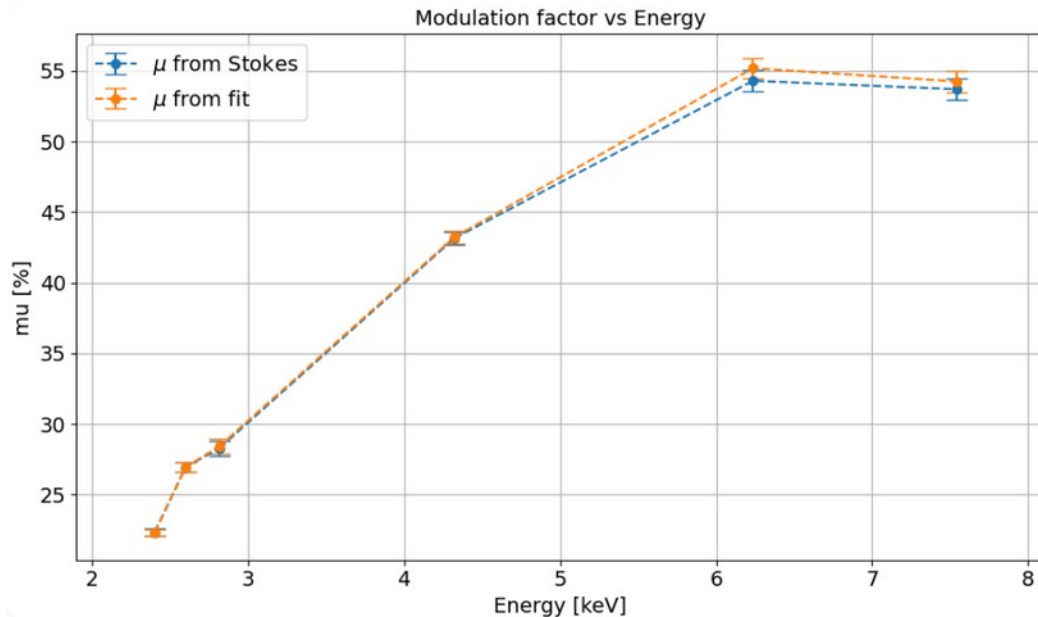
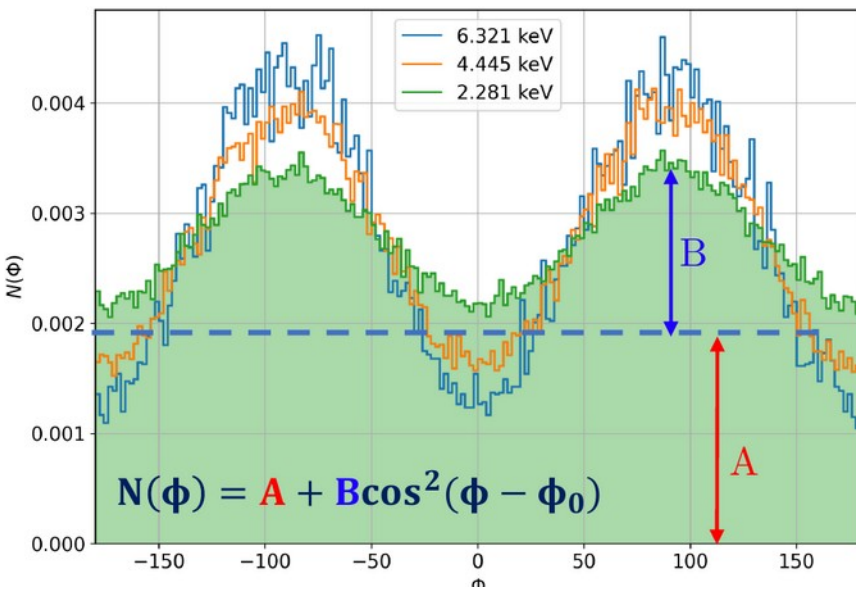
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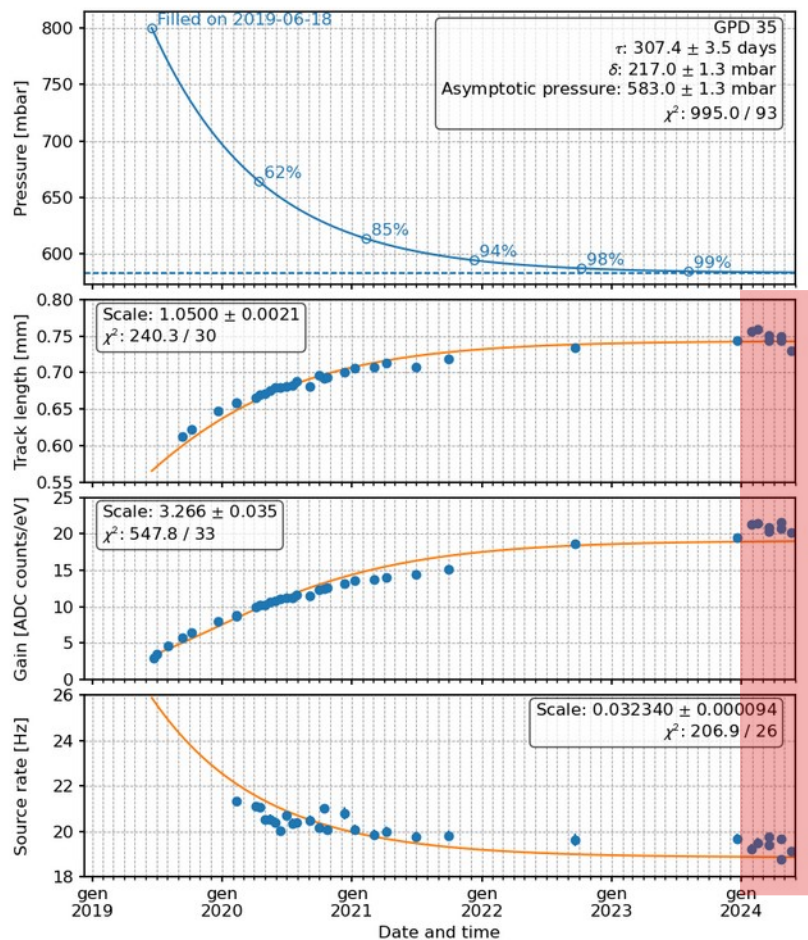


XCF: polarization measurement

GPD #35



XCF: GPD long term monitoring



Periodic measurements with ^{55}Fe source

- track length
- detector gain
- events rate

to monitor the detectors performances
and infer the pressure of the gas

**Periodic measurements
@Torino**