

Report from the meeting "Axions in the Universe and the IAXO experiment"

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IAXO meeting in Frascati

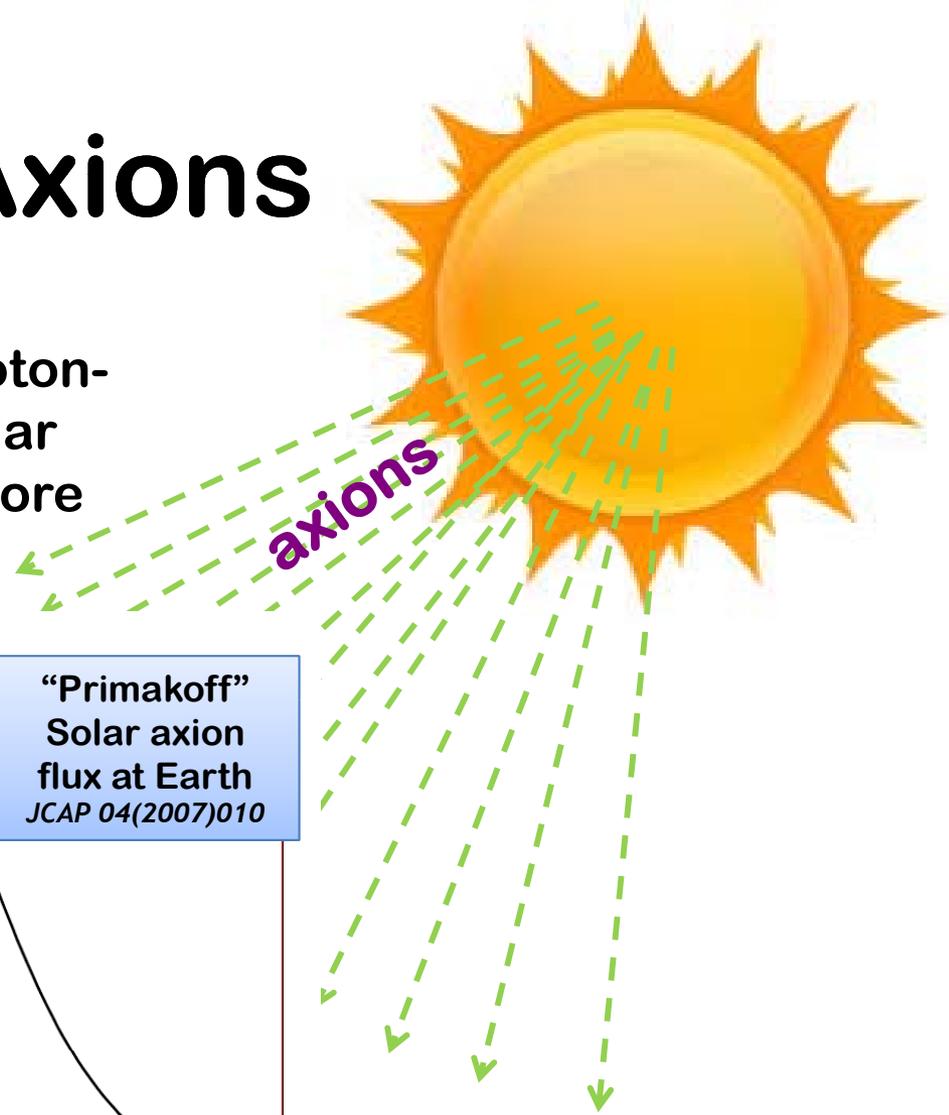
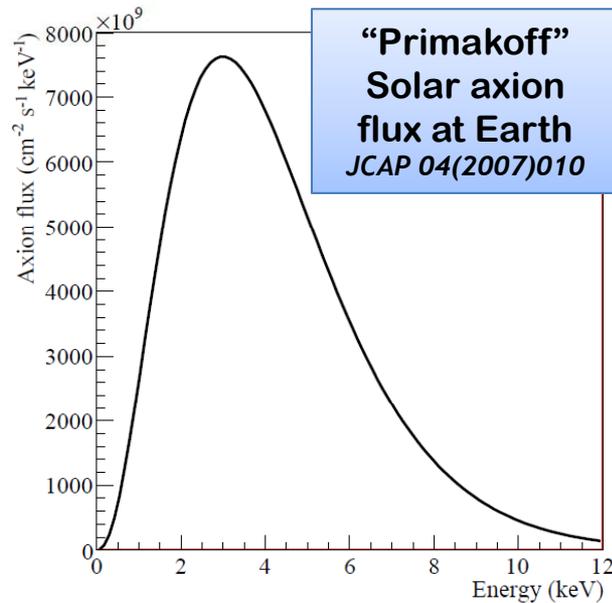
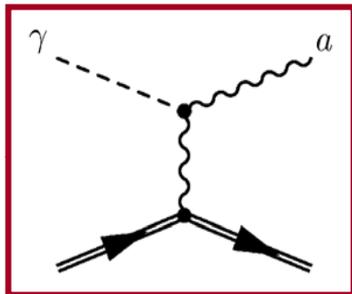
- 18/19 april 2016, Frascati, LNF/INFN
- \approx 50 participants
- “IAXO people” + INAF + INFN + University
Italian Researchers from different fields
- for INAF, CS and MAs invited (and well represented)

Why to search for axions?

- Most compelling solution to the **Strong CP problem** of the SM
- Axion-like particles (ALPs) **predicted by many extensions** of the SM (e.g. string theory)
- Axions, like WIMPs, may **solve the DM problem** *for free*. (i.e. not *ad hoc* solution to DM)
- **Astrophysical hints** for axion/ALPs?
 - Transparency of the Universe to UHE gammas
 - Anomalous cooling of different types of star
- Relevant axion/ALP parameter space at **reach of current and near-future experiments**
- Still too little experimental effort devoted to axions when compared to WIMPs

Solar Axions

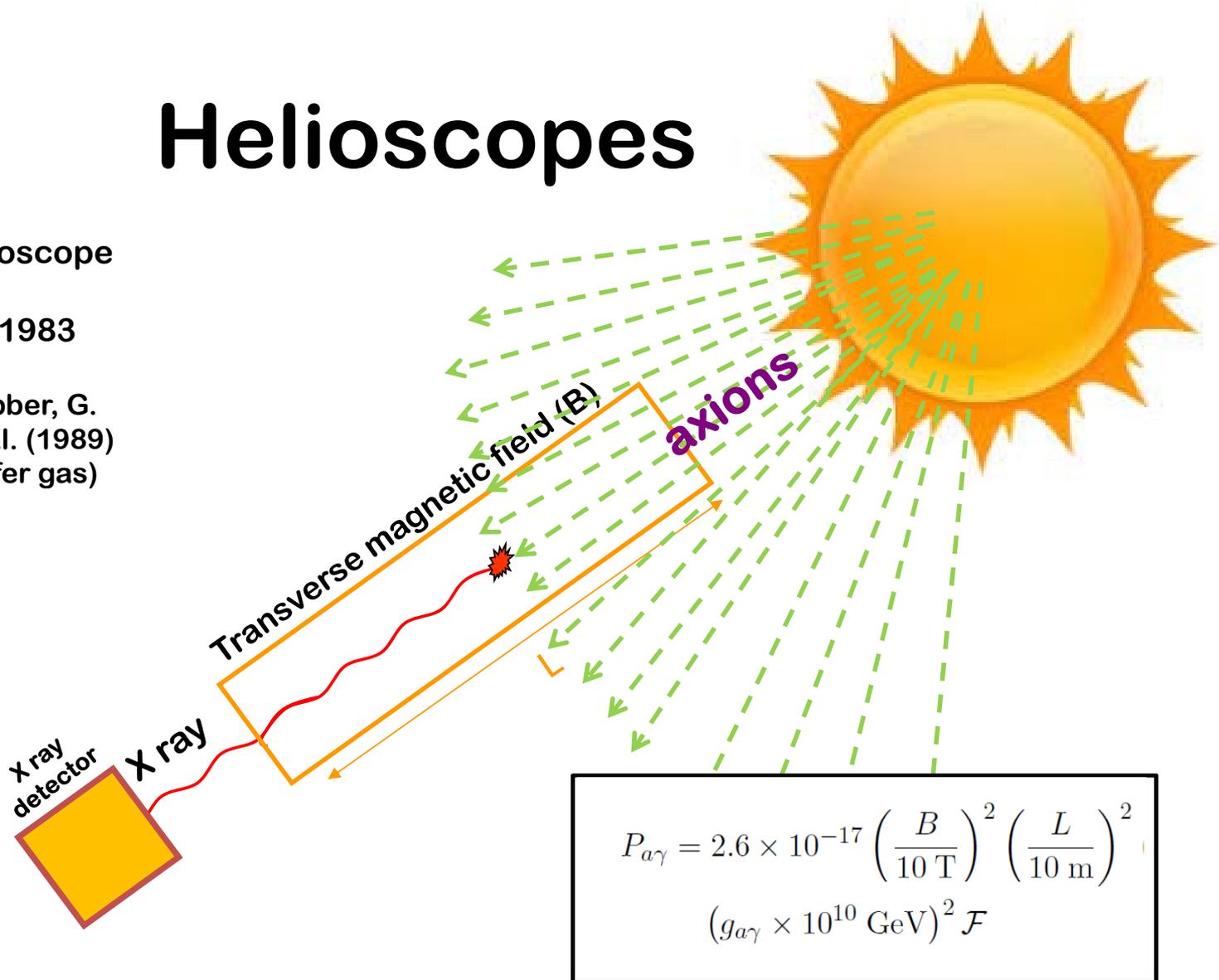
- Solar axions produced by photon-to-axion conversion of the solar plasma photons in the solar core



Helioscopes

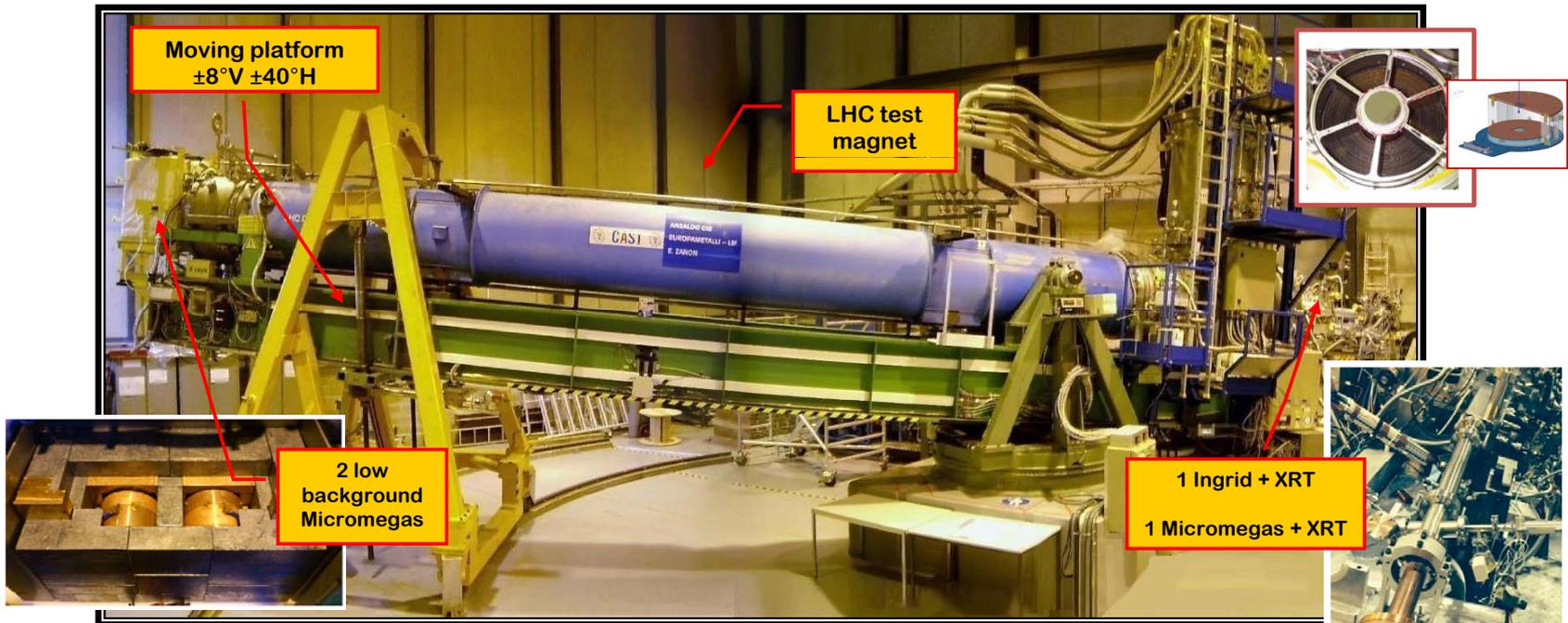
Axion helioscope
concept
P. Sikivie, 1983

+ K. van Bibber, G.
Raffelt, et al. (1989)
(use of buffer gas)



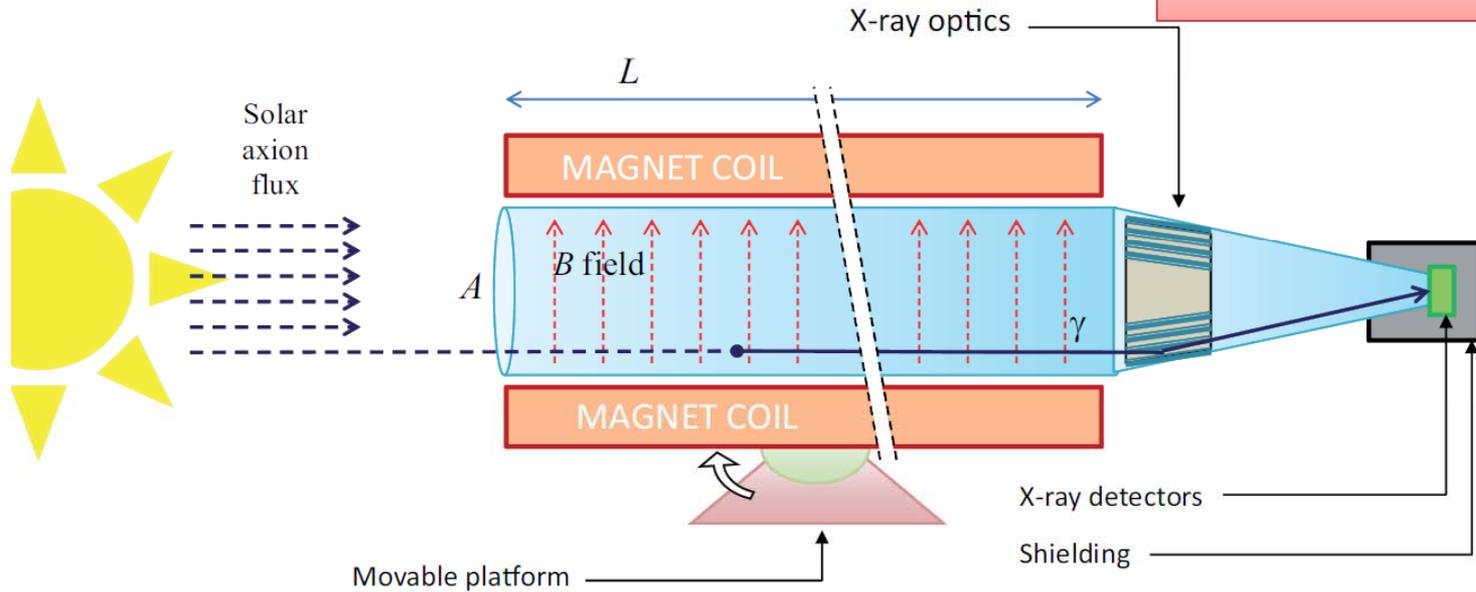
CAST experiment @ CERN

- Decommissioned LHC test magnet (L=10m, B=9 T)
- Moving platform $\pm 8^\circ V \pm 40^\circ H$ (to allow up to 50 days / year of alignment)
- 4 magnet bores to look for X rays
- 2 X ray telescopes to increase signal/noise ratio.



IAXO – Concept

Enhanced axion helioscope:
JCAP 1106:013,2011



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

4+ orders of magnitude better SNR than CAST (JCAP 1106:013)

Agenda

[Download the agenda](#) (2016/03/30)

First day: Monday 18th April: 10:30 a.m. to 07:00 p.m.

10.30-10.45 a.m.	Welcome address		<i>P. Campana (Director INFN Frascati)</i> <i>I. Irastorza (University of Zaragoza)</i> <i>E. Costa (ASI)</i>
10.45-11.15 a.m.	Introduction to Axions		<i>G. Raffelt (MPI, Munich)</i>
11.15-11.45 a.m.	Axions, Dark matter and cosmology		<i>Y. Redondo (University of Zaragoza)</i>
11.45-12.15 p.m.	High-energy astrophysics and axion-like particles - 1		<i>M. Roncadelli (INFN, Pavia)</i>
12.15-12.45 p.m.	High-energy astrophysics and axion-like particles - 2		<i>F. Tavecchio (OABrera/INAF, Milan)</i>
12:45-01:15 p.m.	Axion-like particles searches with sub-THz photons		<i>A. Polosa (University of Roma Sapienza"/INFN)</i>
01.15-02.30 p.m.	Lunch		
02.30-03.00 p.m.	Observations of the the 3.55 keV Emission line and X-ray excesses in clusters		<i>S. Etori (OABologna/INAF, Bologna)</i>
03.00-03.30 p.m.	Possible origin of the 3.55 keV line		<i>M. Cicoli (University of Bologna/INFN)</i>
03.30-04.00 p.m.	The PADME experiment		<i>M. Raggi (INFN Frascati Labs)</i>
04.00-04.15 p.m.	Coffee		

04.15-04.45 p.m.	Axion-Electron Interaction for Cosmological Axion: a possible experimental approach		<i>G. Carugno (INFN, Padua)</i>
04.45-05.10 p.m.	the ALPS II experiment		<i>A. Lindner (DESY, Hamburg)</i>
05.10-05.35 p.m.	NuSTAR solar observations and implications for axions and ALPs		<i>J. Vogel (Lawrence Livermore N Lab.)</i>
05.35-06.00 a.m.	Axions and Stellar Physics		<i>M. Giannotti (Barry University)</i>

Second day: Tuesday 19th April: 09:30 a.m. to 05:00 p.m.

09.00-09.25 a.m.	Results from PVLAS		<i>G. Zavattini (University of Ferrara/It</i>
09.25-09.50 a.m.	Search for axions and ALPs with X-ray Polarimetry		<i>E. Costa (ASI + IAPS/INAF, Roma)</i>
09.50-10.35 a.m.	Motivation, status and prospects of the International Axion Observatory (IAXO)		<i>I. Irastorza (University of Saragoza)</i>
10.35-11.00 a.m.	Coffee		
11.00-11.30 a.m.	X-ray optics requirements for IAXO		<i>M. Pivovarov (Lawrence Liv National Lab.)</i>
11.30-12.00 a.m.	IAXO X-ray optics and possible Italian contributions		<i>M. Civitani (OABrera/INAF, Milano)</i>
12.00-12.20 a.m.	Focal plane concentrators based on Kumakov Lenses: possible use in IAXO		<i>S. Dabagov (INFN Frascati Labs)</i>
12.20-12.40 a.m.	IAXO telescope structure and possible italian contributions		<i>M. Riva</i>
01.20-02.45 p.m.	Lunch		
02:45-4:30 p.m.	Round table on the possible italian participation in IAXO		<i>E. Costa</i>

Possible Italian Contributions

- Science! (DM, gamma rays, stellar evolution....)
- X-ray optics (INAF with the support from ASI?)
(→ optics from XIPE mandrels?)
- X-ray telescope design and development (INAF)
- Magnets (INFN)
- Detectors...

Main Problems

- The experiment is not presented as an European Infra-structure
- At the moment it is based on just national funds for R&D
- Site to be decided (very likely, not at CERN)
- Strategy for the implementation still not clear.

INFN & INAF can participate (also at some high level) but the contribution can be envisaged just after the situation will be more clear.