

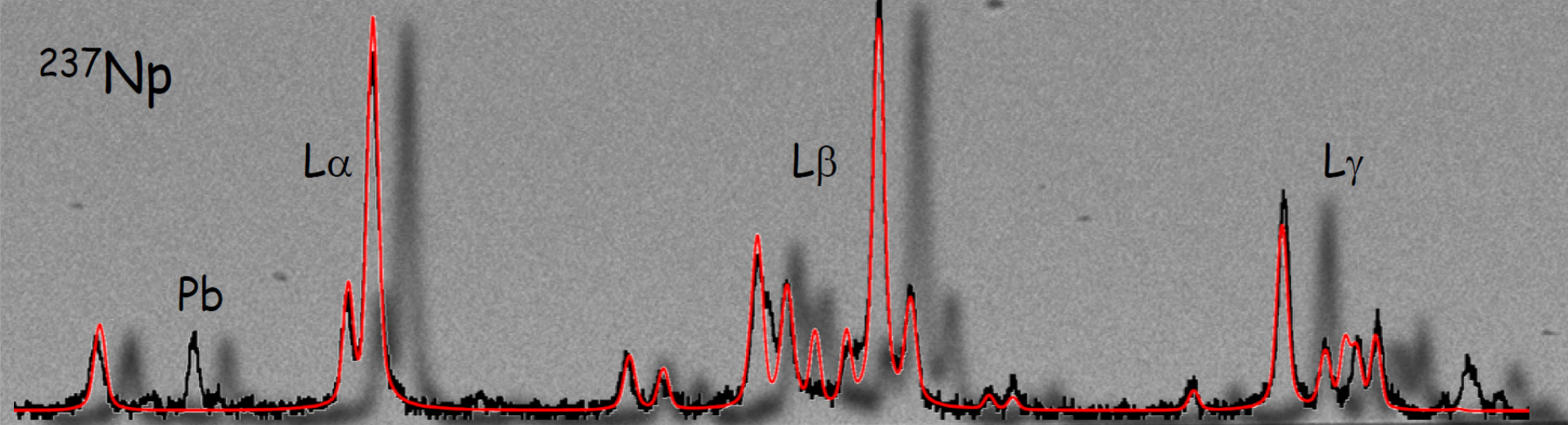
$^{237}\text{Np}$

$L\alpha$

$L\beta$

$L\gamma$

Pb



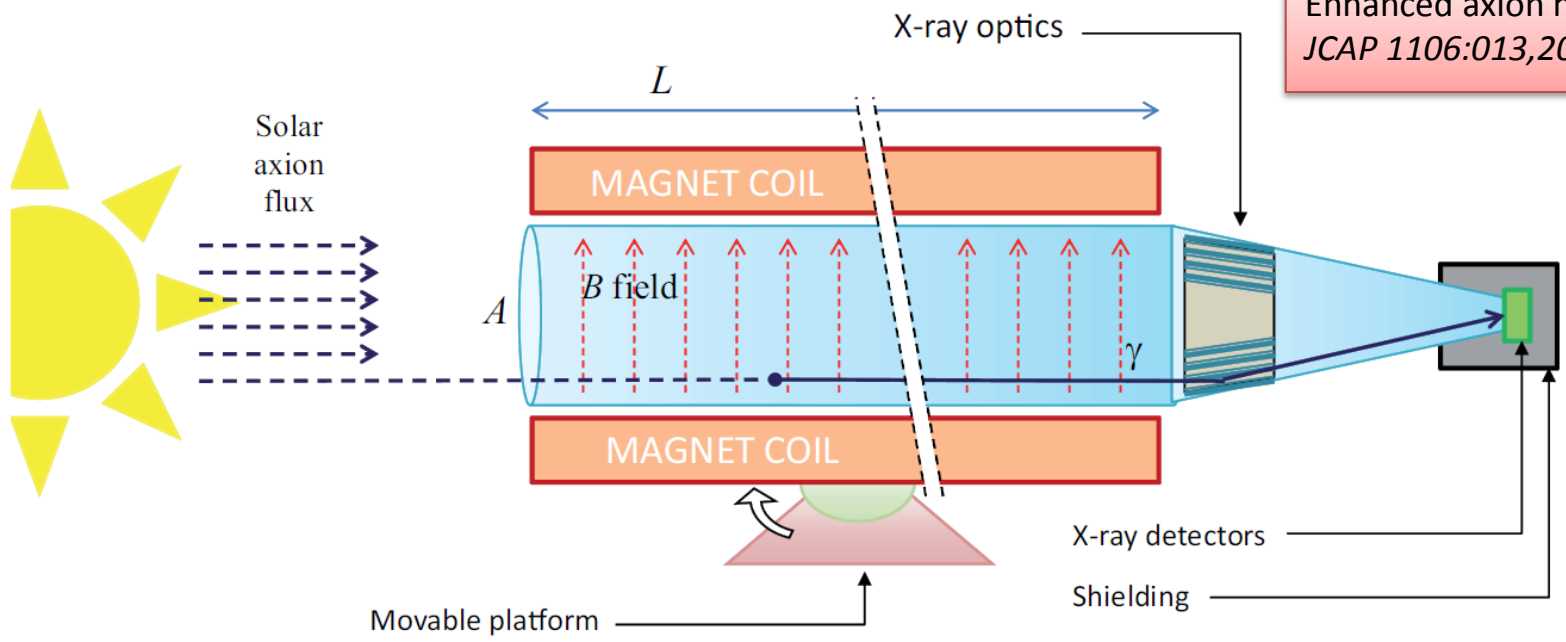
**High energy resolution metallic magnetic calorimeters  
for the IAXO experiment**

Loredana Gastaldo

Kirchhoff-Institute for Physics, Heidelberg University

# Detector requirements for IAXO

Enhanced axion helioscope:  
JCAP 1106:013,2011

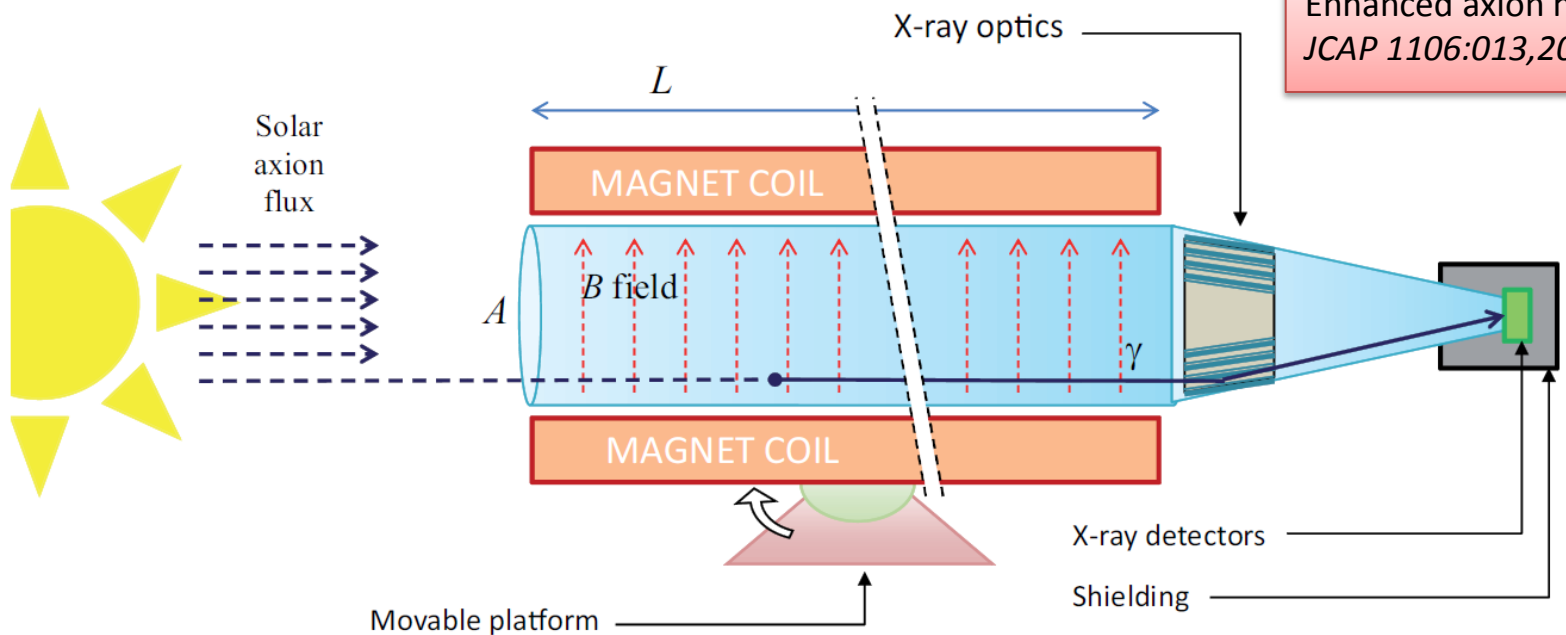


$$g_{a\gamma}^4 \propto \underbrace{b^{1/2} \epsilon^{-1}}_{\text{detectors}} \times \underbrace{a^{1/2} \epsilon_o^{-1}}_{\text{optics}} \times \underbrace{(BL)^{-2} A^{-1}}_{\text{magnet}} \times \underbrace{t^{-1/2}}_{\text{exposure}}$$

high efficiency + low background

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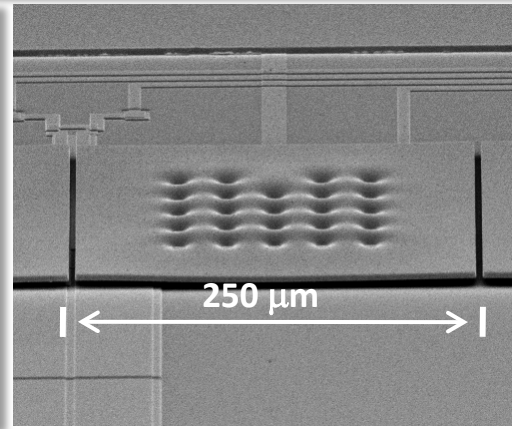
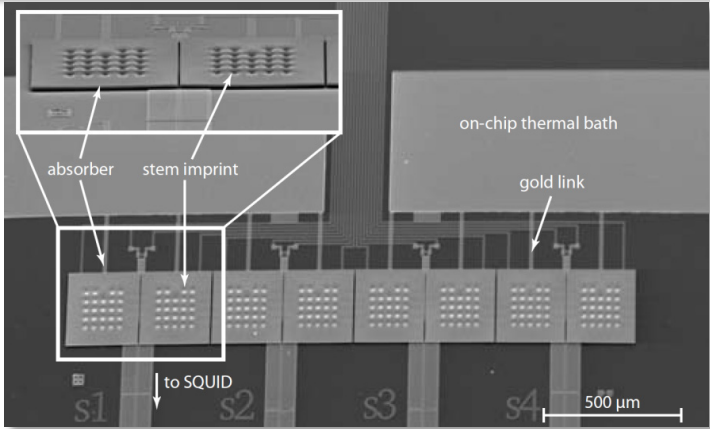
high efficiency + low background  
but also

position sensitivity and energy resolution

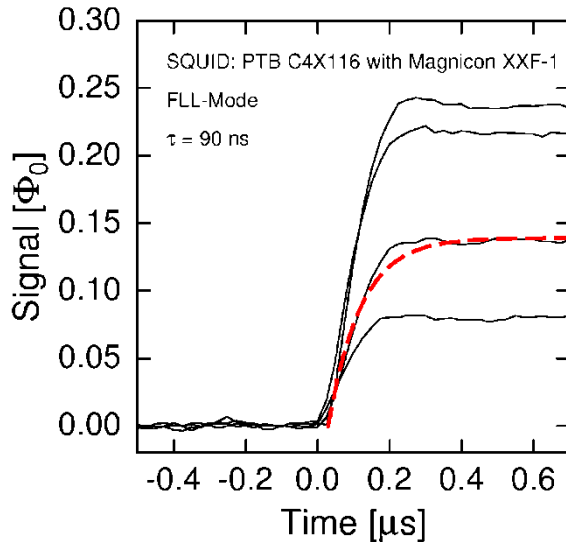
# MMC for soft x-ray spectroscopy

A. Fleischmann, C. Enss and G. M. Seidel,  
Topics in Applied Physics 99 (2005) 63

$$\Delta E_{FWHM} = 1.6 \text{ eV @ } 6 \text{ keV}$$

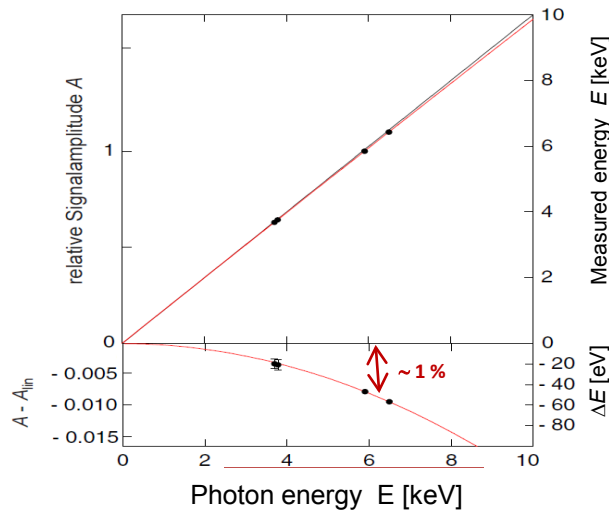


**Rise Time: 90 ns**

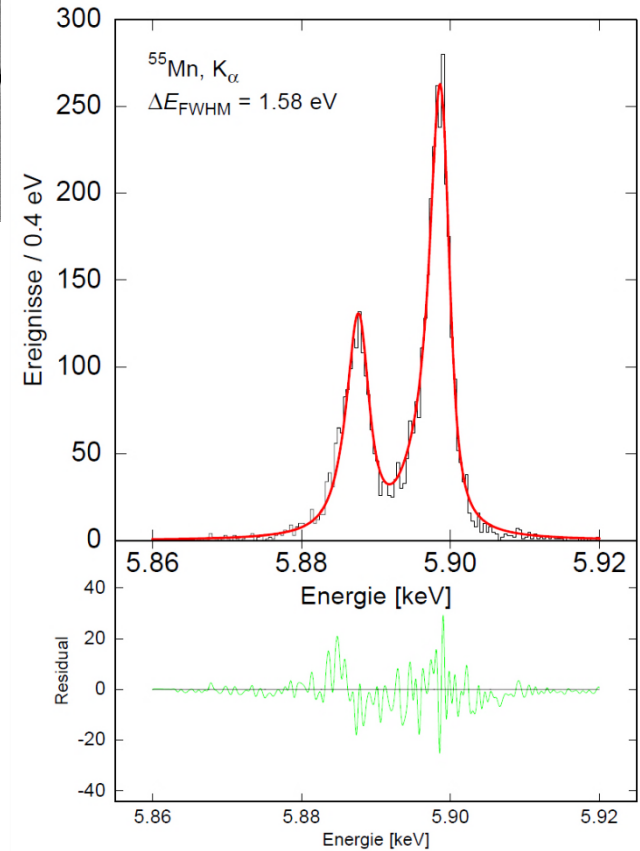


**Reduction  
un-resolved pile-up**

**Non-Linearity < 1% @6keV**

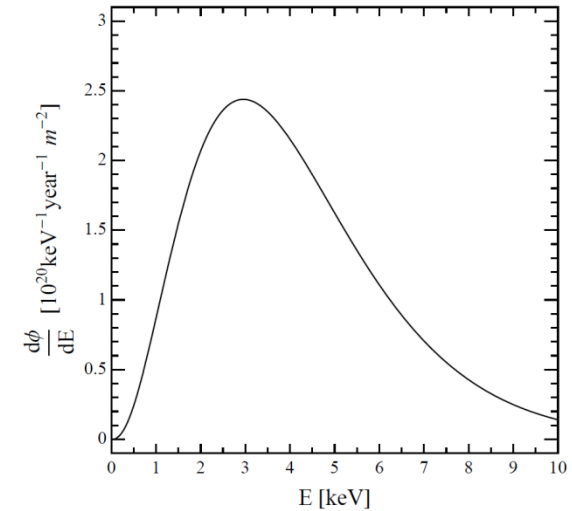
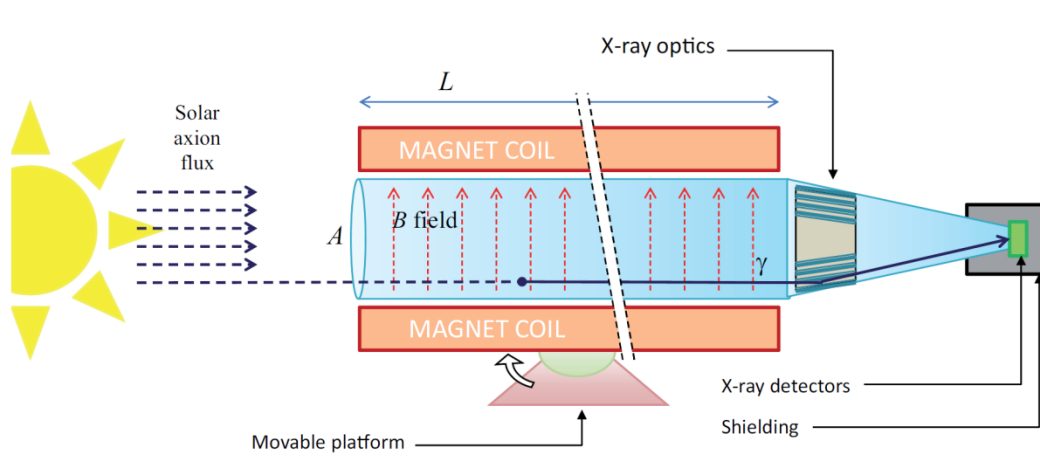


**Definition  
of the energy scale**



**Identification of fine  
structures**

# MMCs @ IAXO



## - Detector requirements

- Low rate
- High QE
- Low dark count rate
- Threshold energy

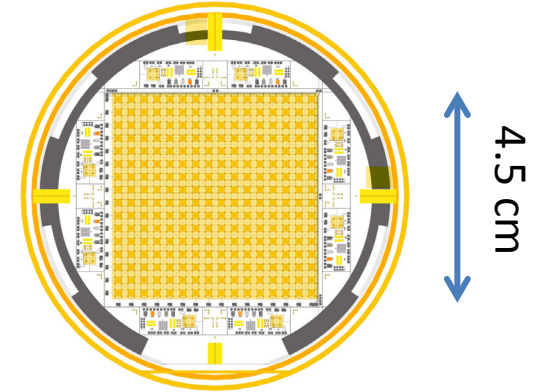
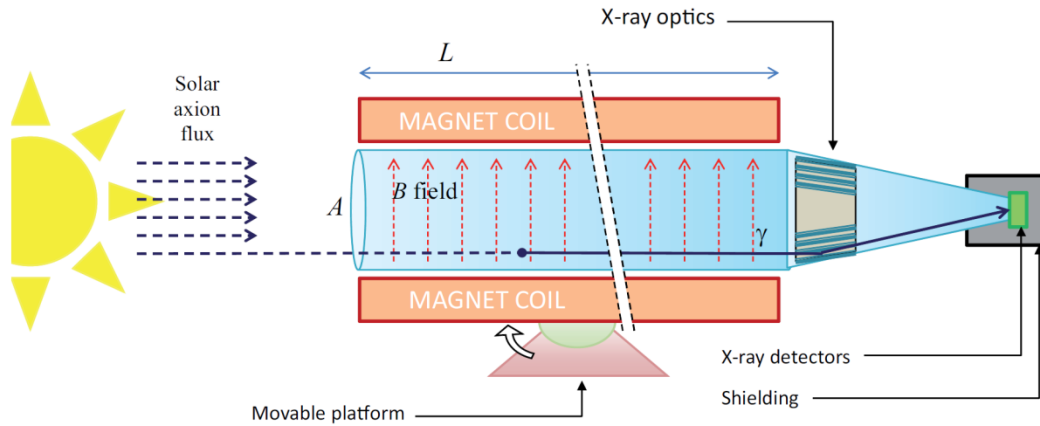
OK for MMC

OK for MMC

Ok for MMC

OK for MMC

# MMCs @ IAXO

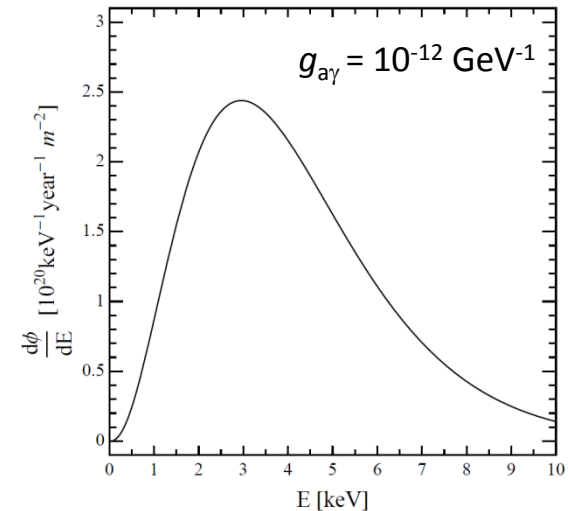


MOCCA-like detector:

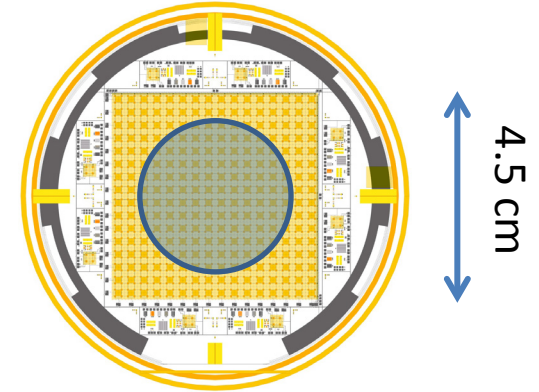
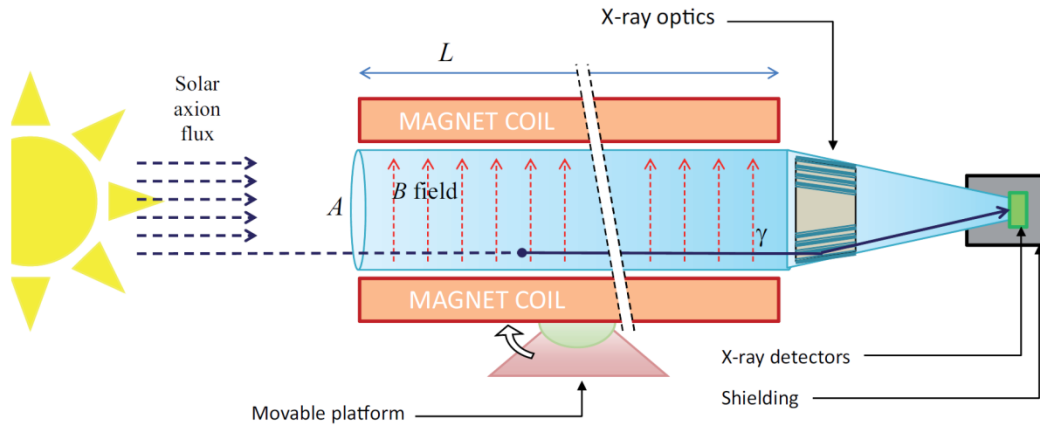
- 32 readout channel
- $\Delta E_{FWHM} \sim 200 \text{ eV}$
- $4.5 \times 4.5 \text{ cm}^2$
- 4096 pixels  $\rightarrow$  700  $\mu\text{m}$  position resolution

Possibility to be coupled to one of **the 8 ports**

- About same performance of Micromegas but **different systematics**



# MMCs @ IAXO

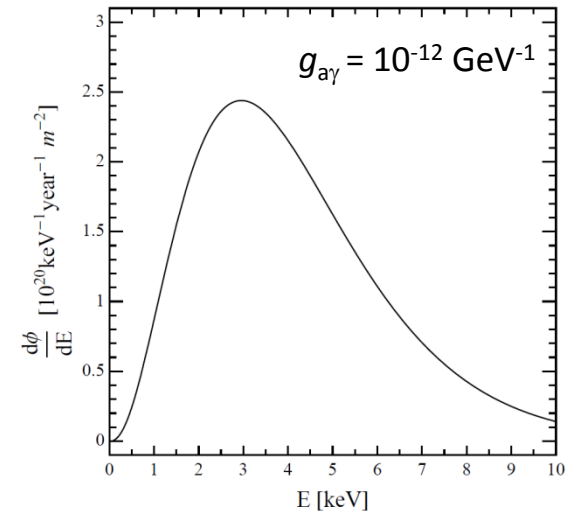


MOCCA-like detector:

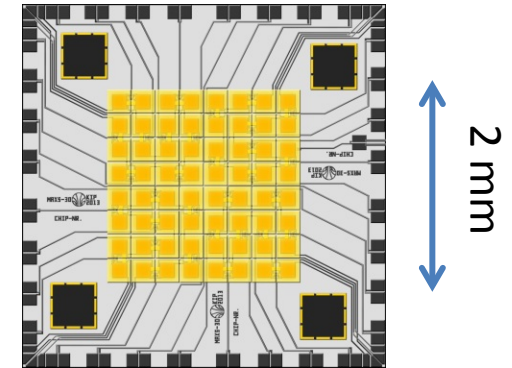
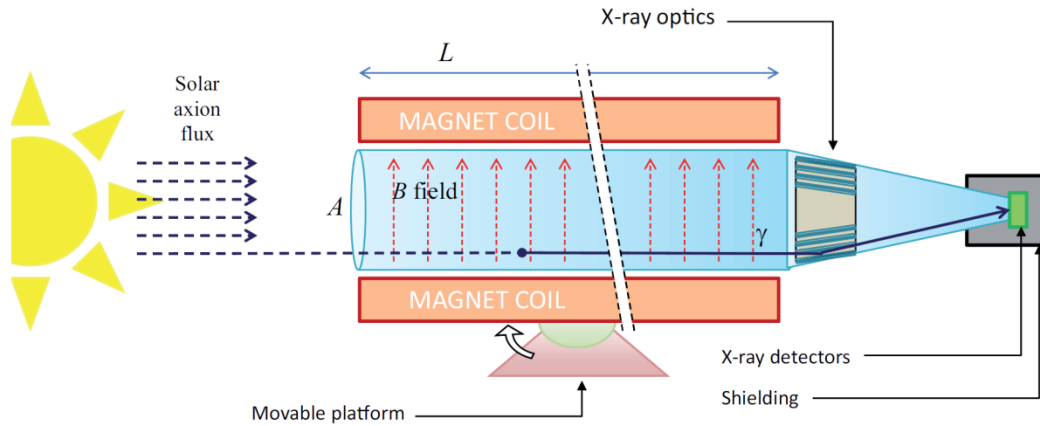
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Possibility to be coupled to **one of the 8 ports**

- About same performance of Micromegas but **different systematics**
- Detection area larger than focused spot  $\rightarrow$  **in-situ background measurements**



# MMCs @ IAXO



maXs-20 detector:

- 32 readout channel
- $\Delta E_{FWHM} = 2 \text{ eV}$
- $2 \times 2 \text{ mm}^2$
- 64 pixels

Allow to investigate fine structures in the spectrum originating from processes involving electrons, bremsstrahlung, Compton and axio-recombination

