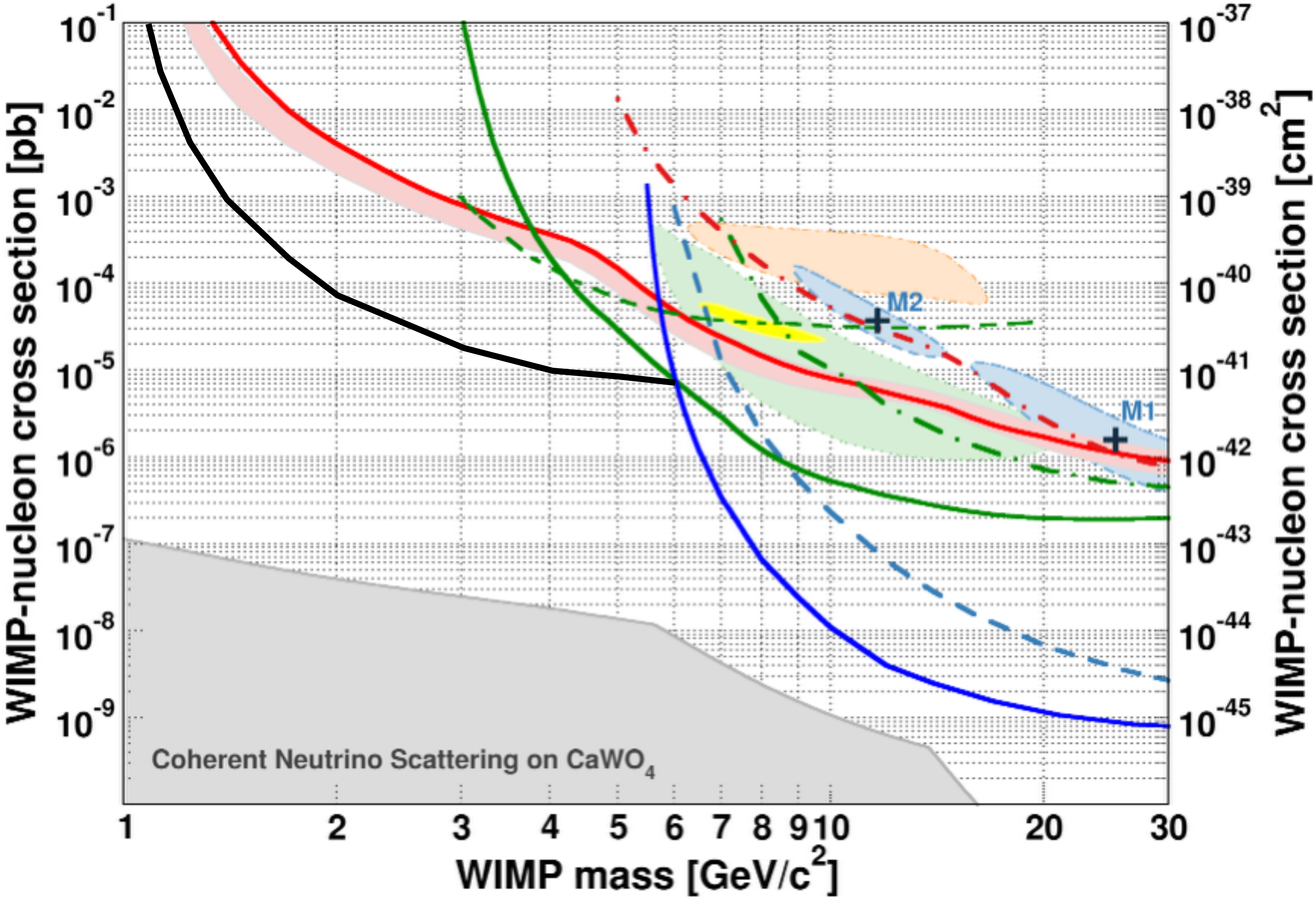
DM @ LPNHE



CRESST-II 2014 (solid red). CRESST 2 light blue. The dash-dotted red line refers to the reanalyzed data from the CRESST commissioning run [22]. In green : SuperCDMS (solid)[7], CDMSlite (dashed) [23] and EDELWEISS (dashdotted) [24]. The parameter space favored by CDMS-Si [4] is shown in light green (90% C.L.), the one favored by CoGeNT (99% C.L. [2]) and DAMA/ Libra (3 C.L. [25]) in yellow and orange. The exclusion curves from liquid xenon experiments (90% C.L.) are drawn in blue, solid for LUX [6],dashed for XENON100 [5]. Black : Future DAMIC 100g after 1y.

Recherche de particules minces
(WISP)
(Axion Like Particles and PQ axions)

The Strong CP Problem

$$L_{\text{QCD}} = \;\ldots + \theta \frac{g^2}{32\pi^2} G^a{}_{\mu\nu}\, \tilde{G}^{a\mu\nu}$$

Because the strong interactions conserve P and CP, $\theta \leq 10^{-10}$.

The Standard Model does not provide a reason for θ to be so tiny,

but a relatively small modification of the model does provide a reason …

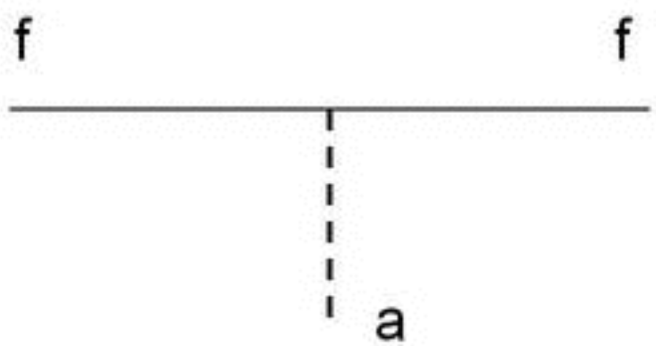
If a $U_{PQ}(1)$ symmetry is assumed,

$$L = \ldots + \frac{a}{f_a}\frac{g^2}{32\pi^2} G^a{}_{\mu\nu}\tilde{G}^{a\mu\nu} + \frac{1}{2}\partial_\mu a\,\partial^\mu a + \ldots$$

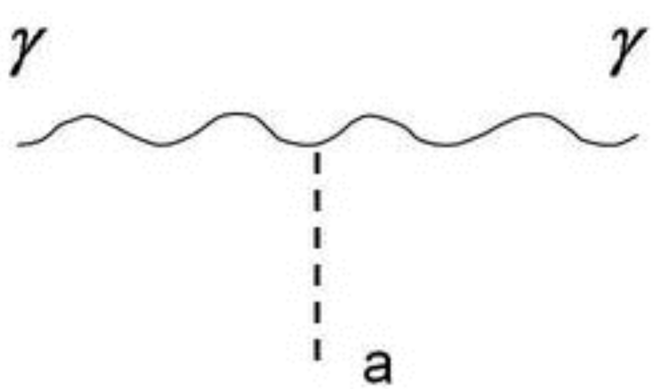
$\theta = \dfrac{a}{f_a}$ relaxes to zero,

and a light neutral pseudoscalar particle is predicted: the axion.

$$m_a \approx 6\ \mathrm{eV}\ \frac{10^6\ \mathrm{GeV}}{f_a}$$



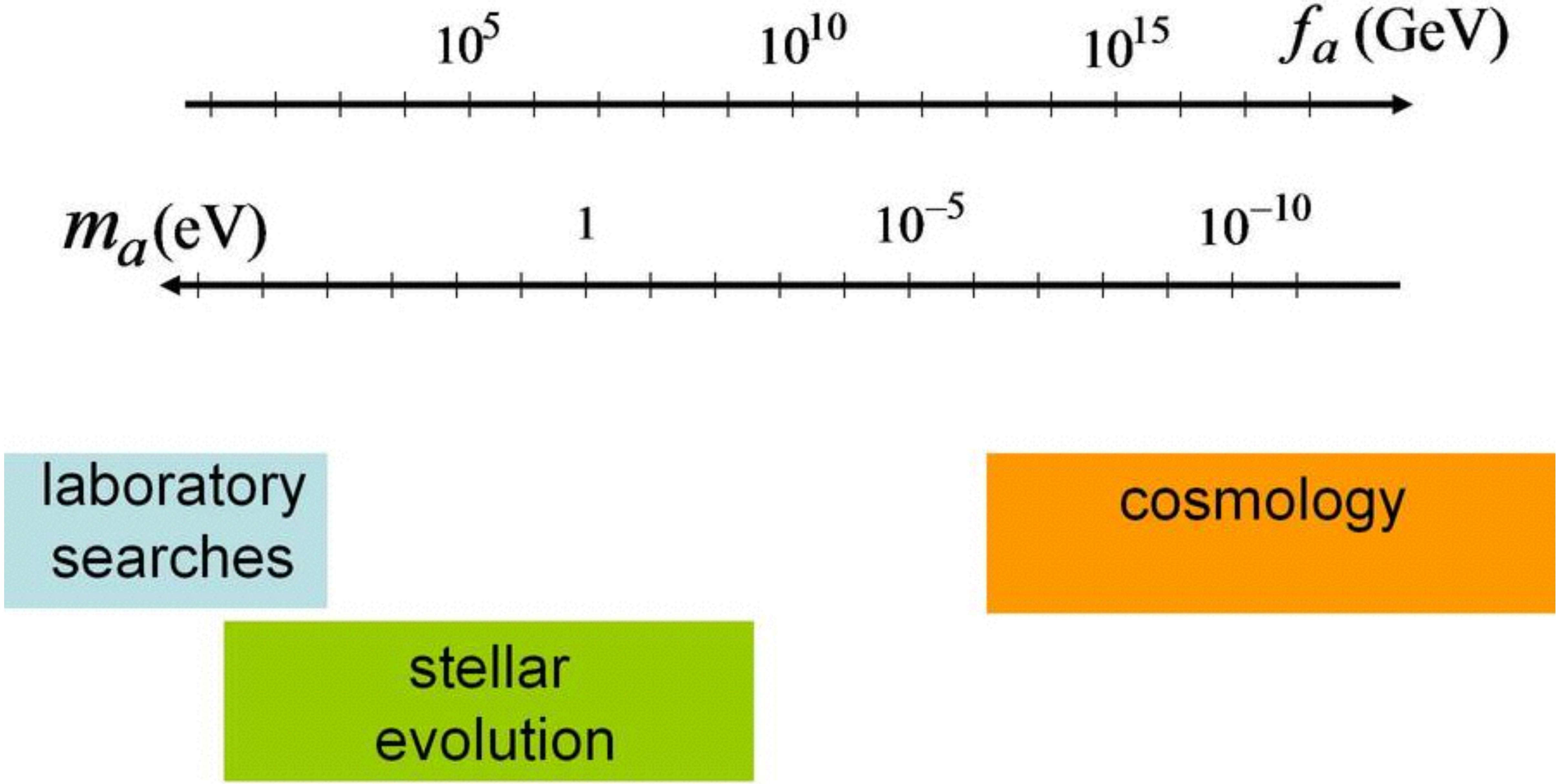
$$L_{a\bar{f}f} = i\, g_f \frac{a}{f_a} \bar{f} \gamma_5 f$$



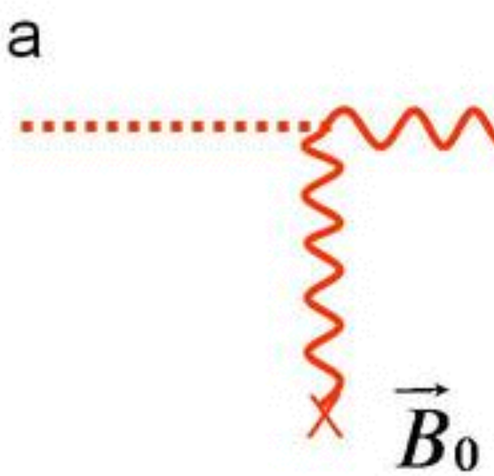
$$L_{a\gamma\gamma} = g_\gamma \frac{\alpha}{\pi} \frac{a}{f_a} \vec{E} \cdot \vec{B}$$

g_γ = 0.97 in KSVZ model
0.36 in DFSZ model

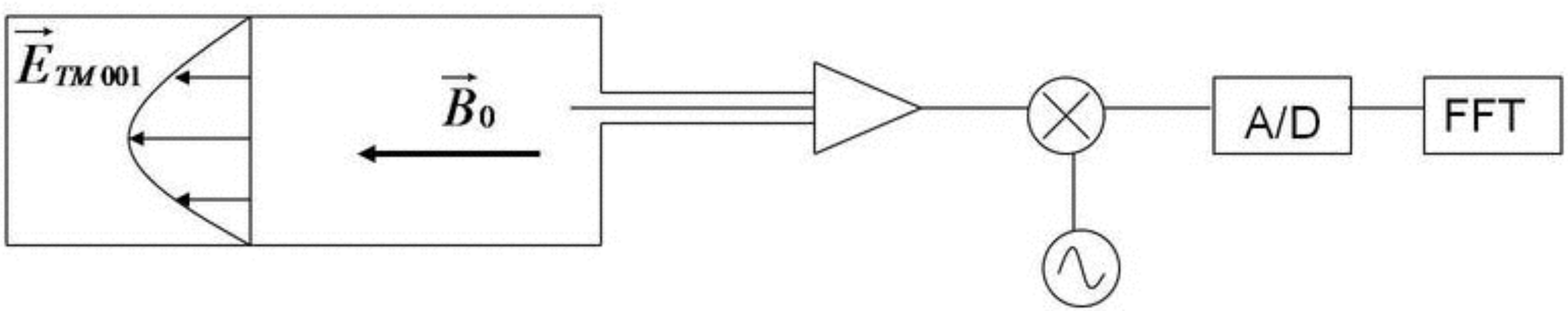
The remaining axion window

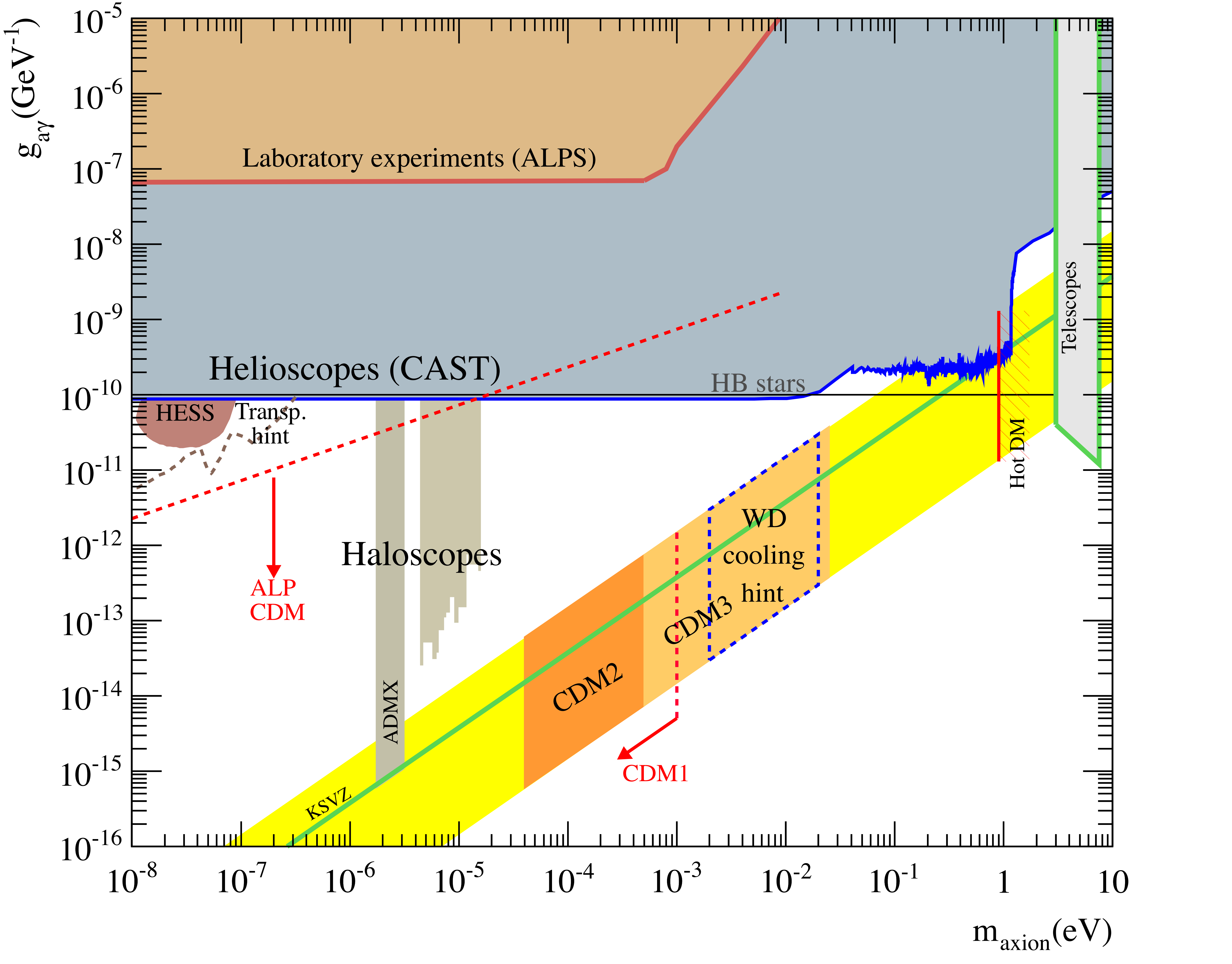


Axion dark matter is detectable



$$L_{a\gamma\gamma} = g_\gamma \frac{\alpha}{\pi} \frac{a}{f_a} \vec{E} \cdot \vec{B}$$

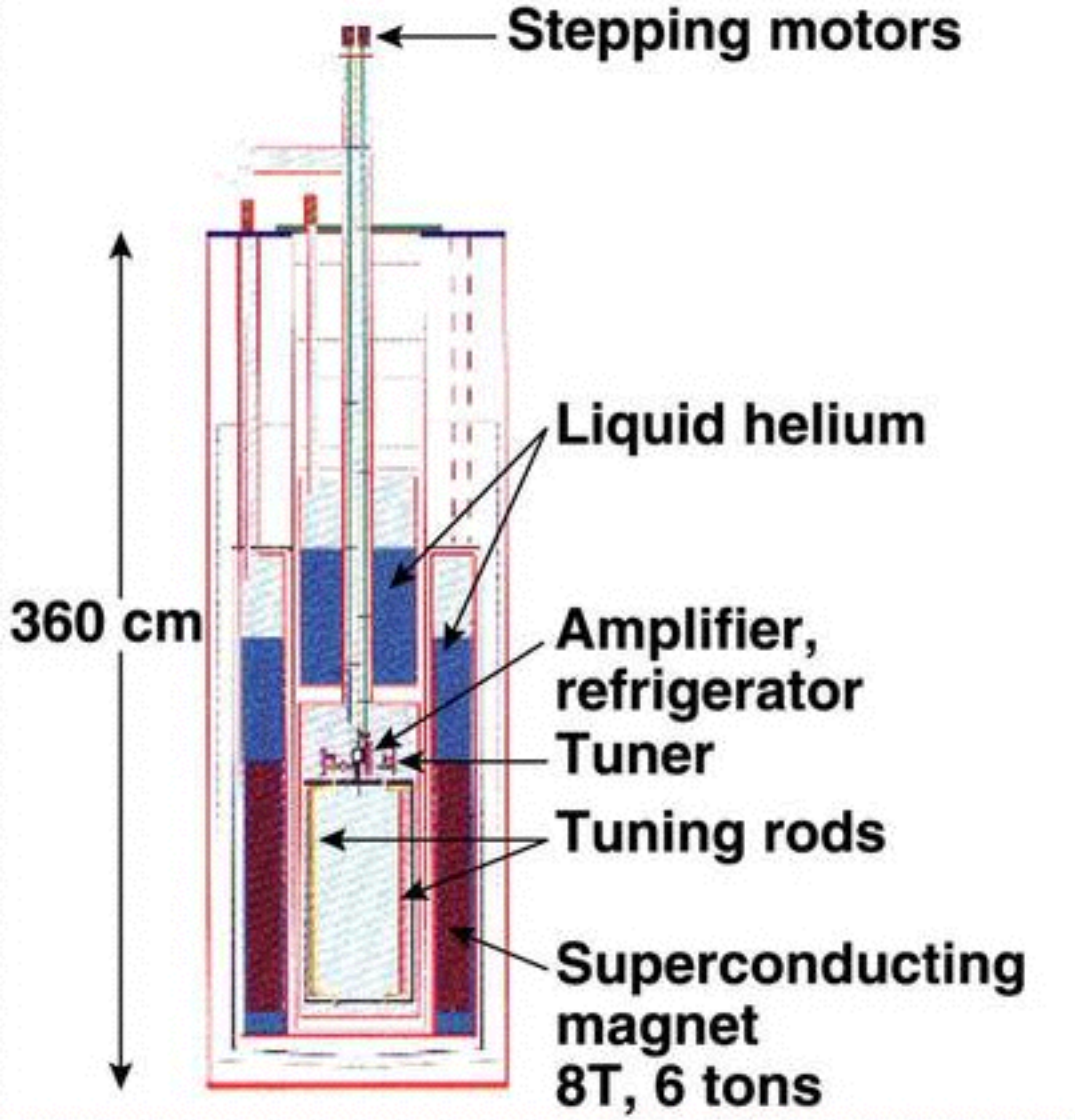




$g_{a\gamma}$(GeV^{-1})
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-16}
Laboratory experiments (ALPS)
Helioscopes (CAST)
HB stars
HESS
Transp. hint
ALP CDM
Haloscopes
ADMX
KSVZ
CDM2
CDM3
CDM1
WD cooling hint
Hot DM
Telescopes
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
m_{axion}(eV)

Axion Dark Matter eXperiment

Magnet with Insert (side view)



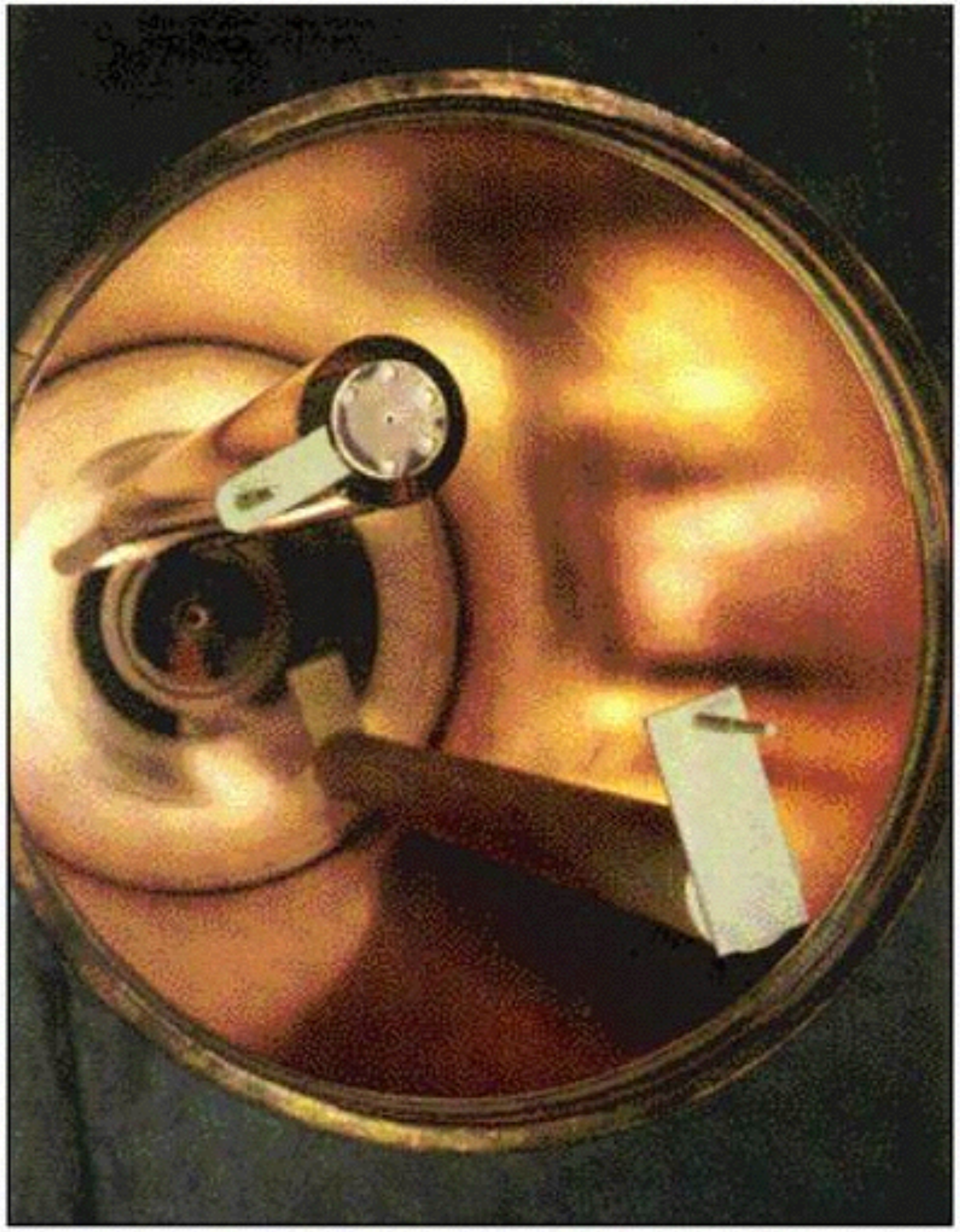
Pumped LHe → T ~ 1.5 k

Magnet

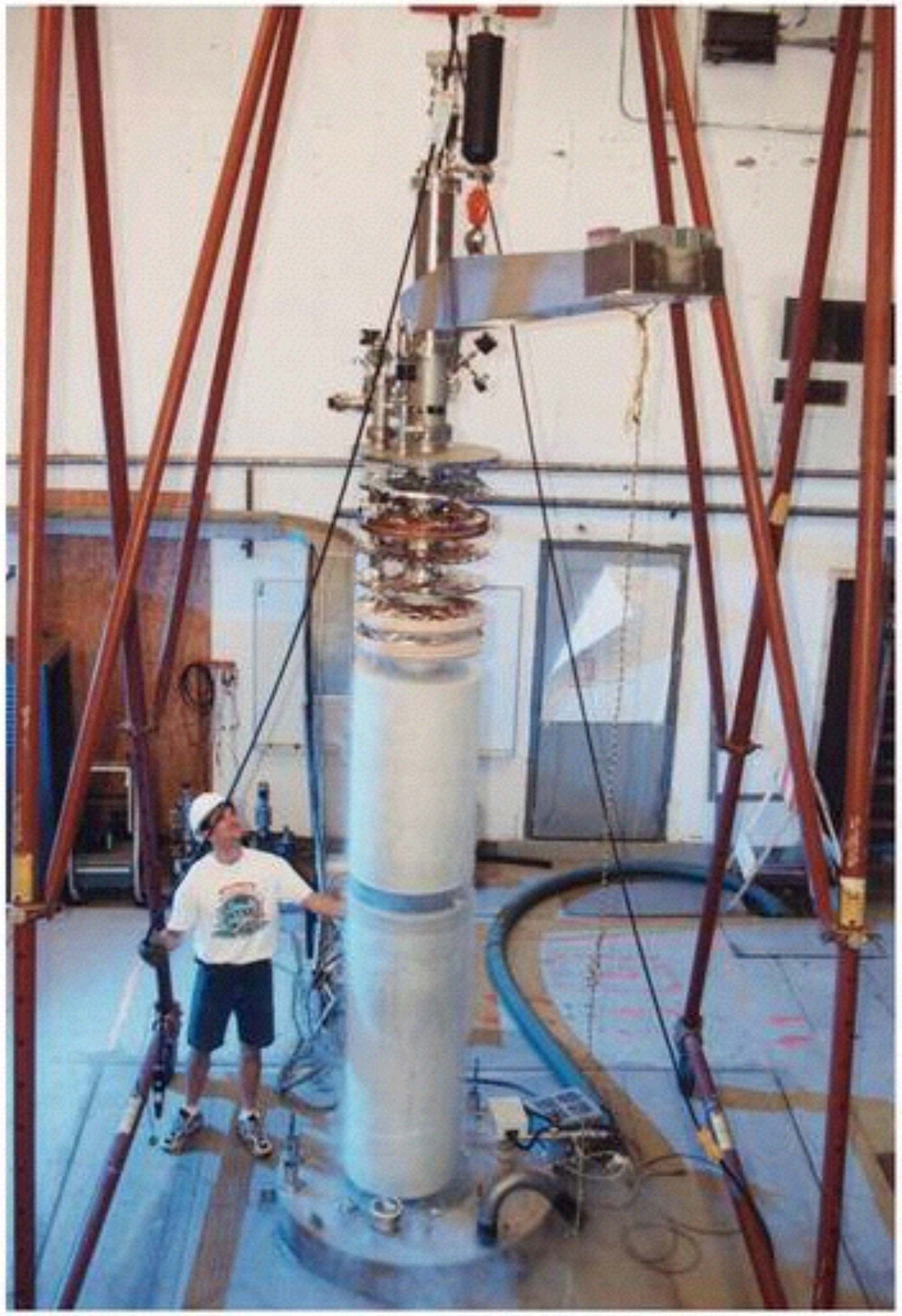
8 T, 1 m × 60 cm ∅

ADMX hardware

high Q cavity

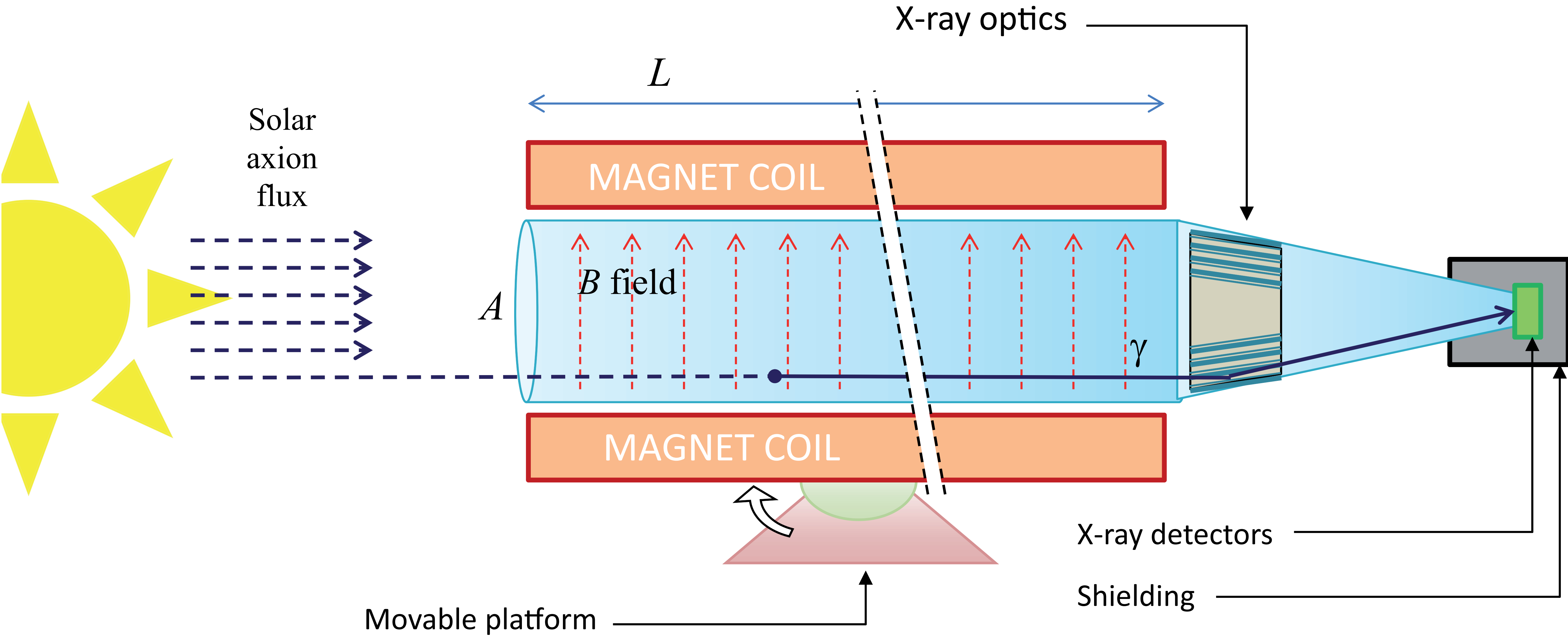


experimental insert

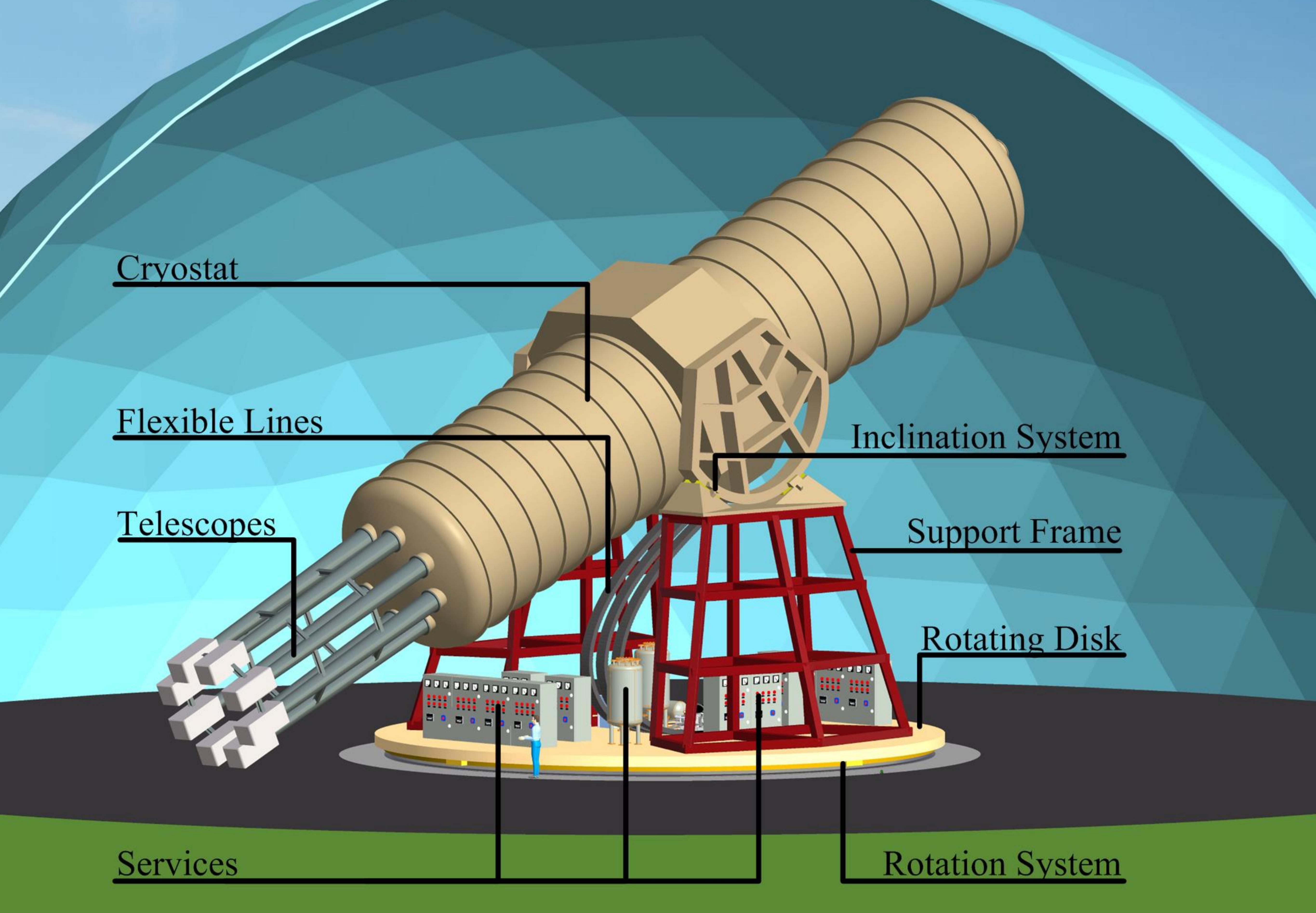


IAXO

CERN-SPSC-2013-022 / SPSC-I-242
08/08/2013



IAXO


Cryostat
Flexible Lines
Telescopes
Inclination System
Support Frame
Rotating Disk
Services
Rotation System

sufficient to accomplish the primary physics goal of the experiment. The additional equipment described below rely on less developed considerations but offer potential improvements beyond the baseline of the experiment. They include GridPix detectors, Transition Edge Sensors (TES), low noise Charge Coupled Devices (CCD) and microwave cavities and antennas. None of the quantified physics potential explained in section 5 relies on any of these devices. The motivations to consider an complementary or alternative use of this equipment are several:

- They offer potential to span the detection energy window of solar ALPs to lower energy ranges (GridPix, TES, CCD) which could be interesting for additional searches of more specific ALPs or WISP models (e.g., hidden photons, chamaleons or other ALPs)

- They offer potential for new physics cases, like the detection of dark matter axions and ALPs (microwave cavities or antennas).

- Even if at the moment the Micromegas detectors are the ones with best prospects to achieve the needed FOM for low background x-ray detection in IAXO, other technologies, e.g., low noise CCD, could eventually prove competitive too as R&D is ongoing in this direction. Provided similar FOMs were achieved by a second technology, the preferred configuration for IAXO would be a combination of the two (e.g. half the magnet bores equipped with one kind of detector and half with another), as this configuration is more immune to systematics effects in case of a positive detection.

- Finally, the consideration of more technologies is helpful to attract and built community around the project.