Search for solar paraphotonss

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Part II.: K. Baker, A. Siemko, K. Zioutas

Part I: → earth bound → CAST

H. Bräuninger, M. Davenport, S.N. Gninenko, V.A. Matveev, S. Troitsky, K. Zioutas

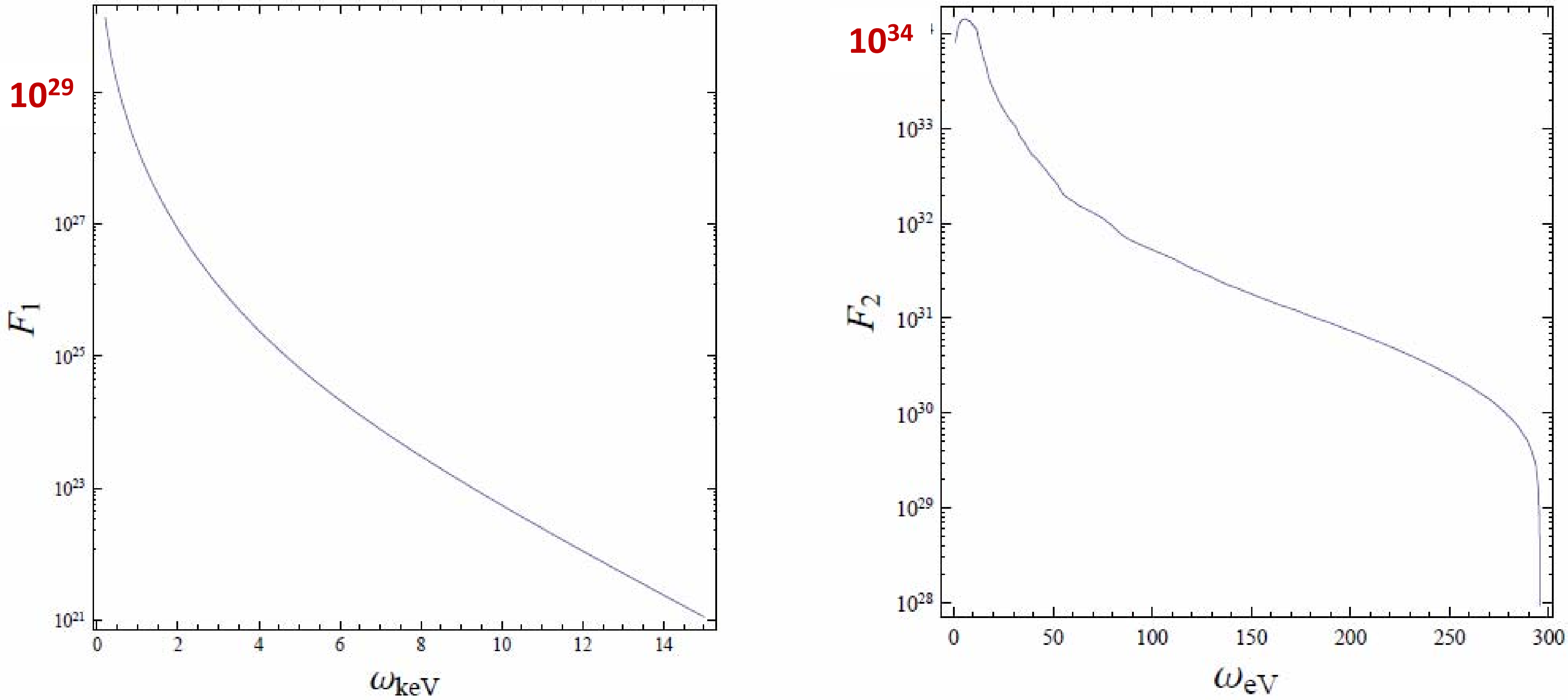
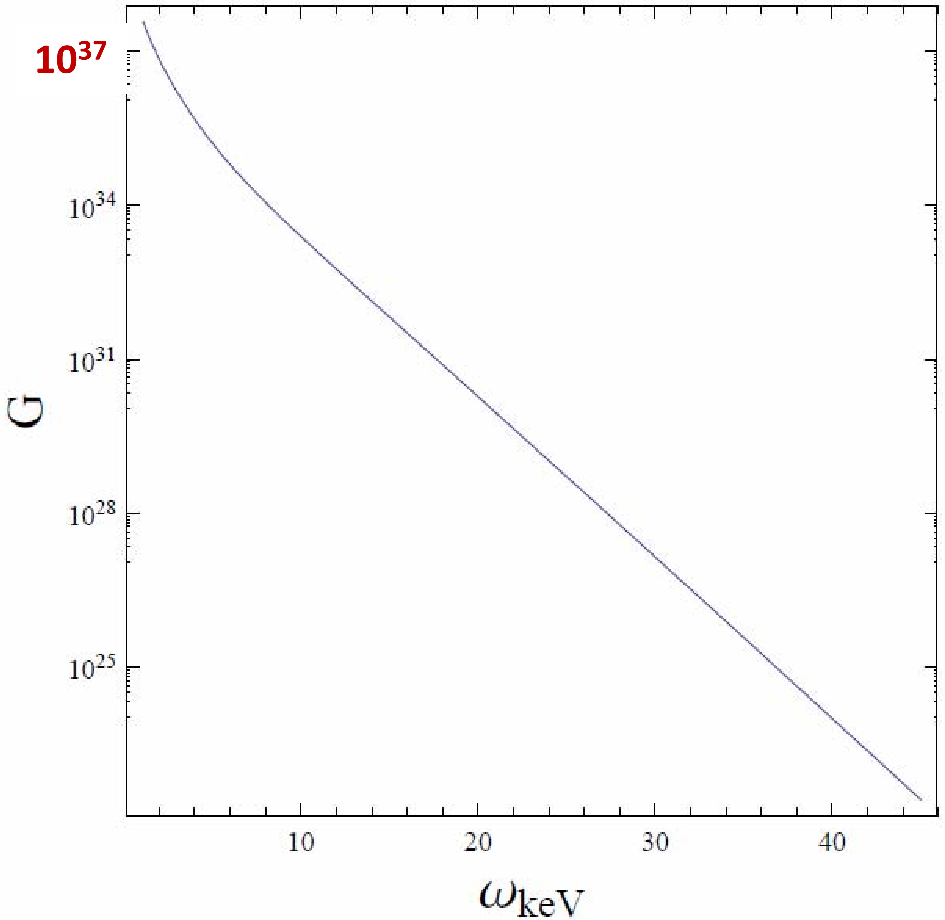


Figure 2: The F_1 and F_2 functions give the flux of solar transverse and longitudinal B's at the Earth for $m_{\gamma'} \ll 1$ eV. Notice the different energy scales, only eV L-hidden photons are emitted while the spectrum of T-modes extends to X-ray energies, although considerably suppressed. See the text for details.

... final spectra?

Javier Redondo, Helioscope Bounds on Hidden Sector Photons, http://xxx.lanl.gov/PS_cache/arxiv/pdf/0801/0801.1527v2.pdf

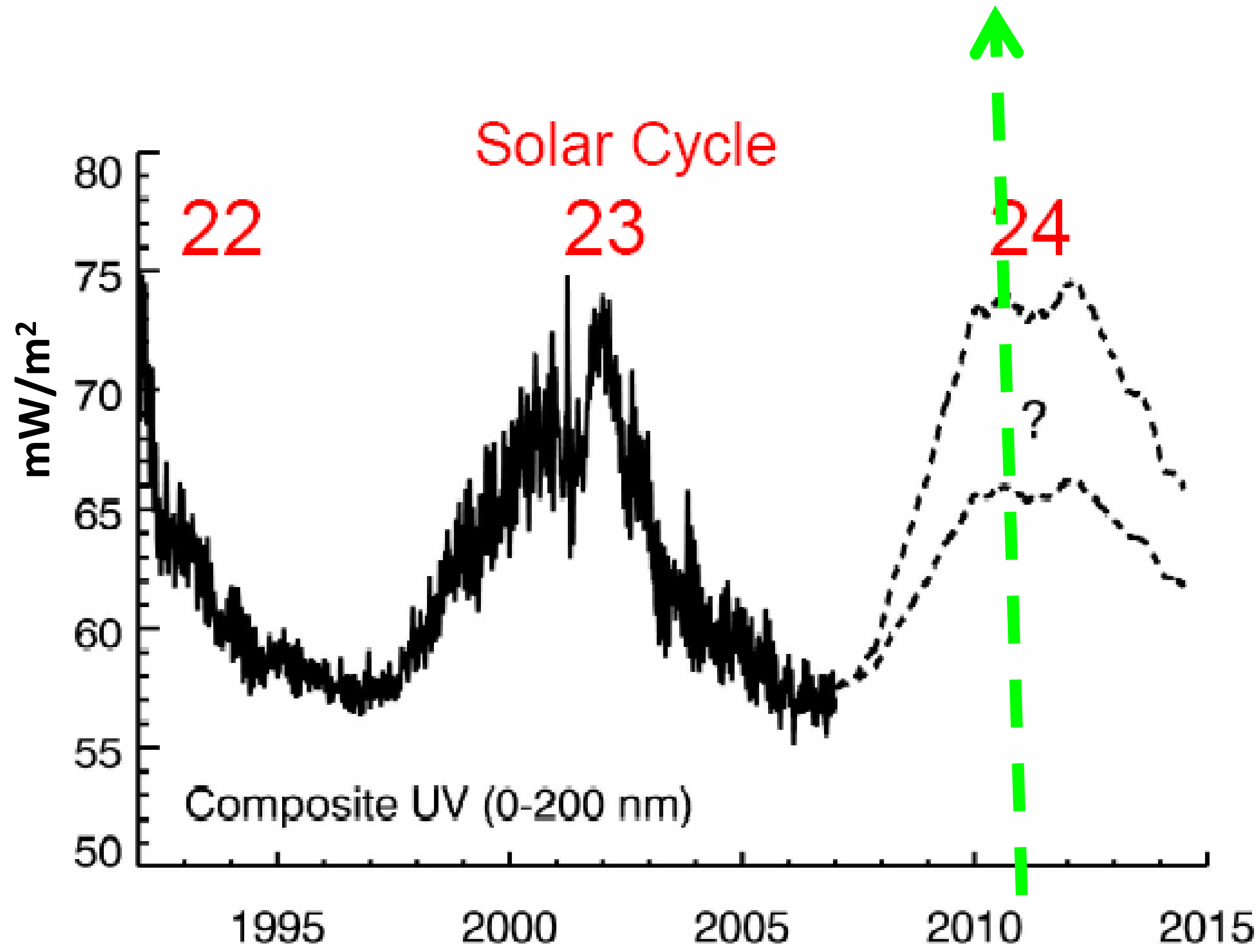
2.1.3 Unsuppressed production ($m_{\gamma'} > 295$ eV)



The function G gives the flux of $m_{\gamma'} \gg 295$ eV hidden photons from the Sun.

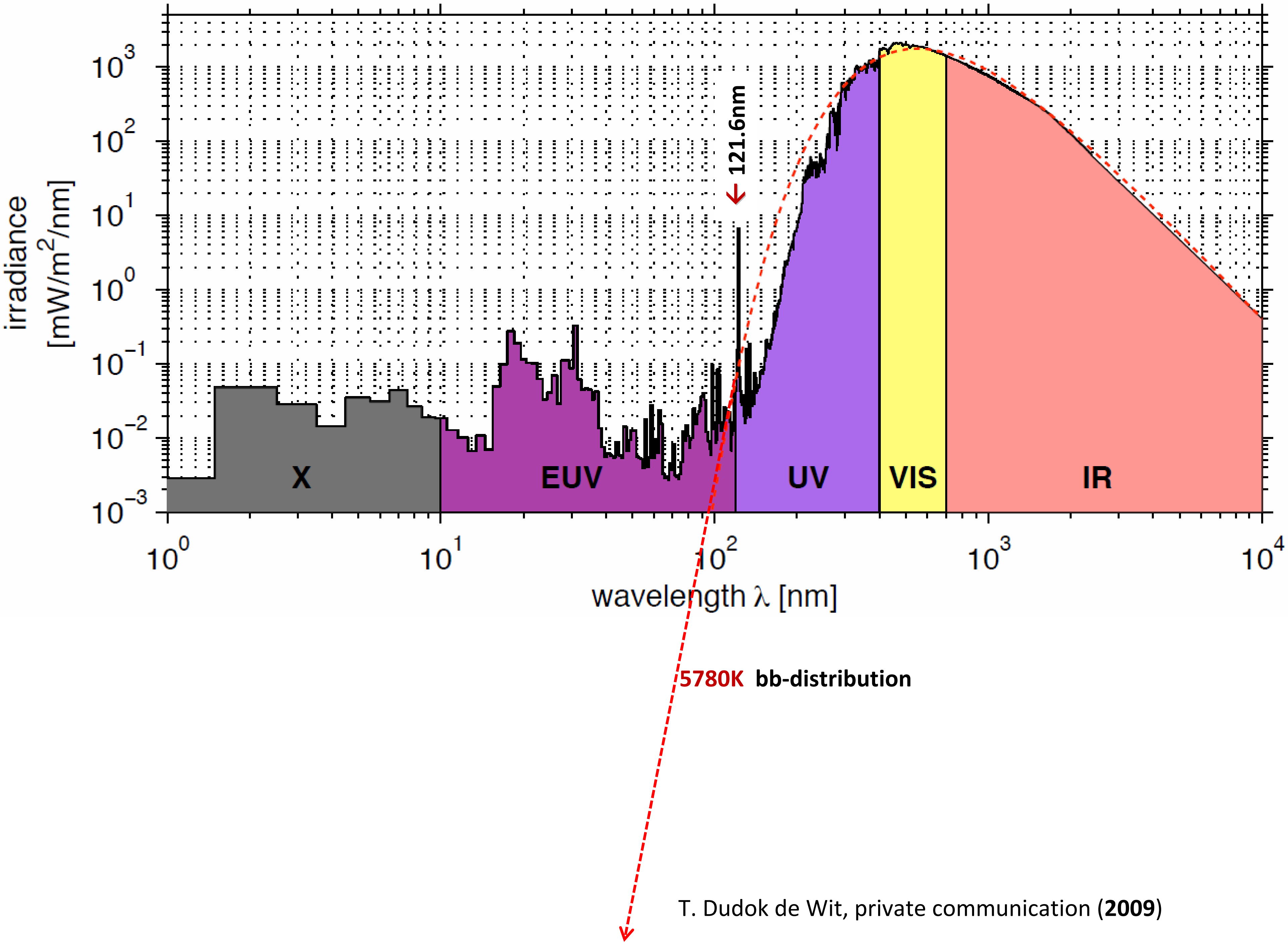
Javier Redondo, Helioscope Bounds on Hidden Sector Photons,
http://xxx.lanl.gov/PS_cache/arxiv/pdf/0801/0801.1527v2.pdf

2011/12



Use: active sun → corona + flares

http://solar.physics.montana.edu/SVECSE2008/pdf/woods_svecse.pdf

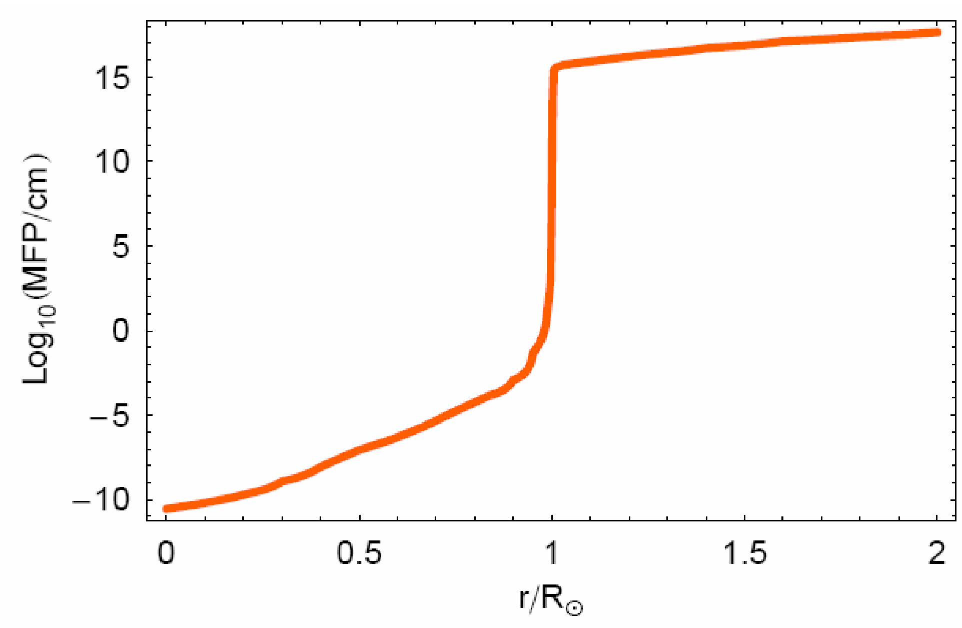


T. Dudok de Wit, private communication (**2009**)

Approximation: Sun = optically thick plus optically thin parts

Derivation works for photon energy >> plasma frequency, paraphoton mass
All results presented below are for energy = 1 keV

Plot: mean free path of 1 keV photon vs. distance from the solar center



Optically thick: $0 \leq r/Rsun \leq 0.993$
Transparent: $0.993 < r/Rsun < 215$ (mostly corona)
Transition region too thin to contribute significantly even at resonance

Optically thick part: paraphoton flux calculated previously.

- Except for masses >1 eV, our results reproduce previous results.
- The difference with previous results at 1 eV < m < 200 eV is within an order of magnitude

New results:

- calculation of the flux from the transparent part (mostly corona)
- estimate of the flux from a flare

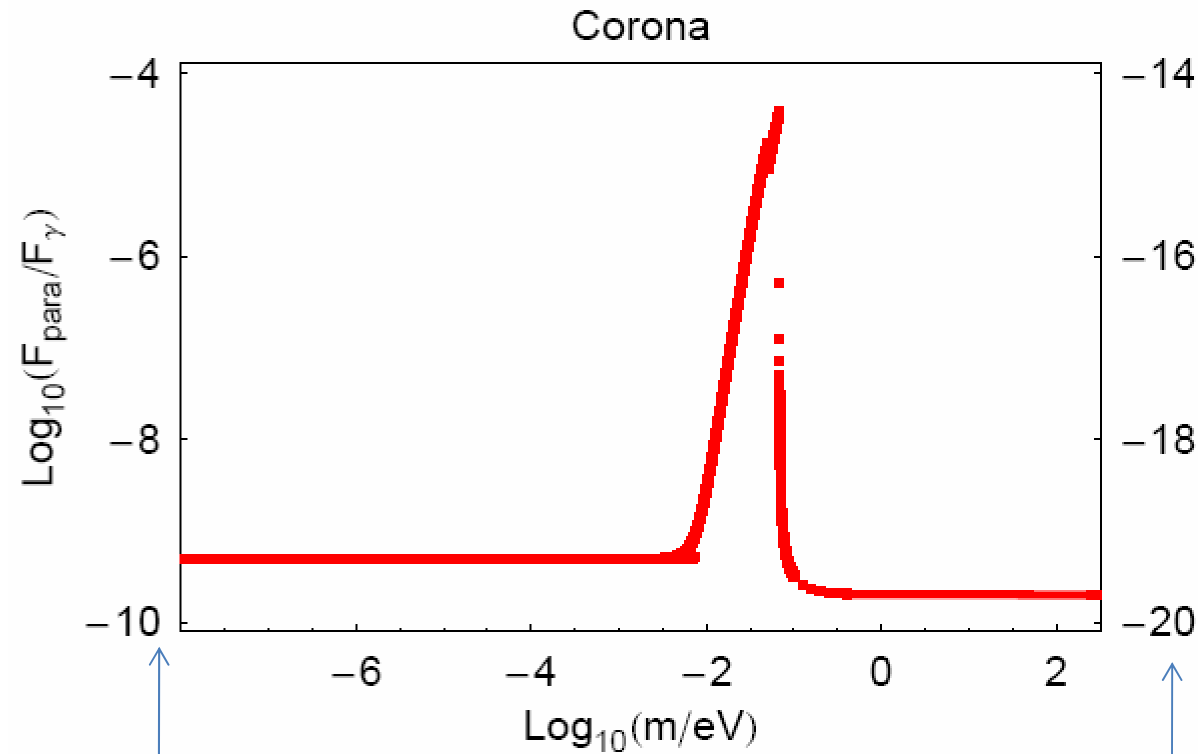
- Resonant production for large regions in the corona

⇨ ***important enhancement of the total flux of light paraphotons***

→ All fluxes scale roughly as χ^2 for the mixing parameter χ.

For estimates, numbers are used mostly from the book:
Aschwanden "Physics of the solar corona" (2006)

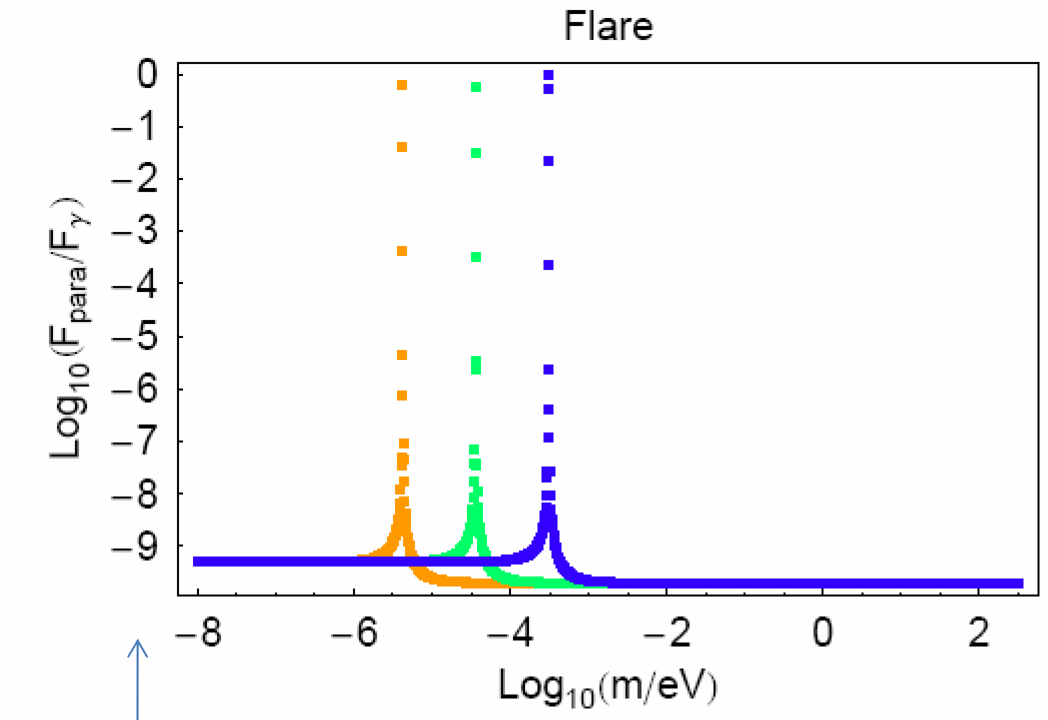
For transparent regions, the paraphoton flux at the Earth may be expressed through the photon flux.



LH scale:
mixing parameter
$\chi=10^{-5}$

RH scale:
mixing parameter
$\chi=10^{-10}$

For transparent regions, the paraphoton flux at the Earth may be expressed through the photon flux.



LH scale:
mixing parameter
$\chi=10^{-5}$

electron density in the flare region (assumed constant) **10^{10}**, **10^{12}**, **10^{14}** cm^{-3}

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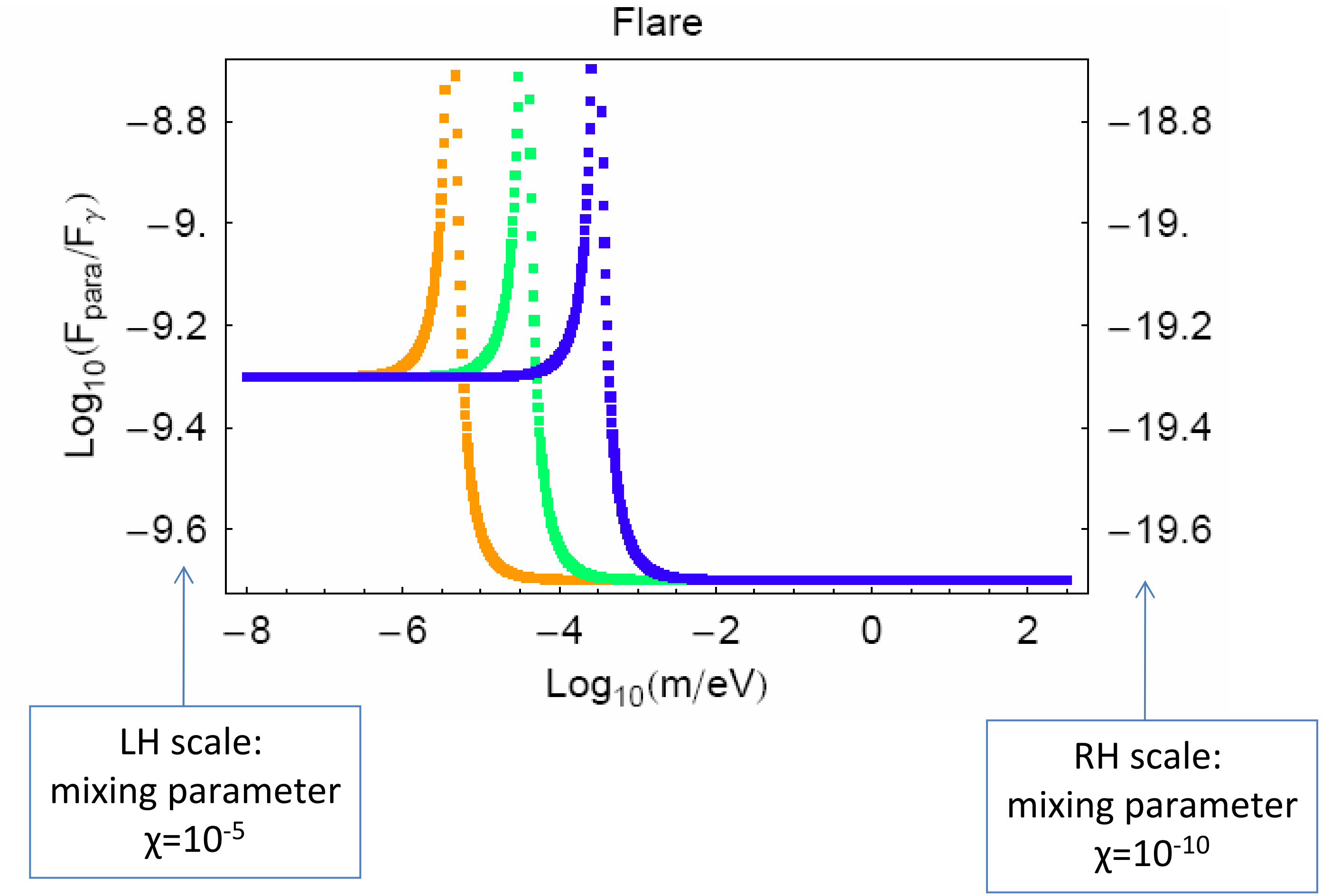
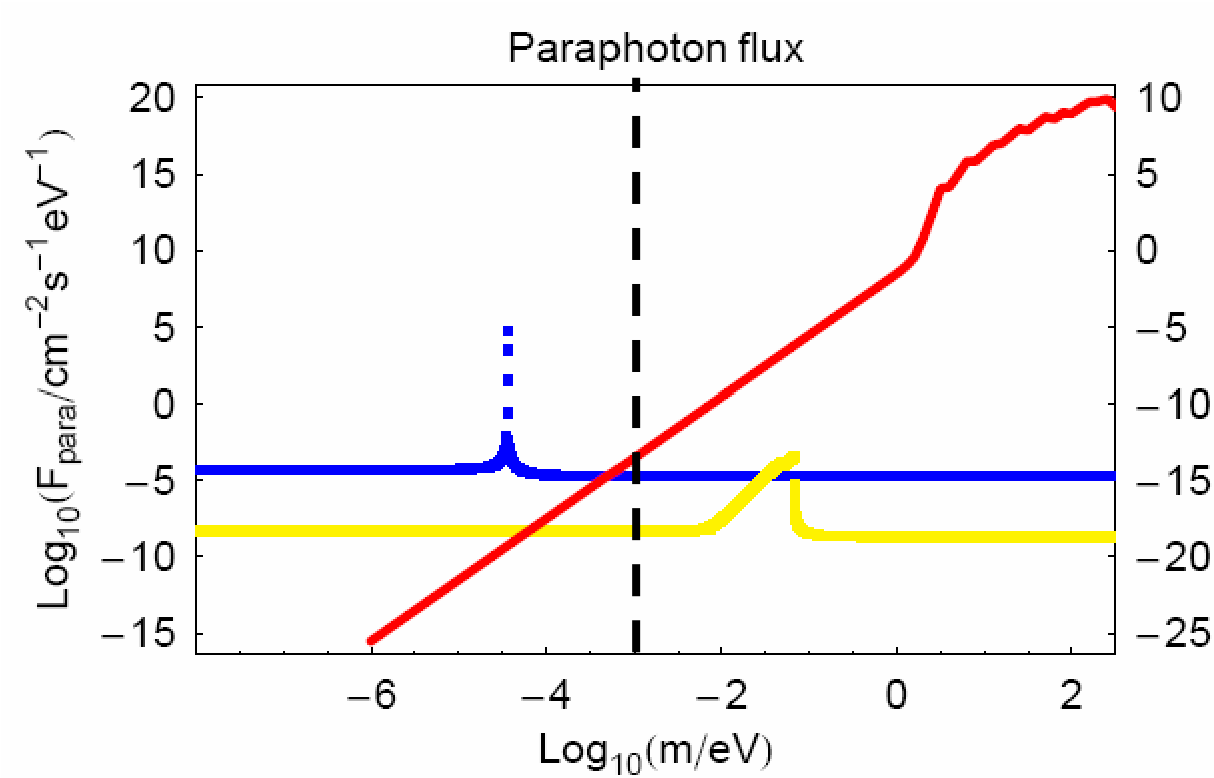


electron density in the flare region (assumed constant) 10^{10}, 10^{12}, 10^{14} cm^{-3}

Compilation of **paraphoton fluxes at 1 keV**



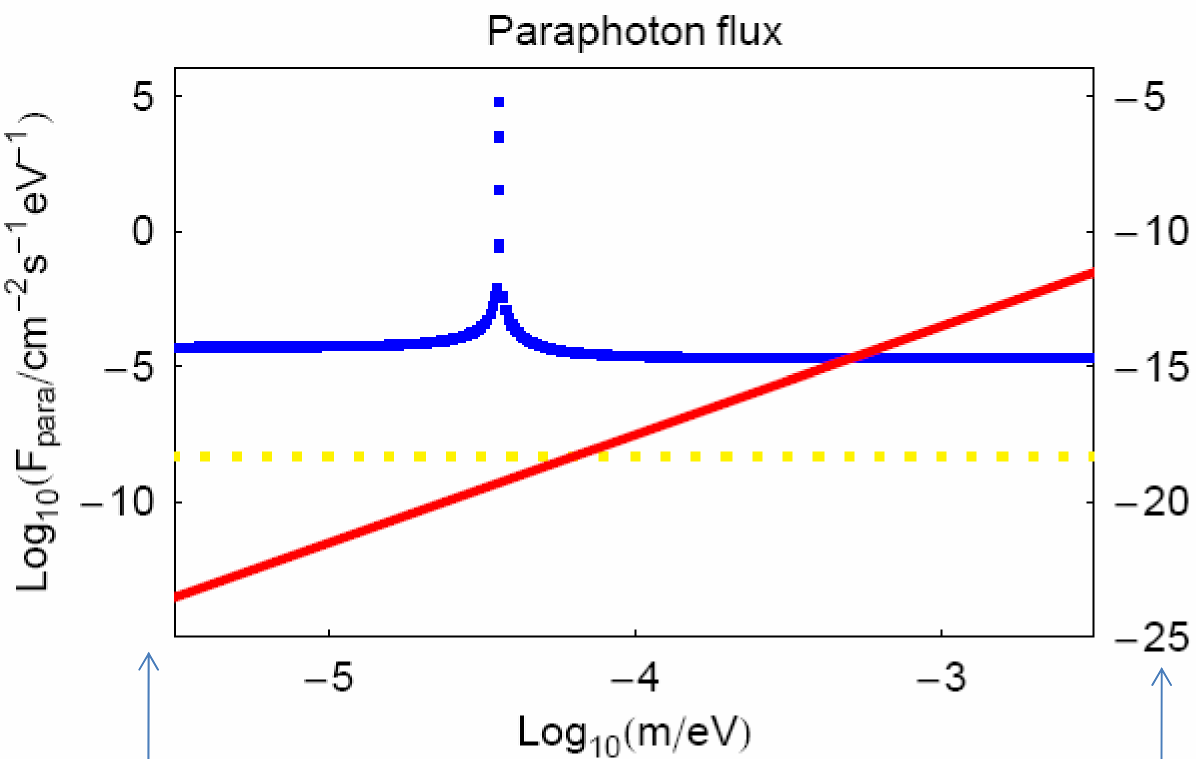
LH scale:
mixing parameter
$\chi=10^{-5}$

RH scale:
mixing parameter
$\chi=10^{-10}$

OPAQUE SUN, **CORONA**, a large but not exceptional **FLARE**

(assuming flare photon flux **10^5 cm^{-2} s^{-1} ev^{-1}**)

Compilation of paraphoton fluxes at 1 keV (zoom)



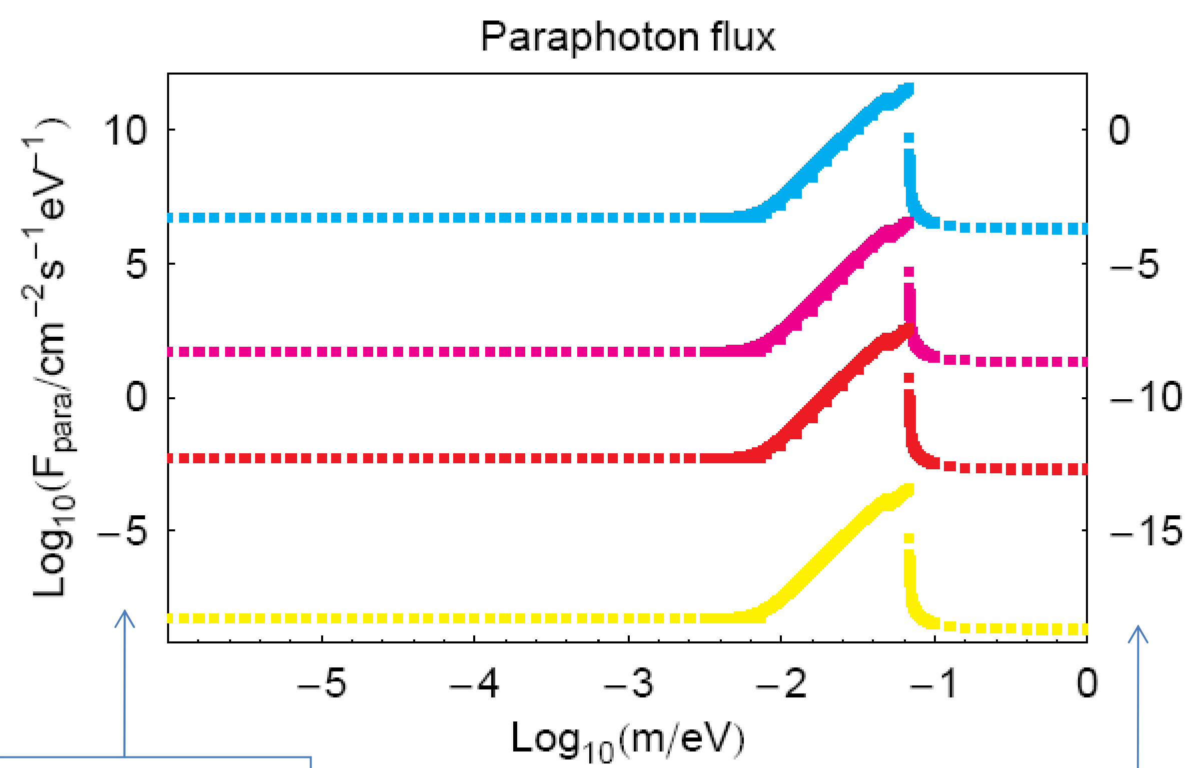
LH scale:
mixing parameter
$\chi=10^{-5}$

RH scale:
mixing parameter
$\chi=10^{-10}$

OPAQUE SUN, **CORONA**, a large but not exceptional **FLARE**

(assuming flare photon flux **10^5 cm^{-2} s^{-1} ev^{-1}**)

Corona paraphoton fluxes at various energies (scale with the photon flux!)

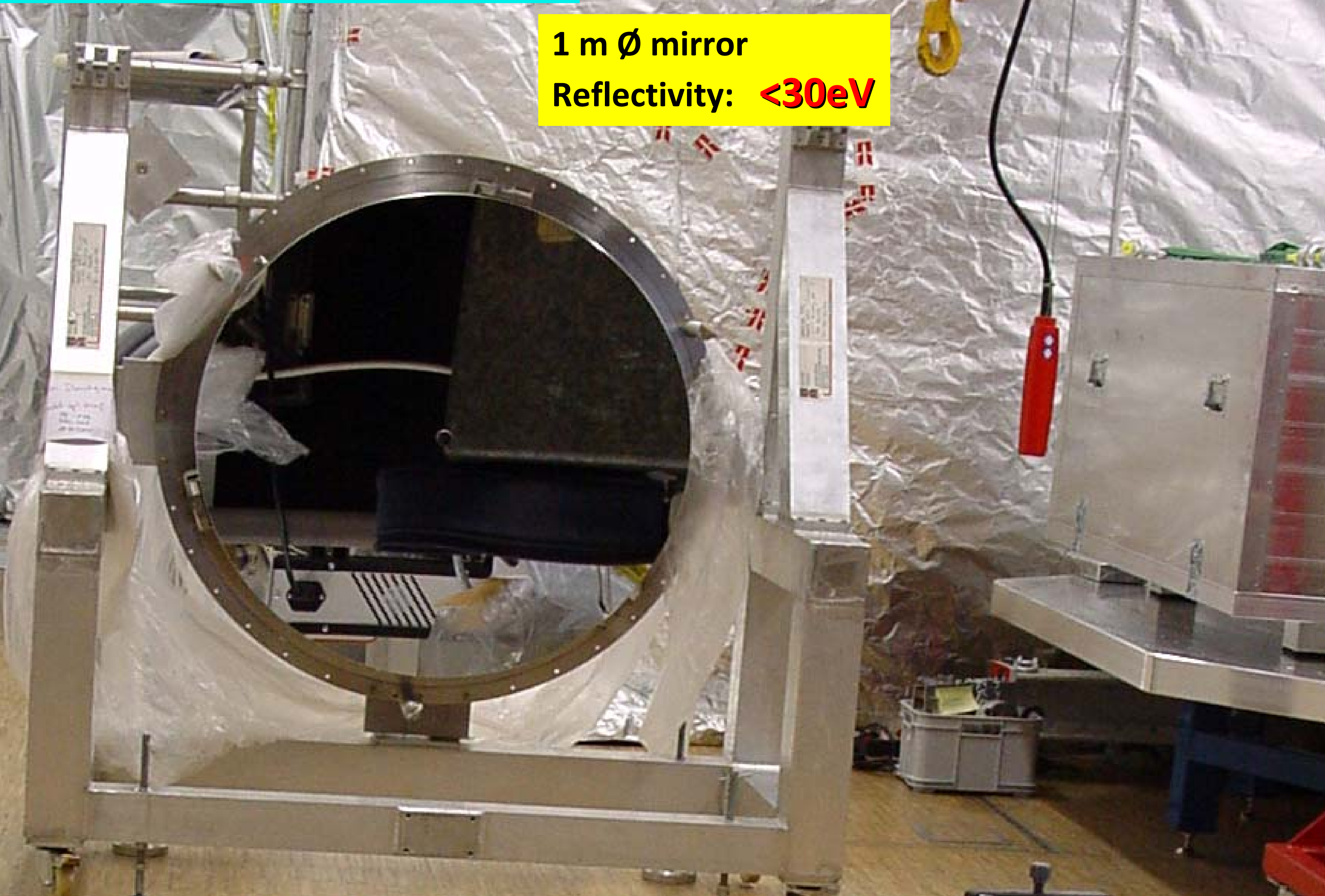


LH scale: mixing parameter $\chi=10^{-5}$

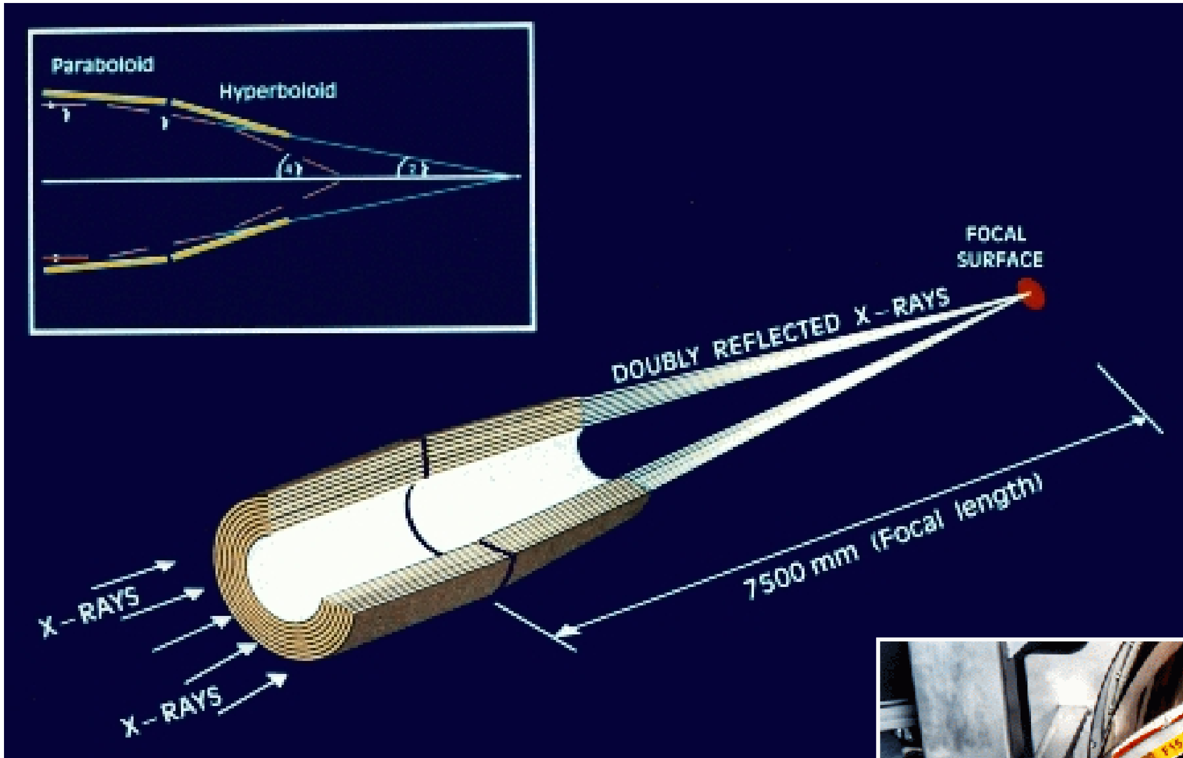
RH scale: mixing parameter $\chi=10^{-10}$

2 eV, 10 eV (E1 line), 100 eV, 1 keV

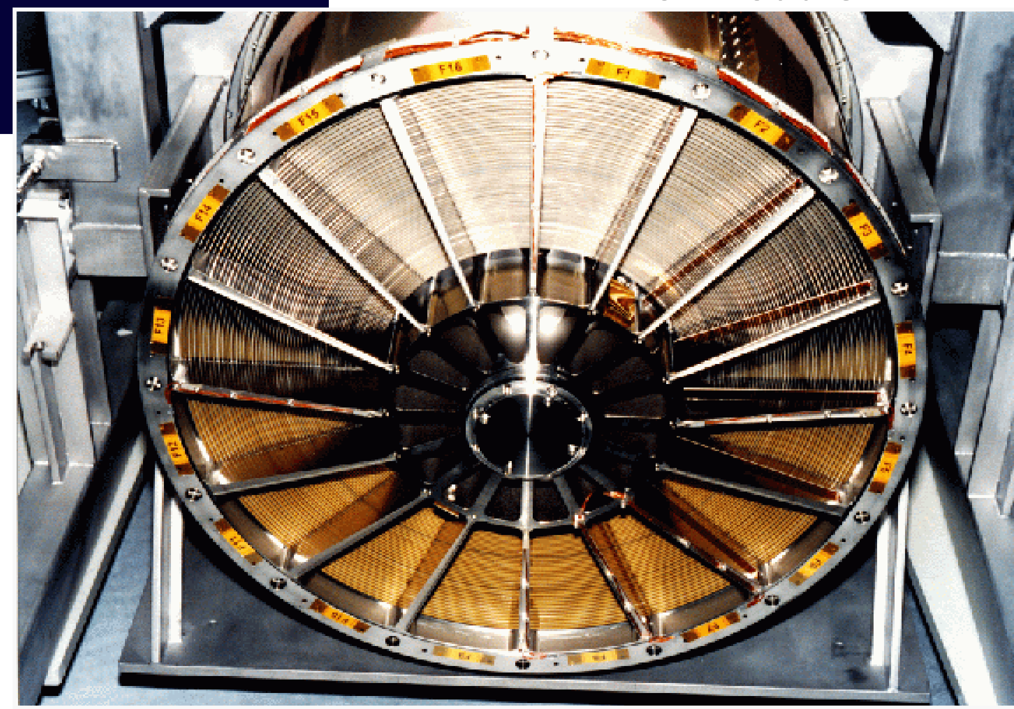
Solar paraphotons?

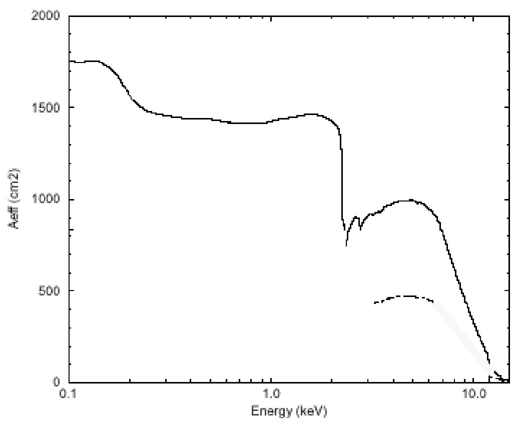


Light Path in XMM-Newton Telescope



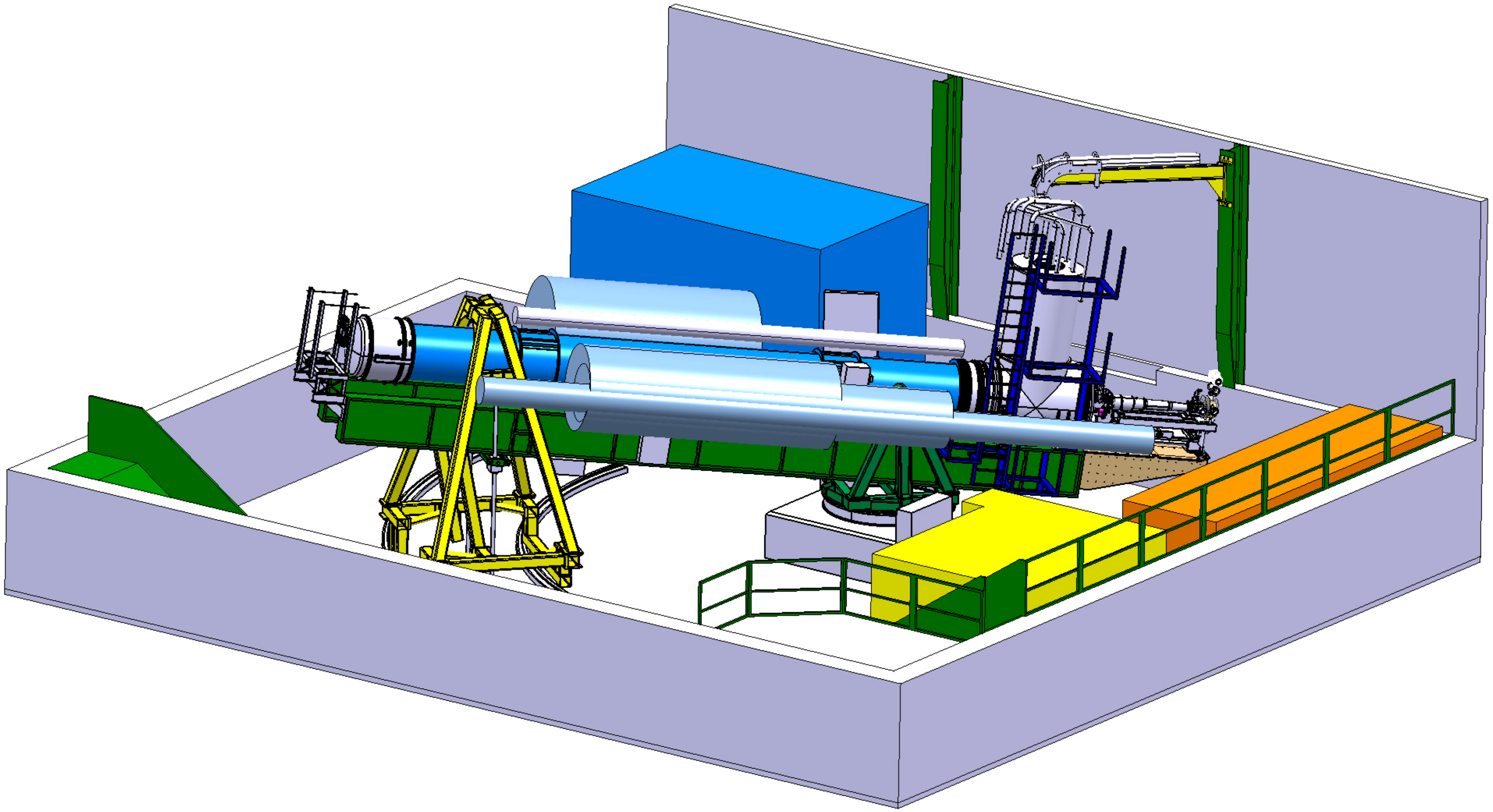
XMM mirror module

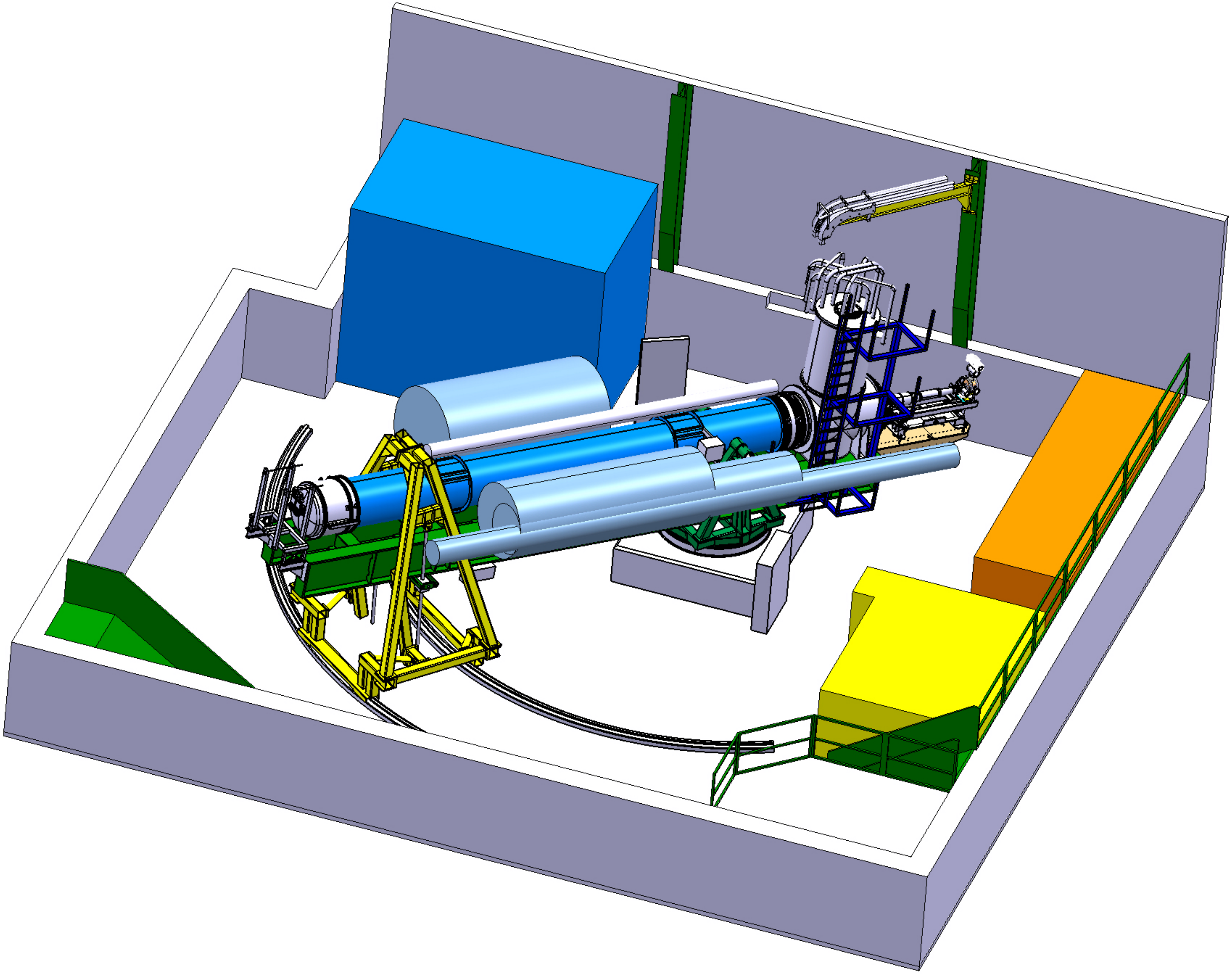




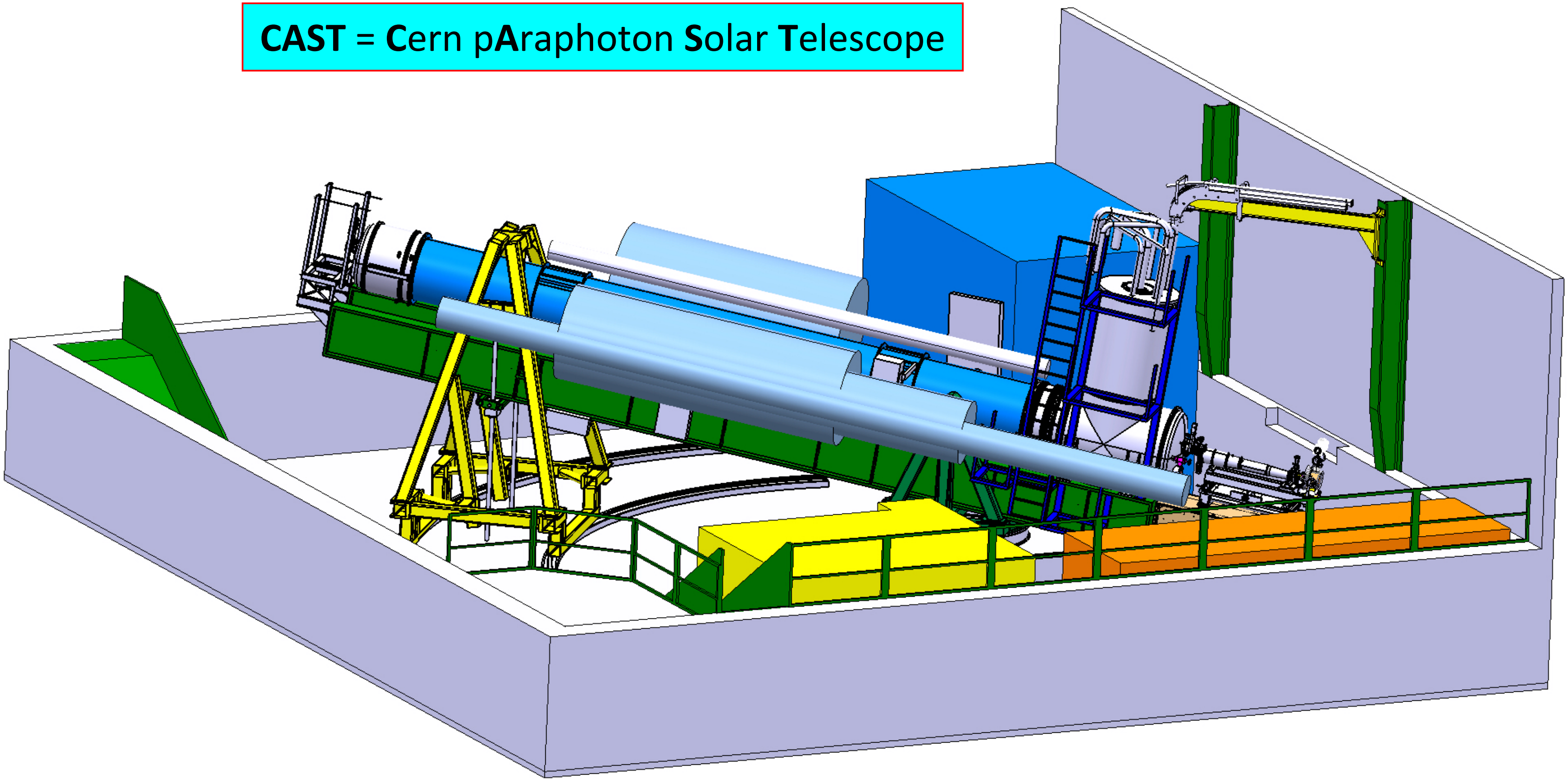
Collecting area:

~1900cm^2 (<150 eV), ~1500cm^2 (@ 2 keV), ~900cm^2 (@ 7keV), ~350 cm^2 (@ 10 keV).





CAST = **C**ern p**A**raphoton **S**olar **T**elescope



Mirror(s)

XRT present → low threshold

XMM/Newton → after axion run finishes without magnet

Part II: space born

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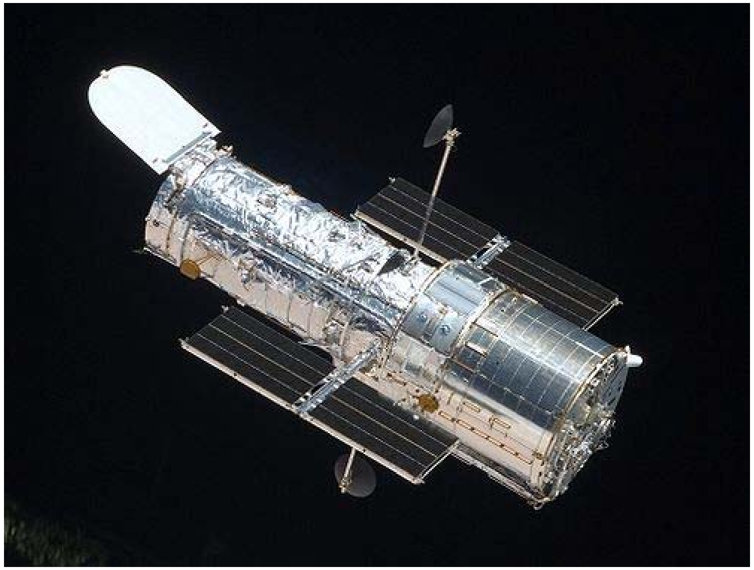
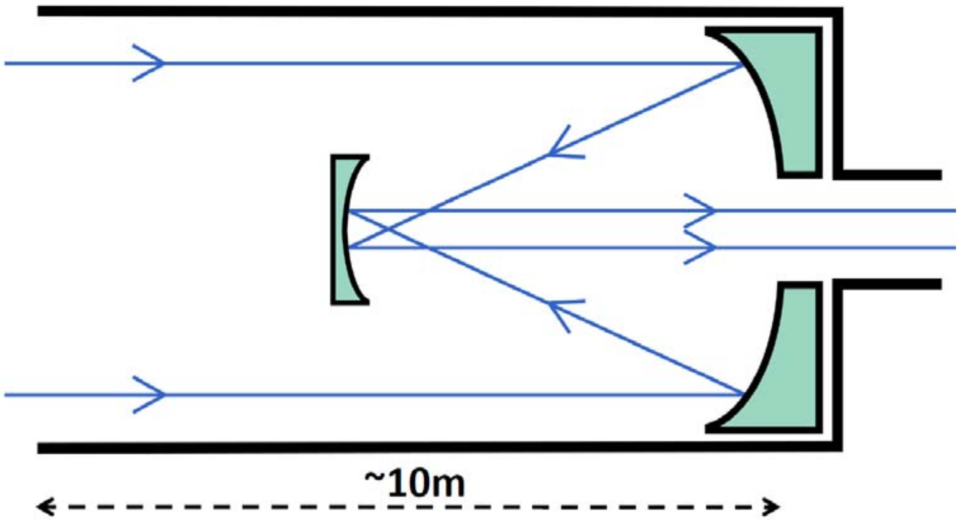
HUBBLE as (solar) paraphoton telescope?

First contacts!





(a) The **HUBBL**E space telescope. **(b)** The light path inside the telescope. The distance between the entrance door (left) and the large primary mirror (right) is about 10 m. If the door is closed, in this 10 m long vacuum tube through going paraphotons can oscillate to photons and be detected as a spot by the camera at the very right end (not shown). The HUBBLE's photon energy range is from **~0.5 to 9eV**, and its 2.4 m mirror effective surface is **4.5 m^2**.

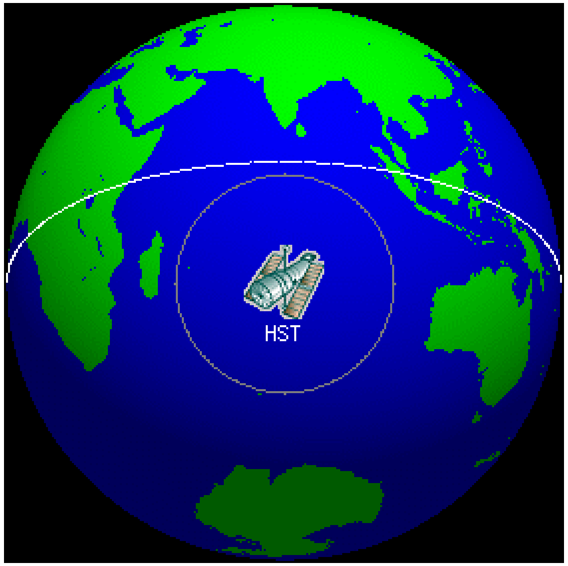
Use HUBBLE telescope with closed the aperture door

&

pointing to the Sun? or other places.

→ Under investigation!

Current Hubble Location



http://science.nasa.gov/temp/hubbleloc.html

Low Energy:

Any strong atomic transitions, e.g., also the 121.6nm /Hydrogen:

→ $L_{121.6} \sim 10^{-5} L_{solar}$

→ **paraphotons**