

Search for Hiden-Photon Dark Matter

Status & Perspectives

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Hidden Photons

$$\mathcal{L} = -\frac{1}{4} (F_{\mu\nu} F^{\mu\nu} + \tilde{X}_{\mu\nu} \tilde{X}^{\mu\nu}) - \frac{\chi}{2} F_{\mu\nu} \tilde{X}^{\mu\nu} + \frac{m^2}{2} \tilde{X}_\mu \tilde{X}^\mu + J^\mu A_\mu$$

light extra U(1)
gauge boson:
hidden photon

kinetic mixing
coupling

mass term

Horns *et al.*, JCAP 04 (2013) 016

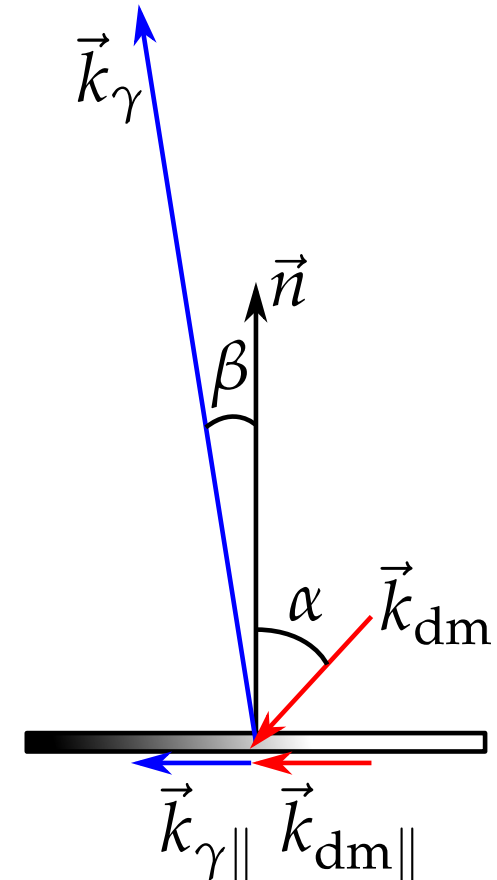
U(1) is simplest extension of SM, predicted by many theories

DM eigenstate has mass $\approx m$

DM mostly HP-like, with small oscillating ordinary EM

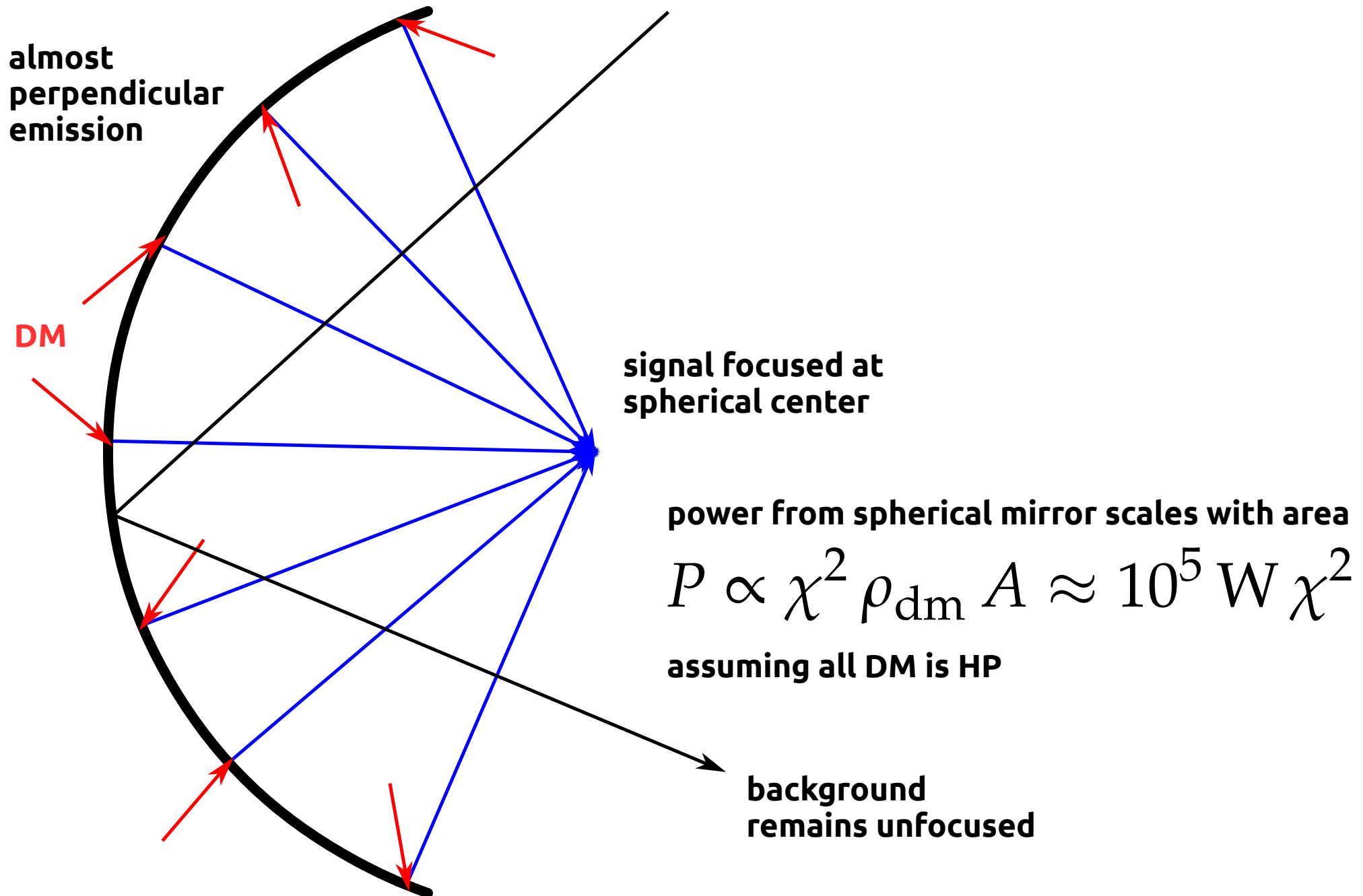
boundary condition for E-field on conducting surface
is vanishing || component \rightarrow ordinary EM emitted

almost perpendicular $\sin \beta = \frac{v_{\text{dm}}}{c} \sin \alpha \approx 10^{-3}$



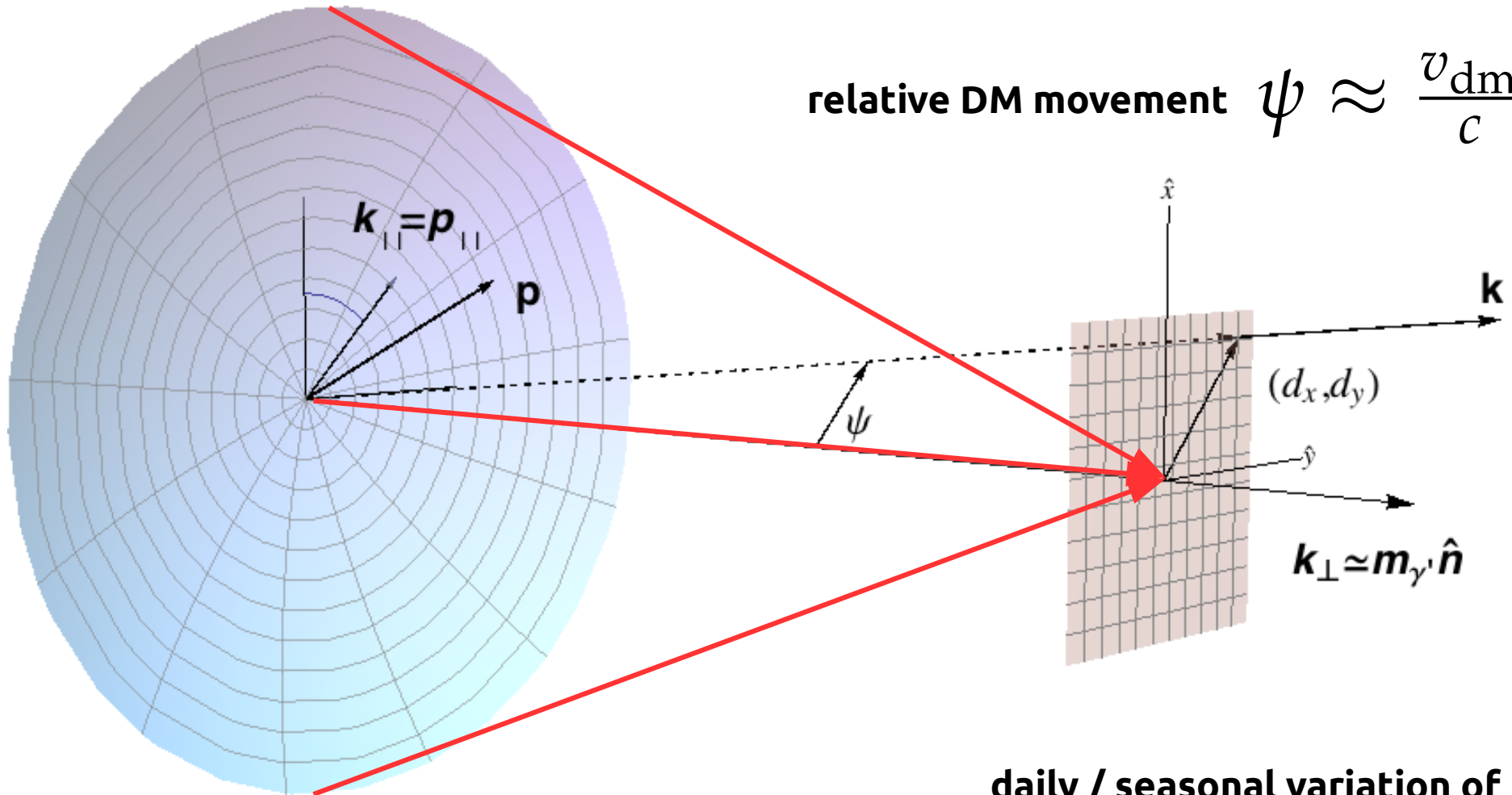
Jaeckel & Redondo, JCAP 11 (2013) 016

Geometrical Amplification



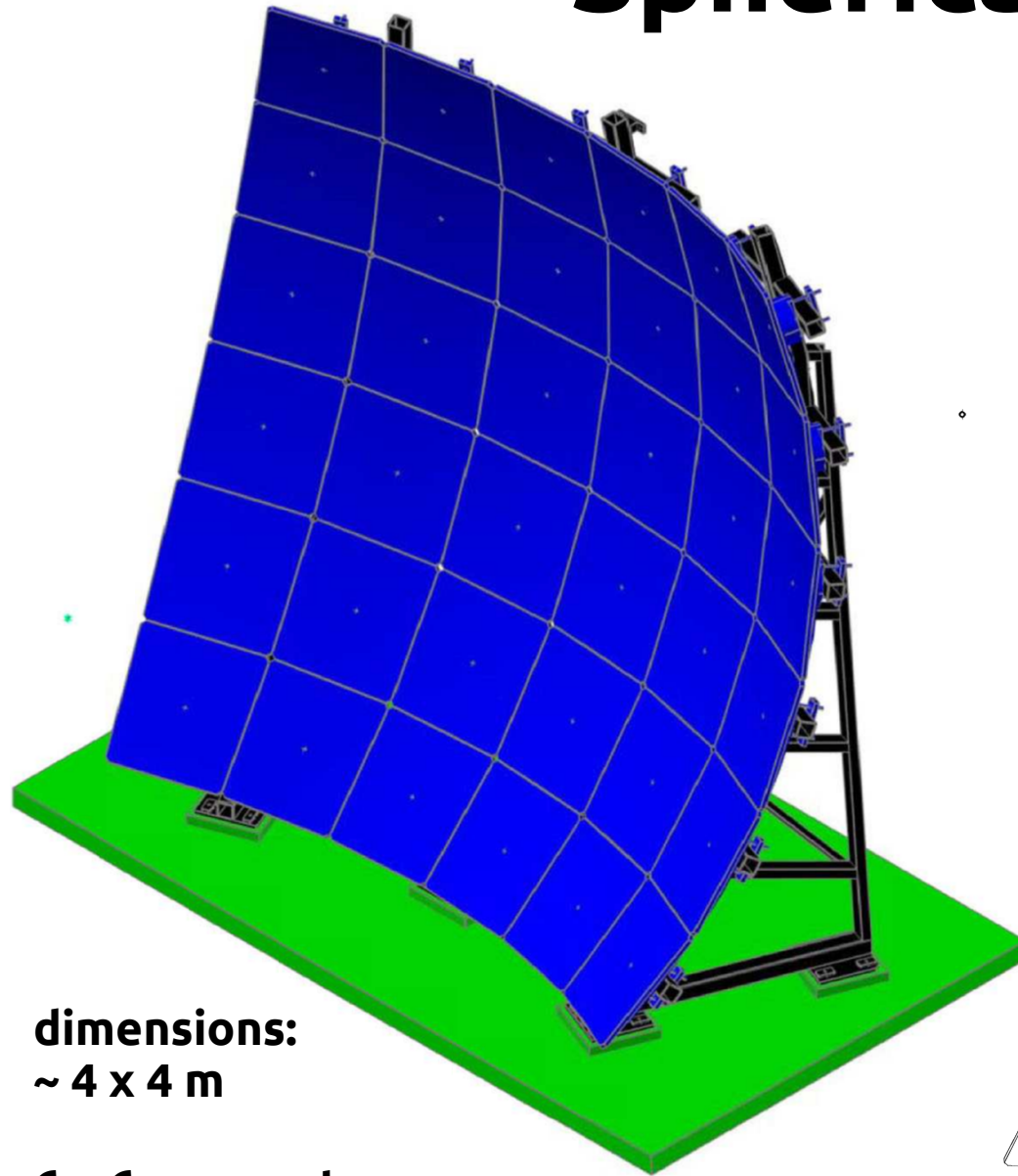
Spherical Mirror

relative DM movement $\psi \approx \frac{v_{dm}}{c}$



daily / seasonal variation of center point ~few mm (for our mirror)

Spherical Mirror

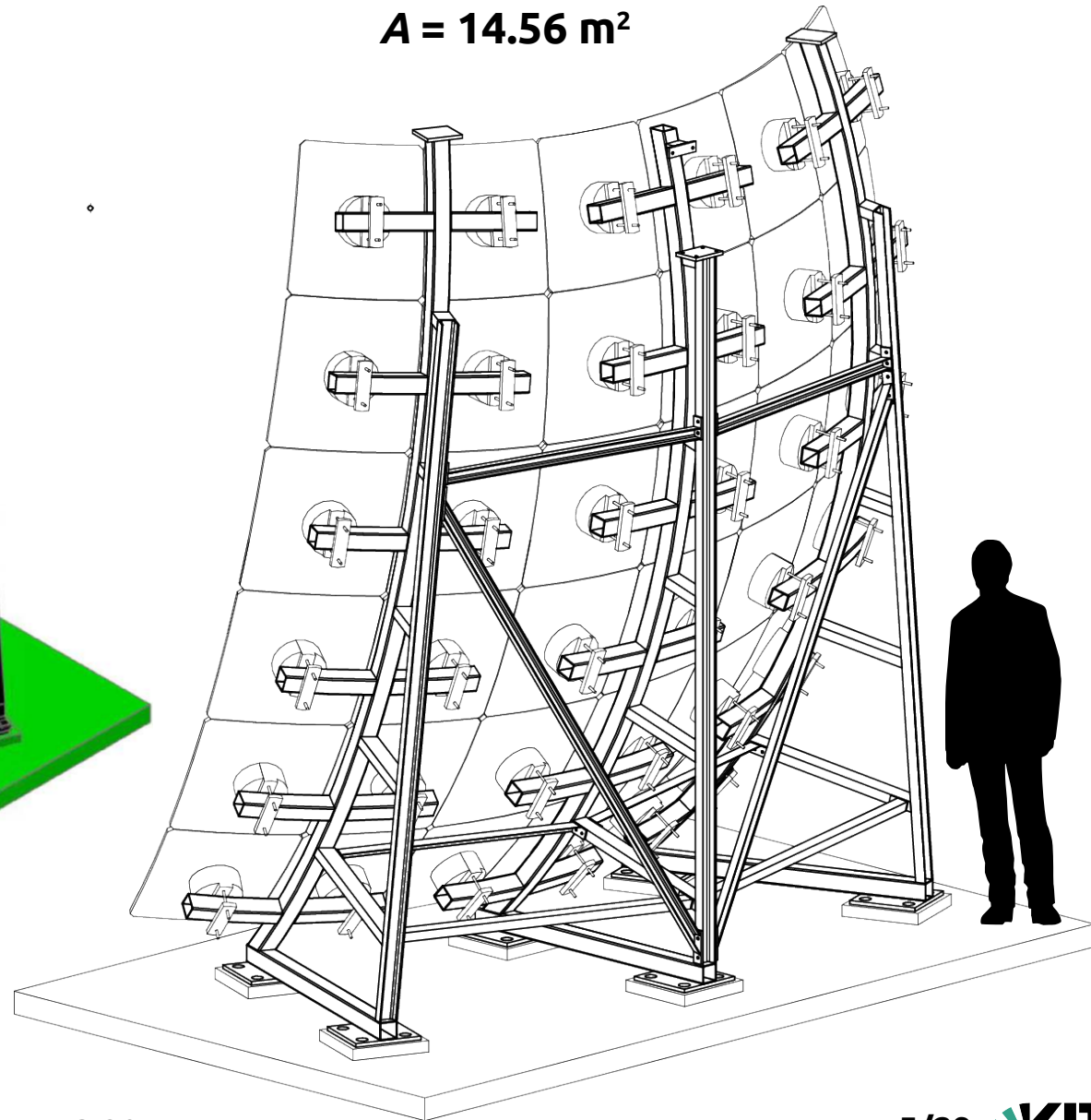


dimensions:
~ 4 x 4 m

6 x 6 segments

only 3 unique shapes

$A = 14.56 \text{ m}^2$



Pierre Auger Observatory

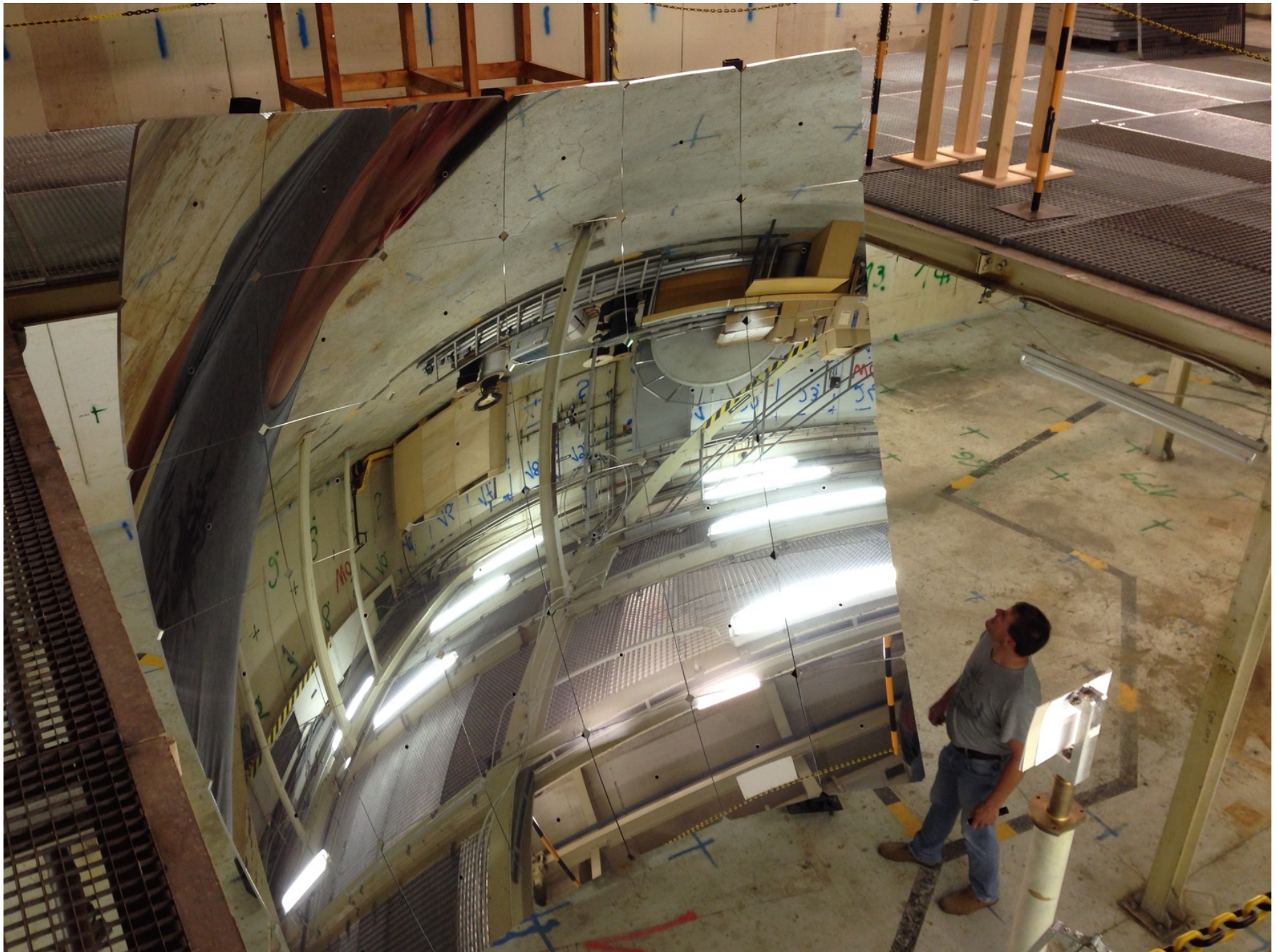


**Schmidt telescope:
corrector ring, 440 PMT camera, mirror**

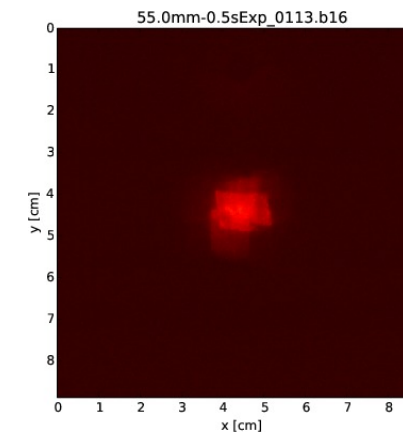
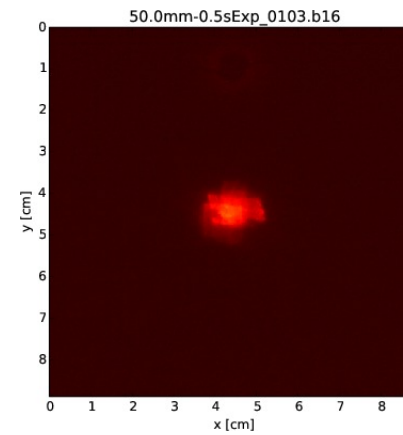
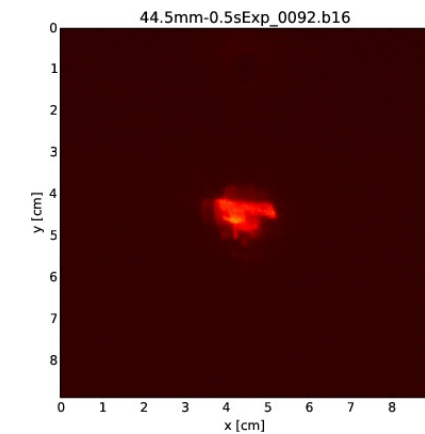
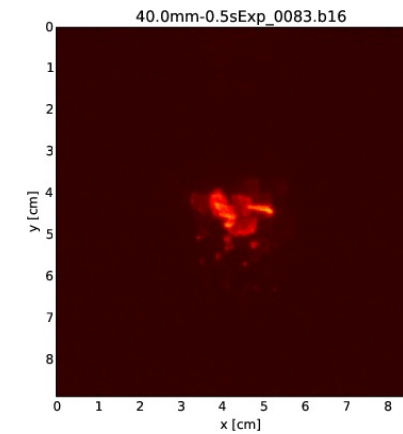
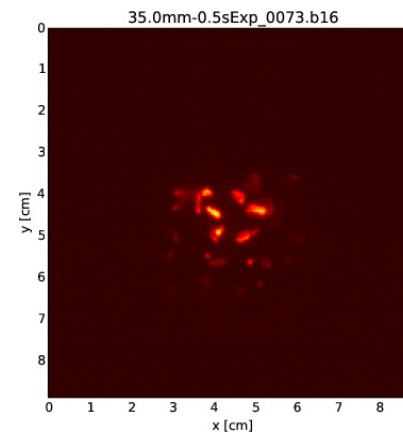
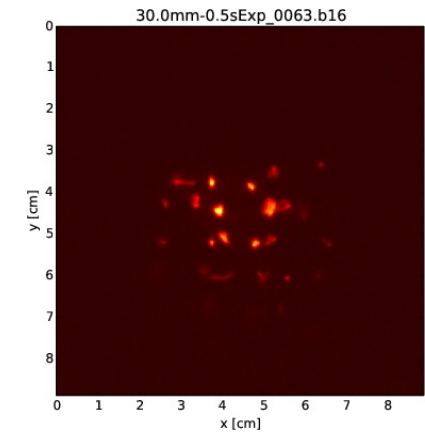
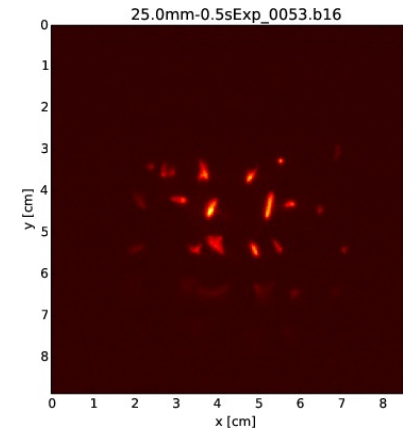
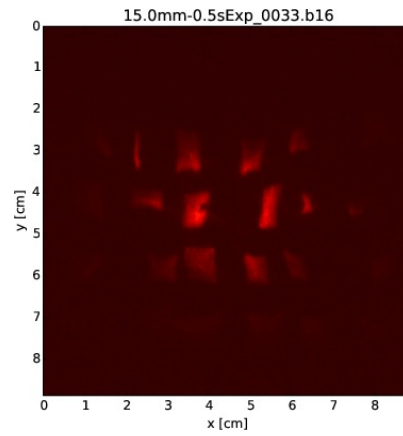
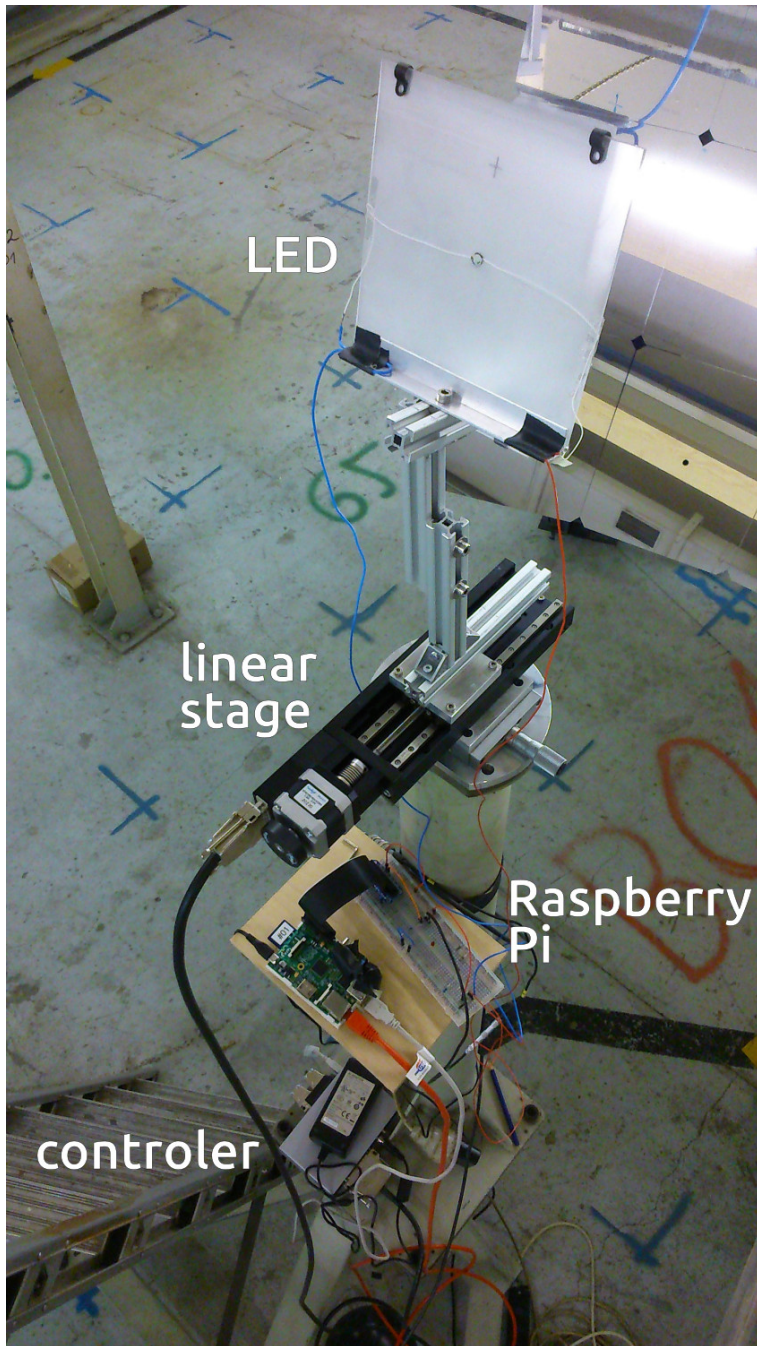
**One of four
Fluorescence Detector sites**



Standard Assembly

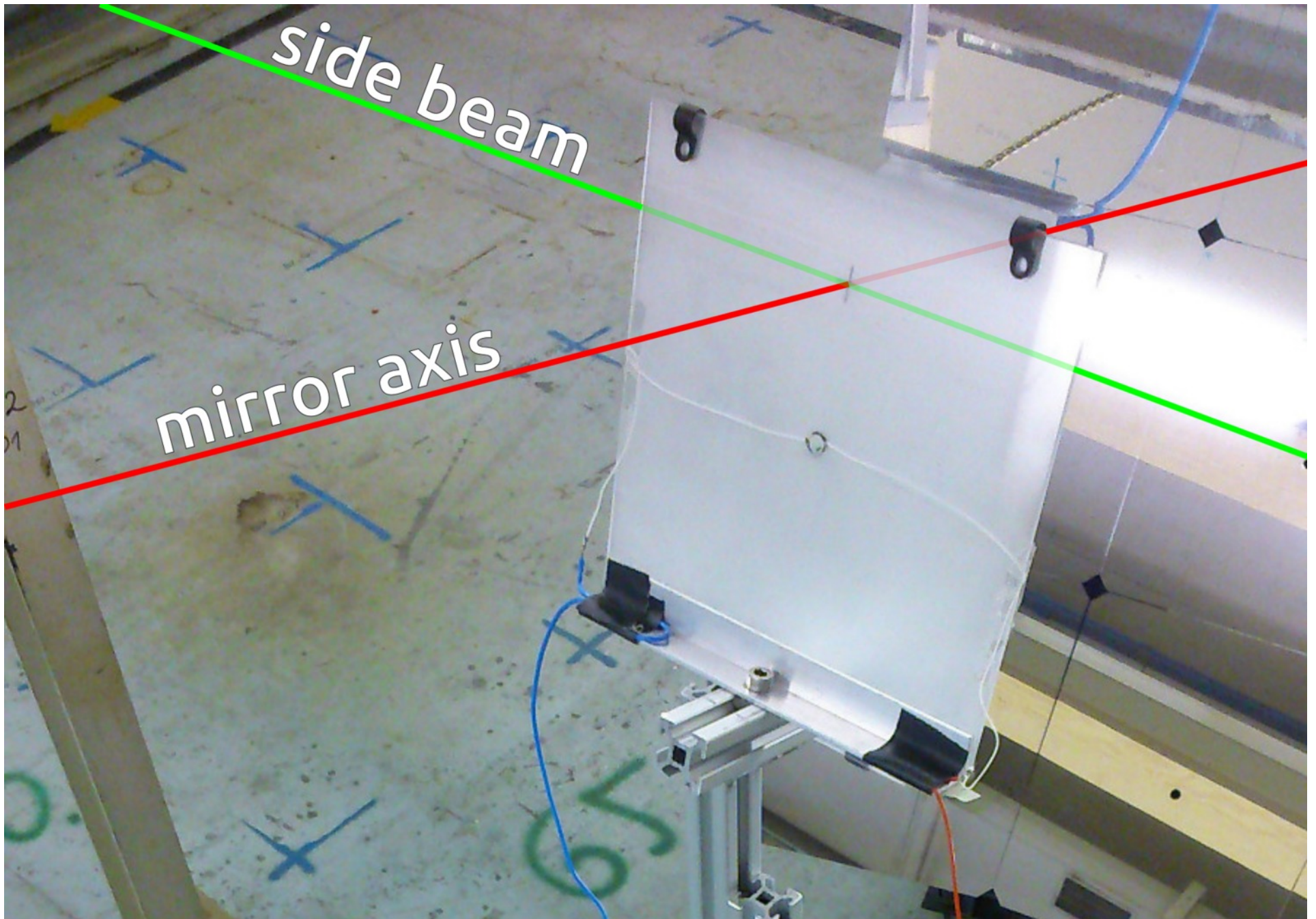


Alignment Quality

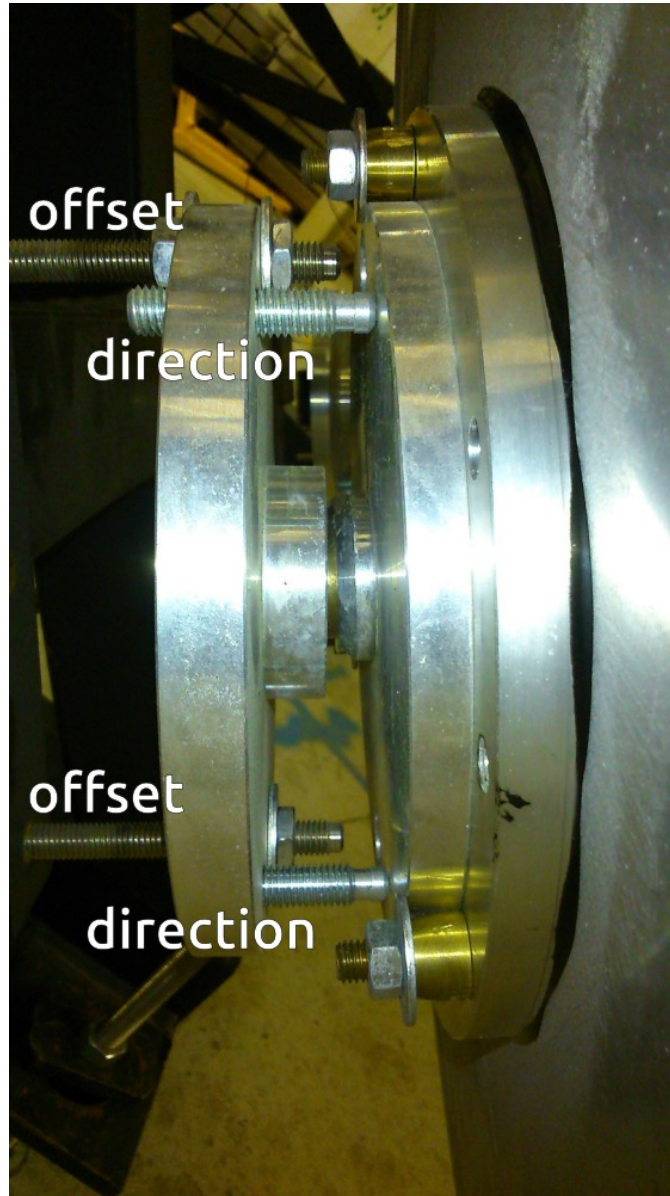


scan with
frosted glass
on a
linear stage

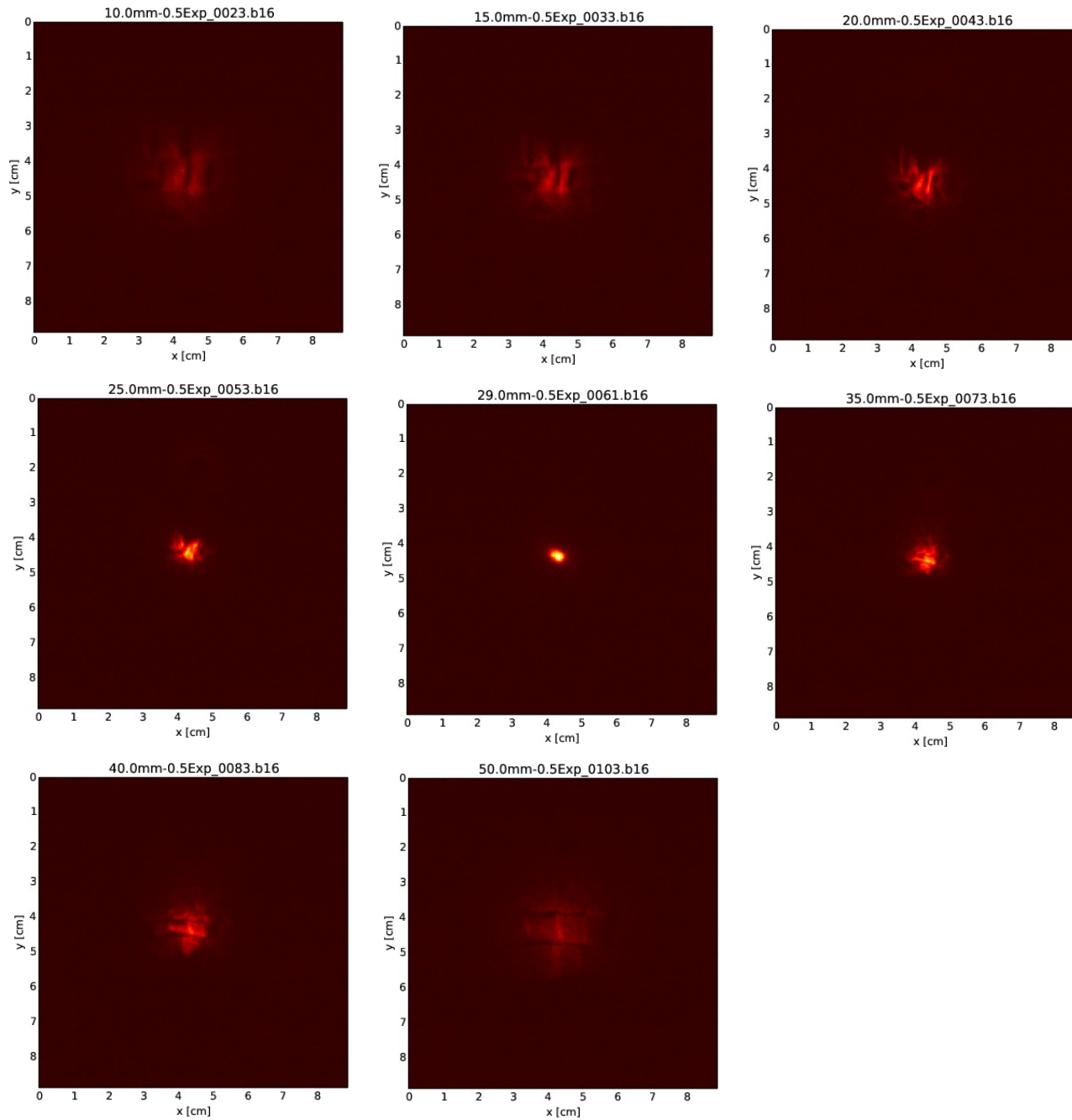
New Center Point



Fine Realignment



New alignment



New alignment

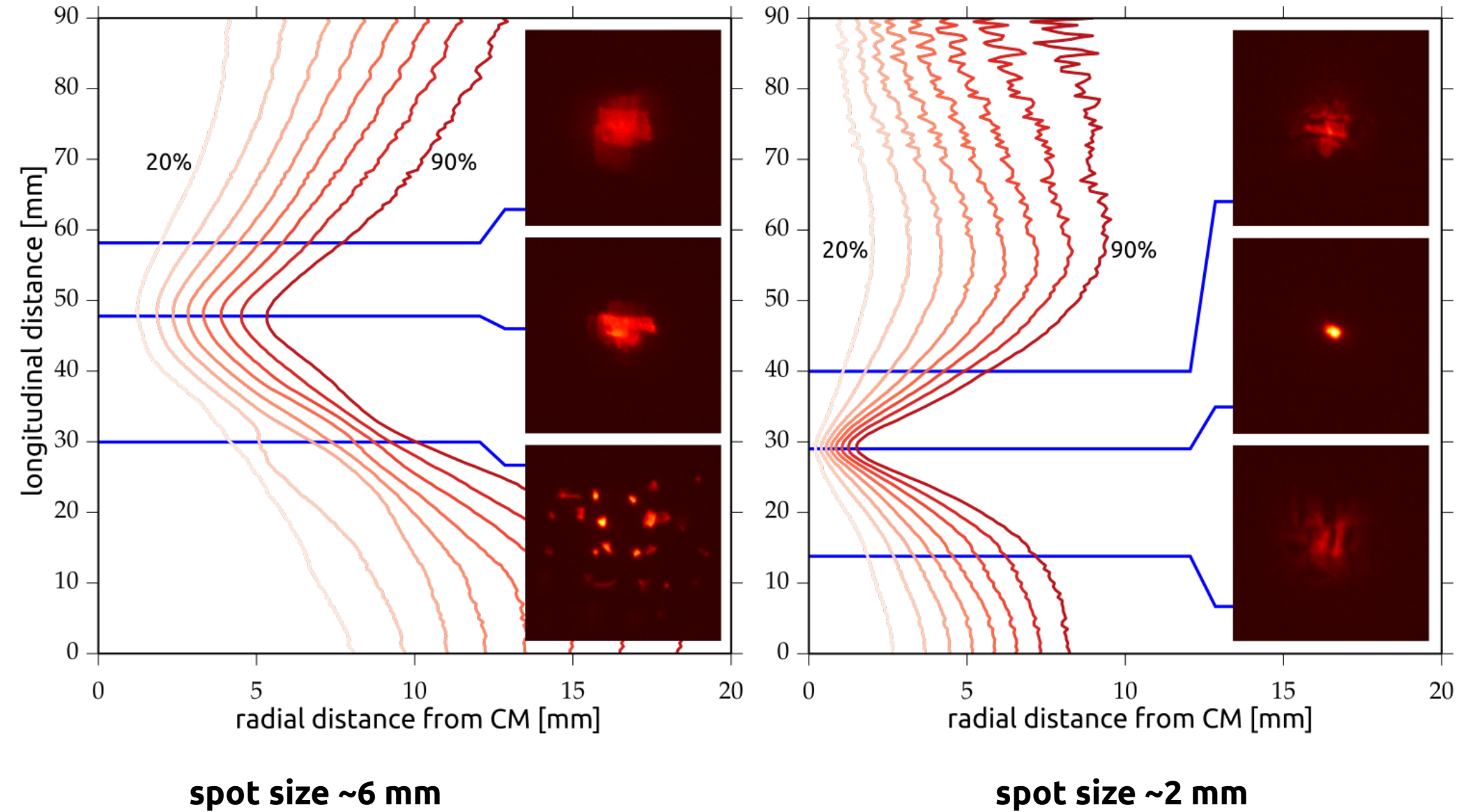
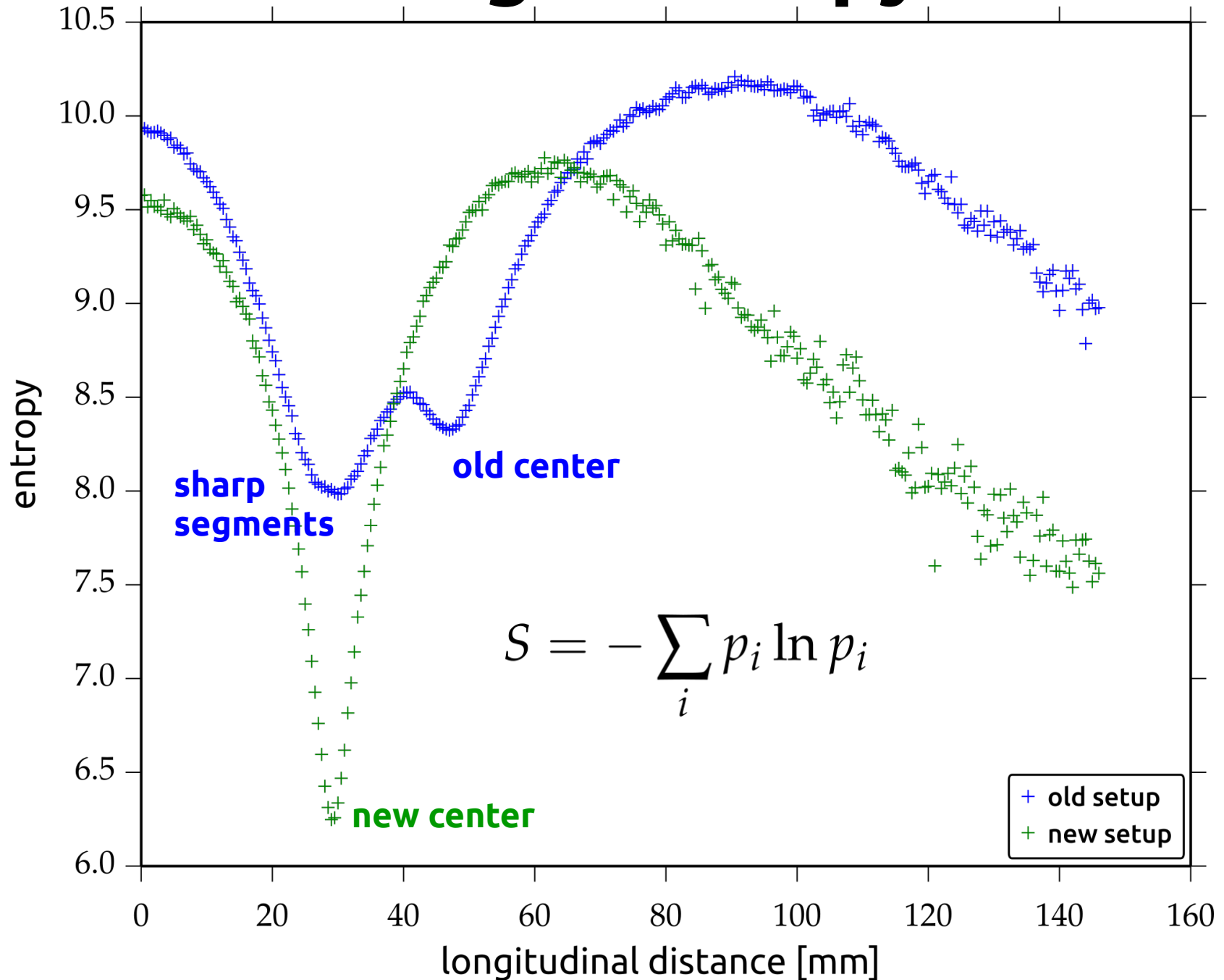
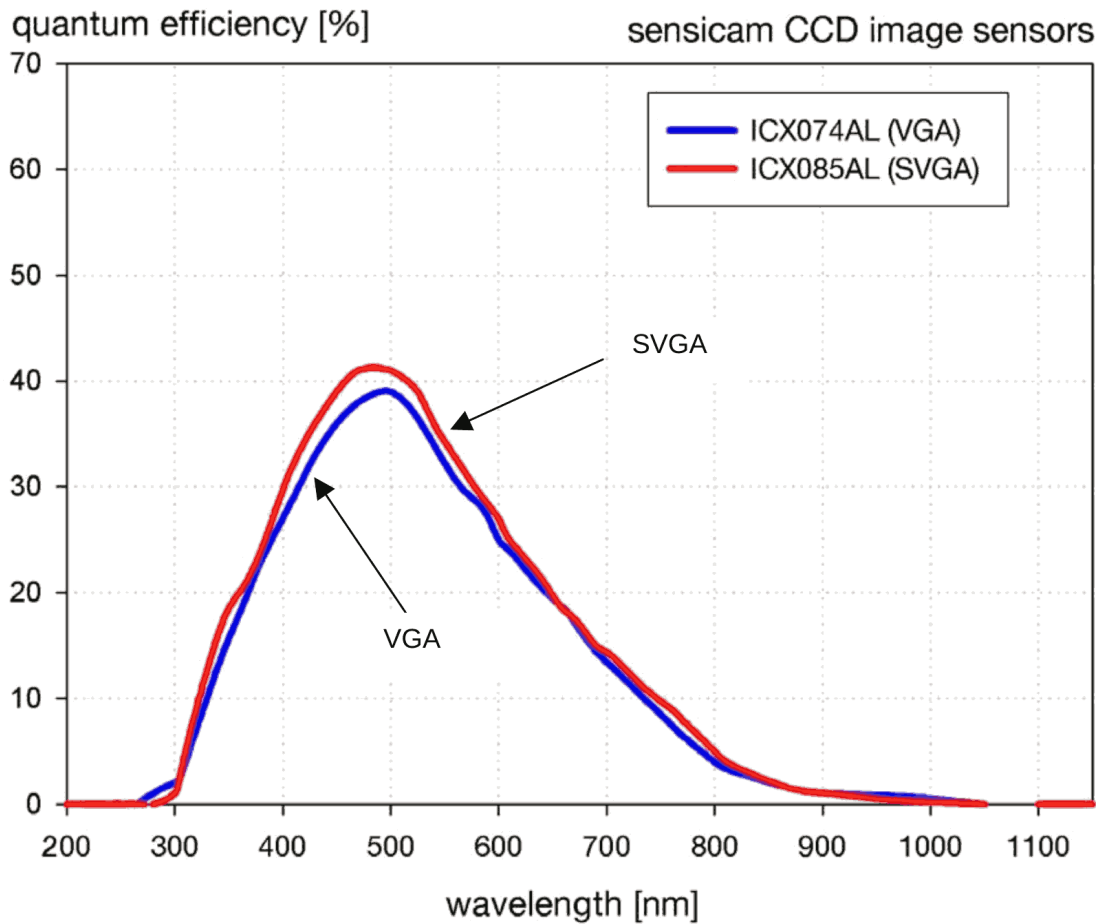


Image Entropy



Test Result



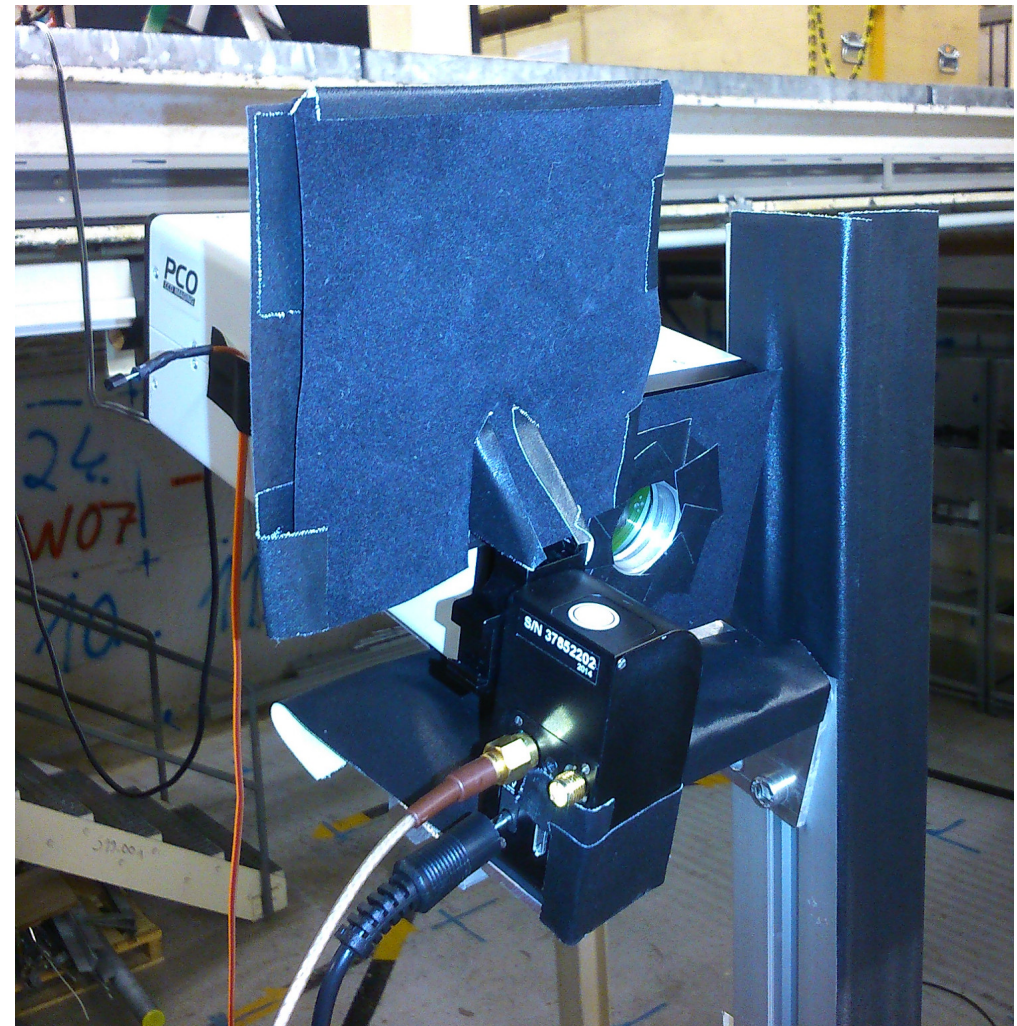
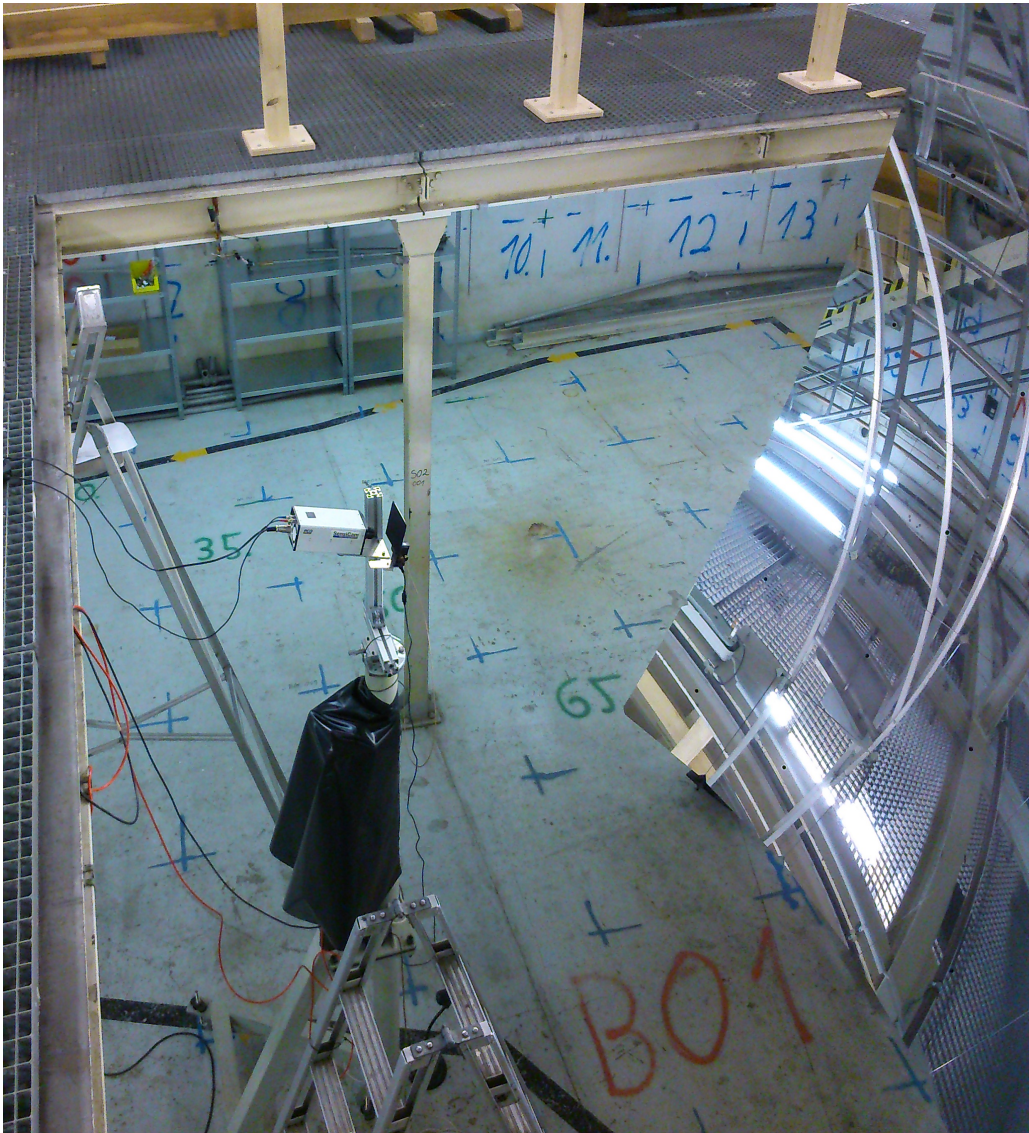
**PCO Sensicam VGA
640x480 pixel CCD
internally Peltier cooled to -15°C**

**no lense, exposed CCD 3x3mm
signal: total image intensity**

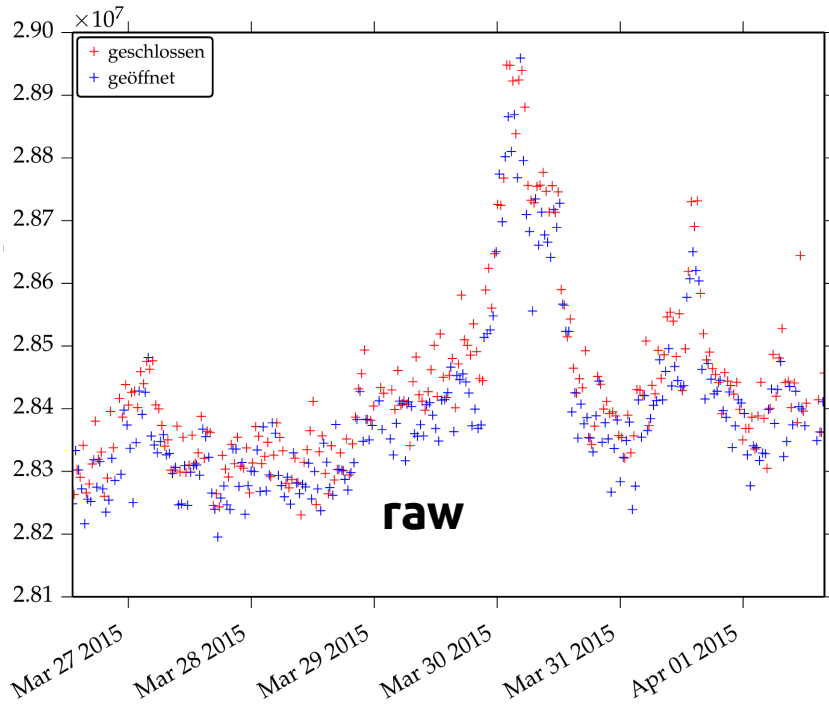


Test Result

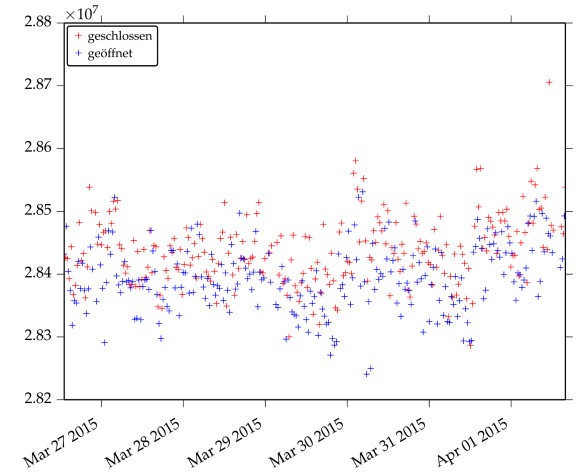
motorized shutter



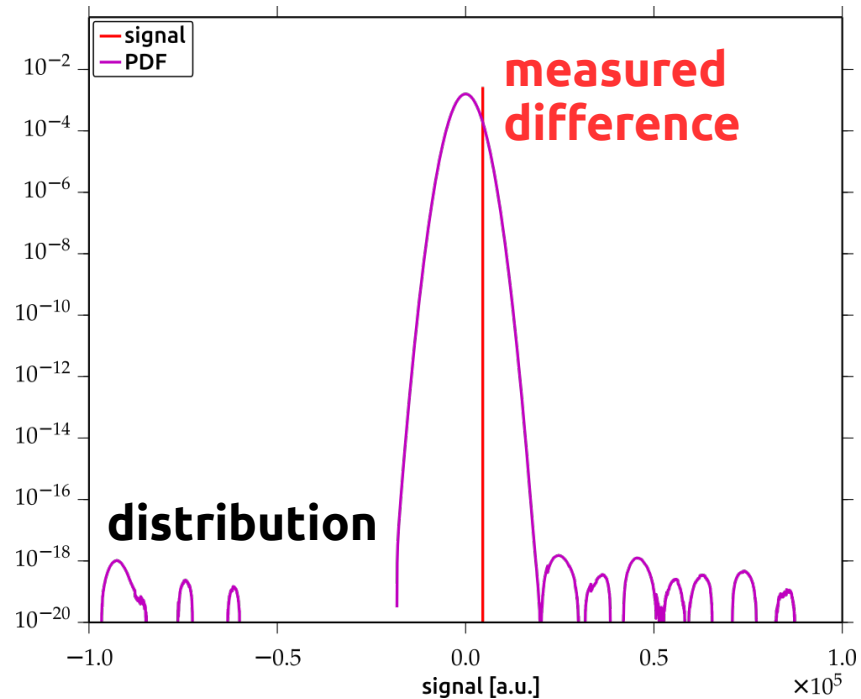
Test Result



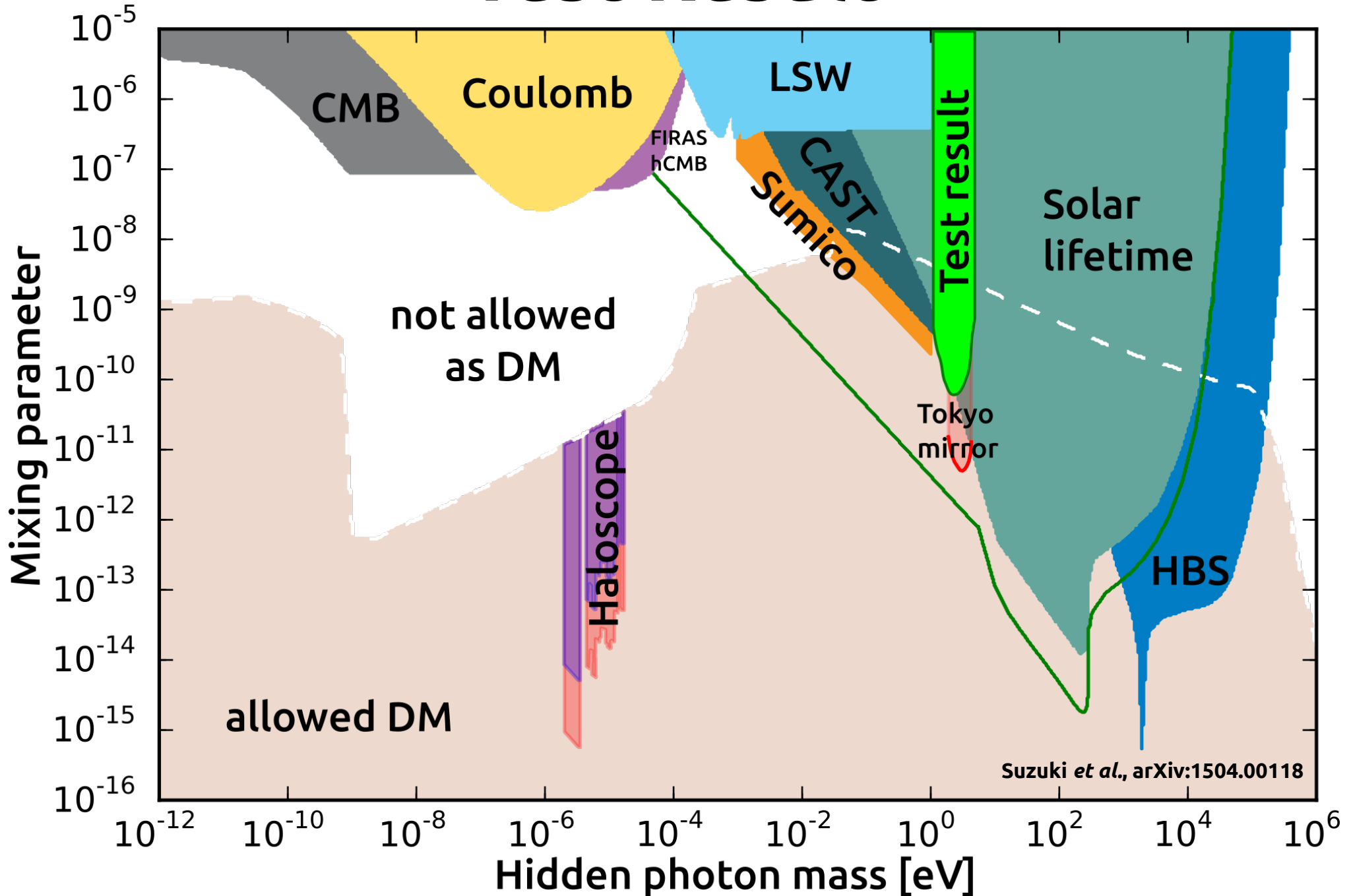
→ temperature correction →



sensitivity →
upper limit for
mixing parameter χ



Test Result



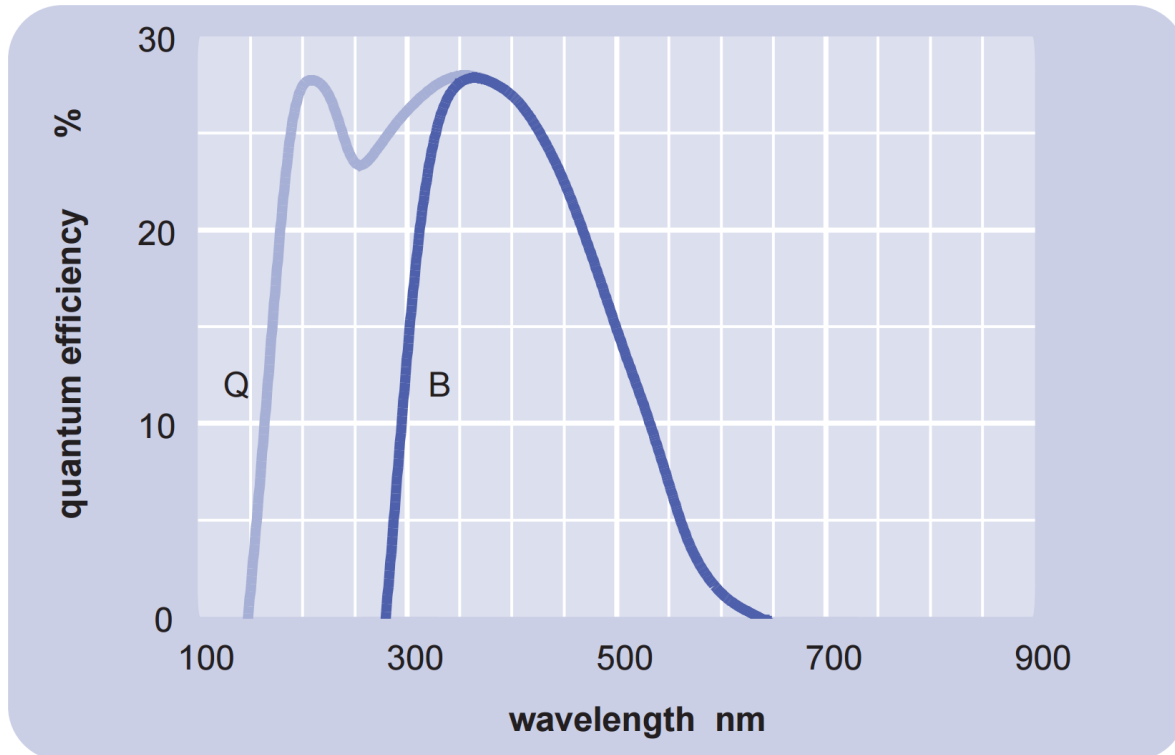
Current Sensor

Low-noise PMT



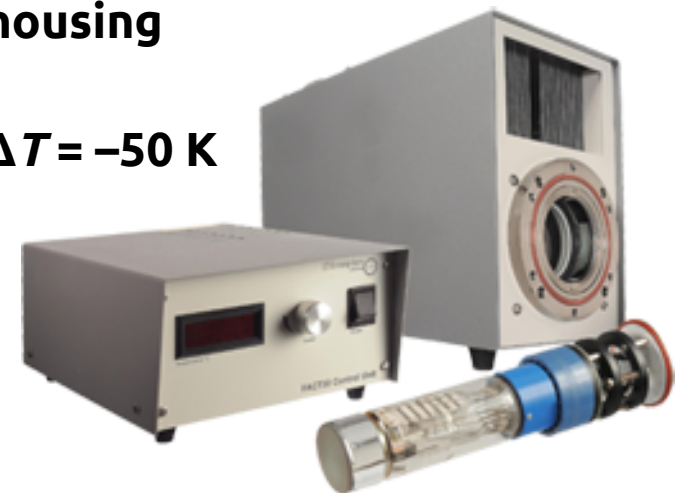
1.13" window

far-UV extended sensitivity (Q): 160→630 nm



Peltier cooled housing

$\Delta T = -50$ K



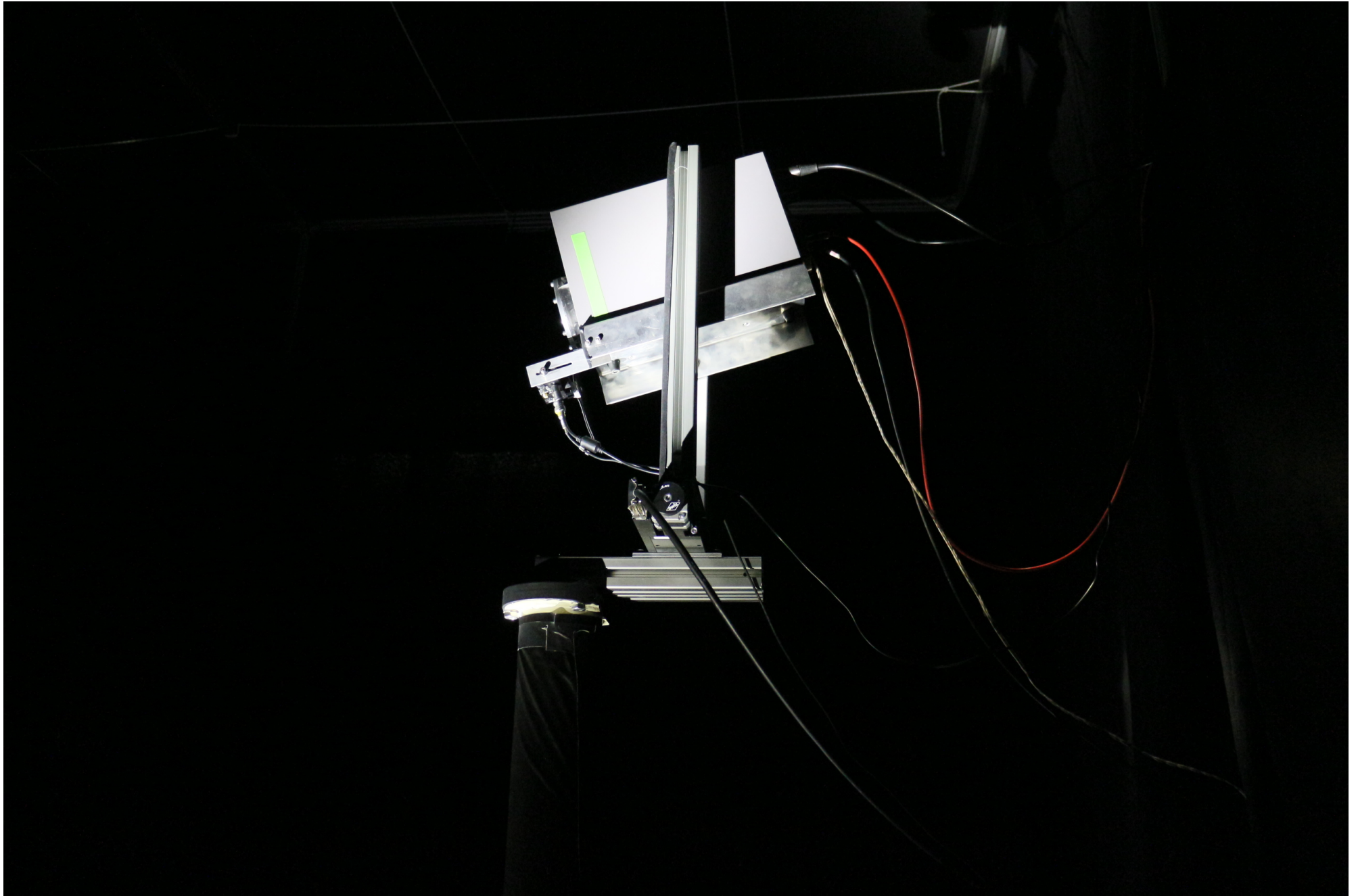
Current Setup



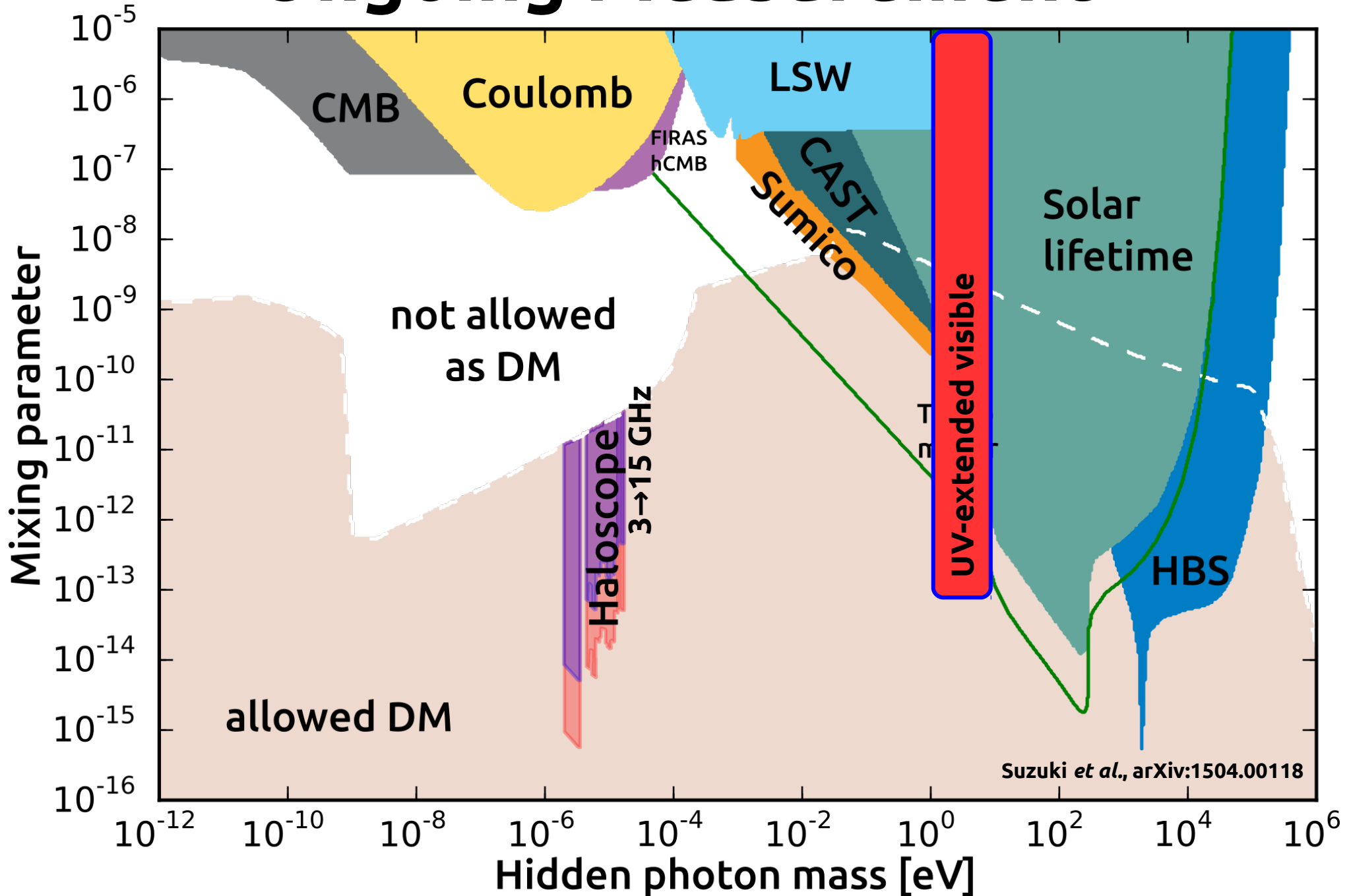
Current Setup



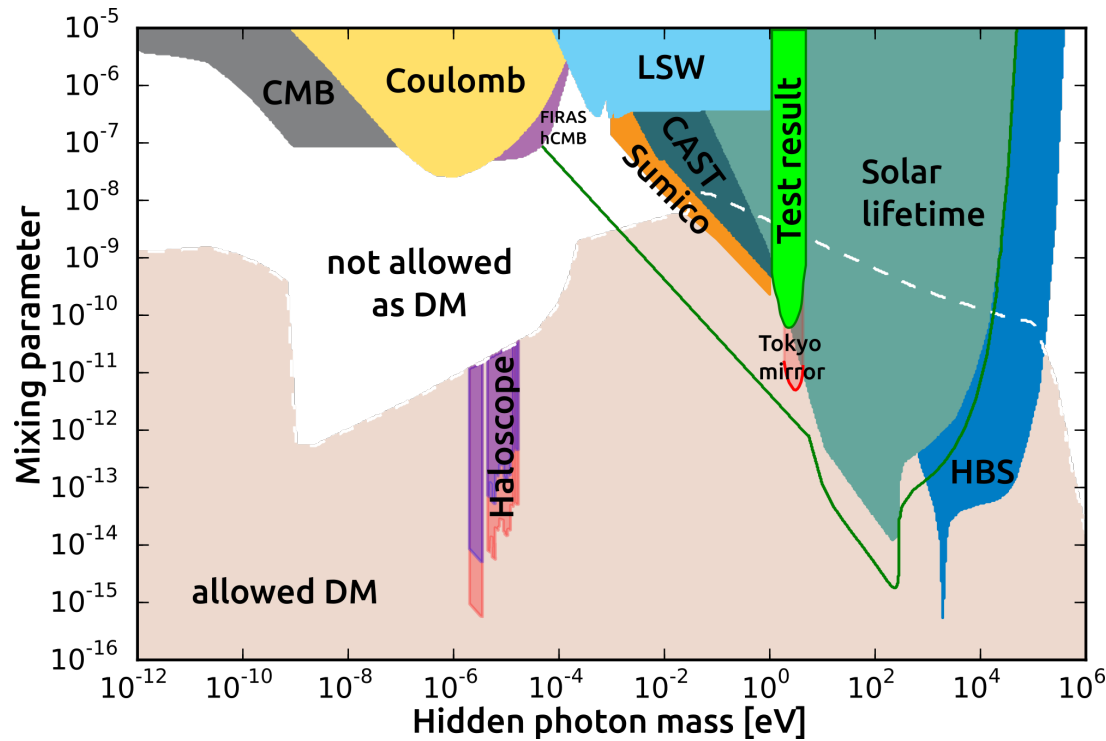
Current Setup



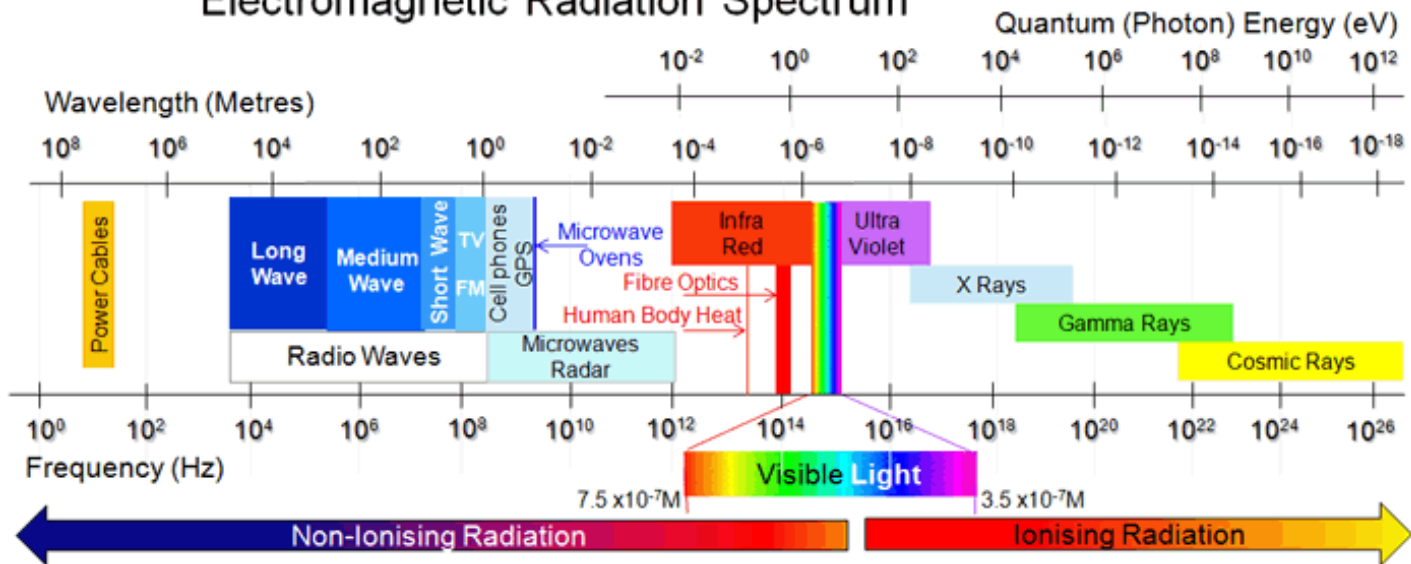
Ongoing Measurement



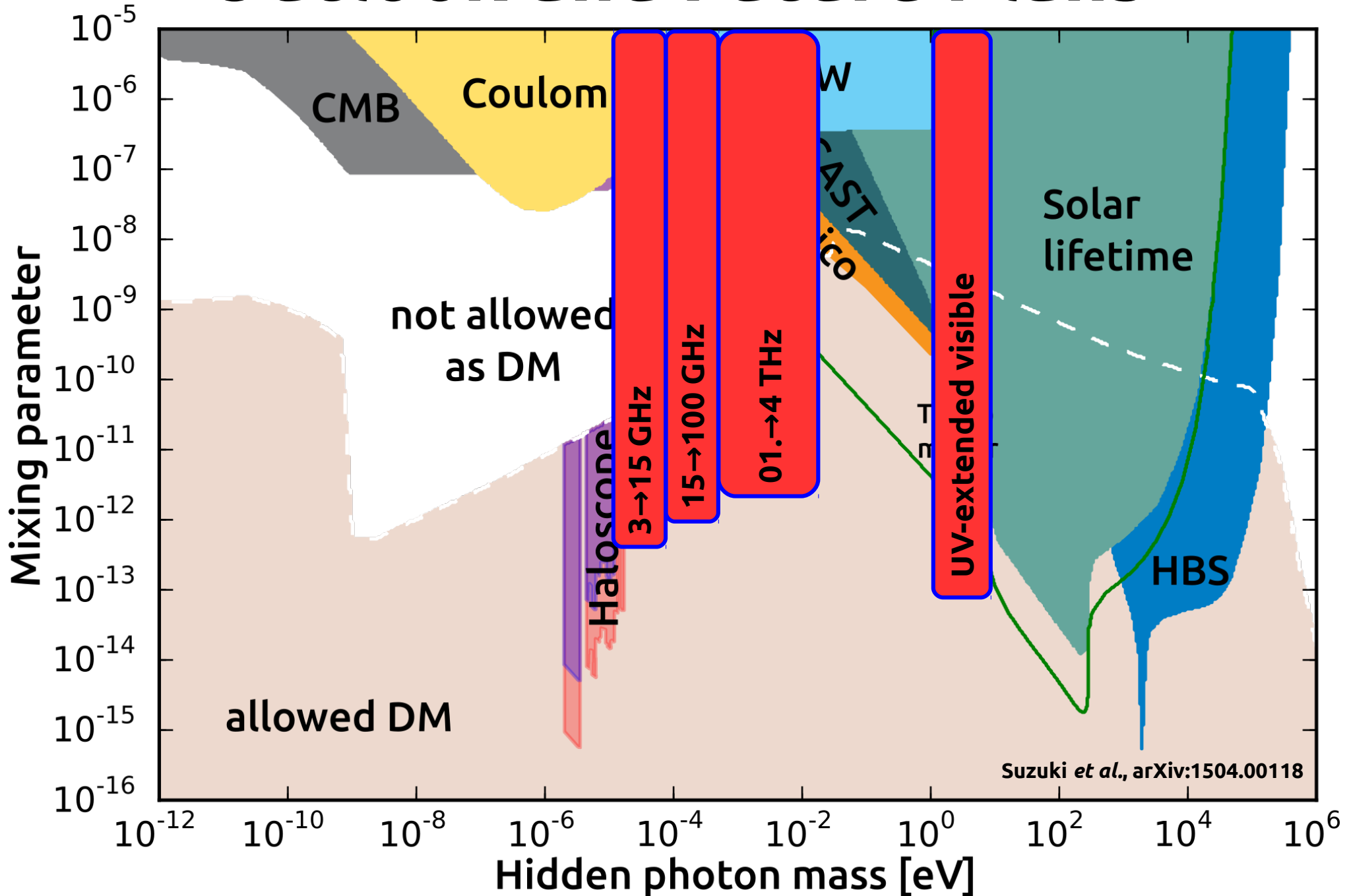
Spectrum



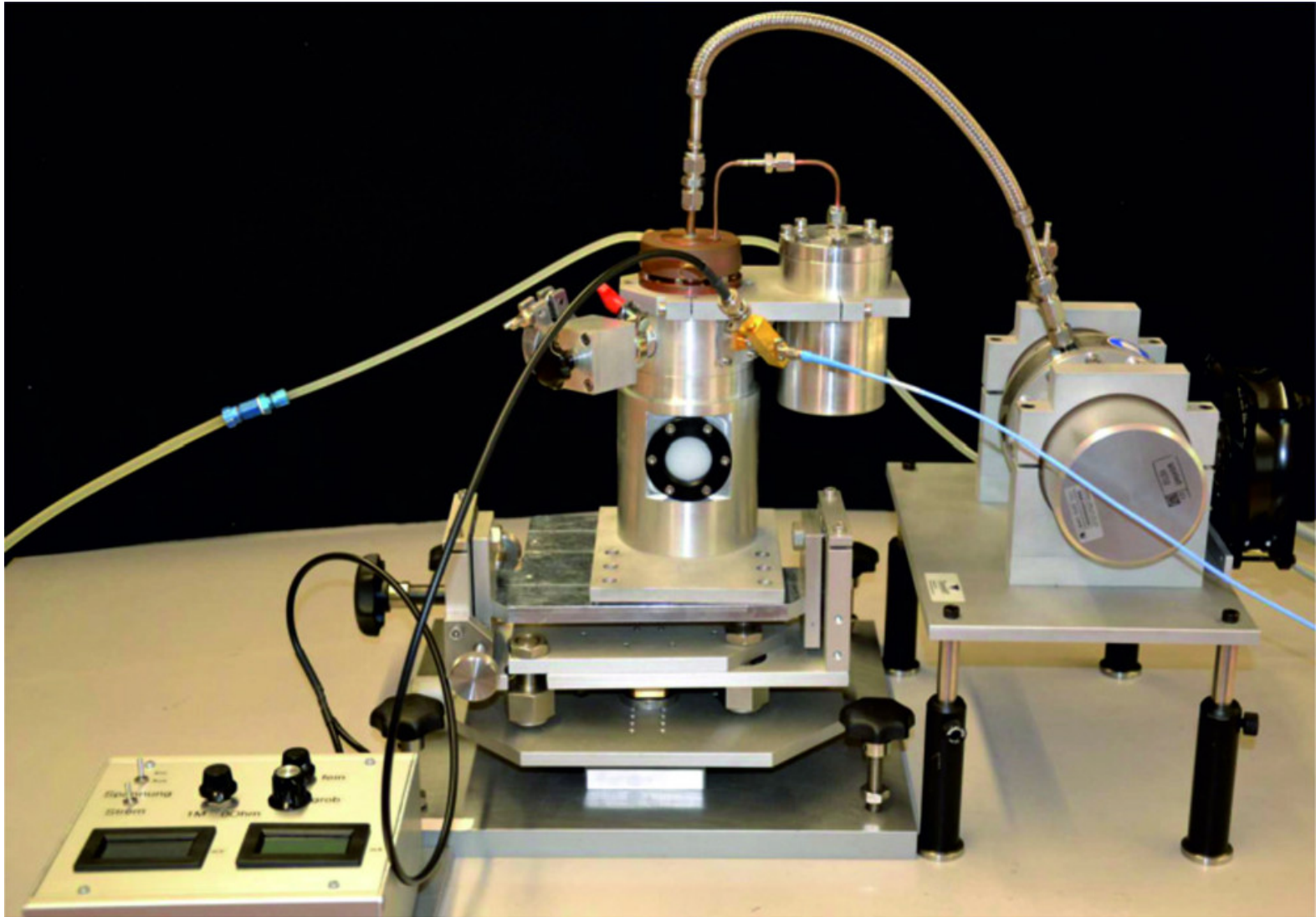
Electromagnetic Radiation Spectrum



Outlook and Future Plans



THz Band



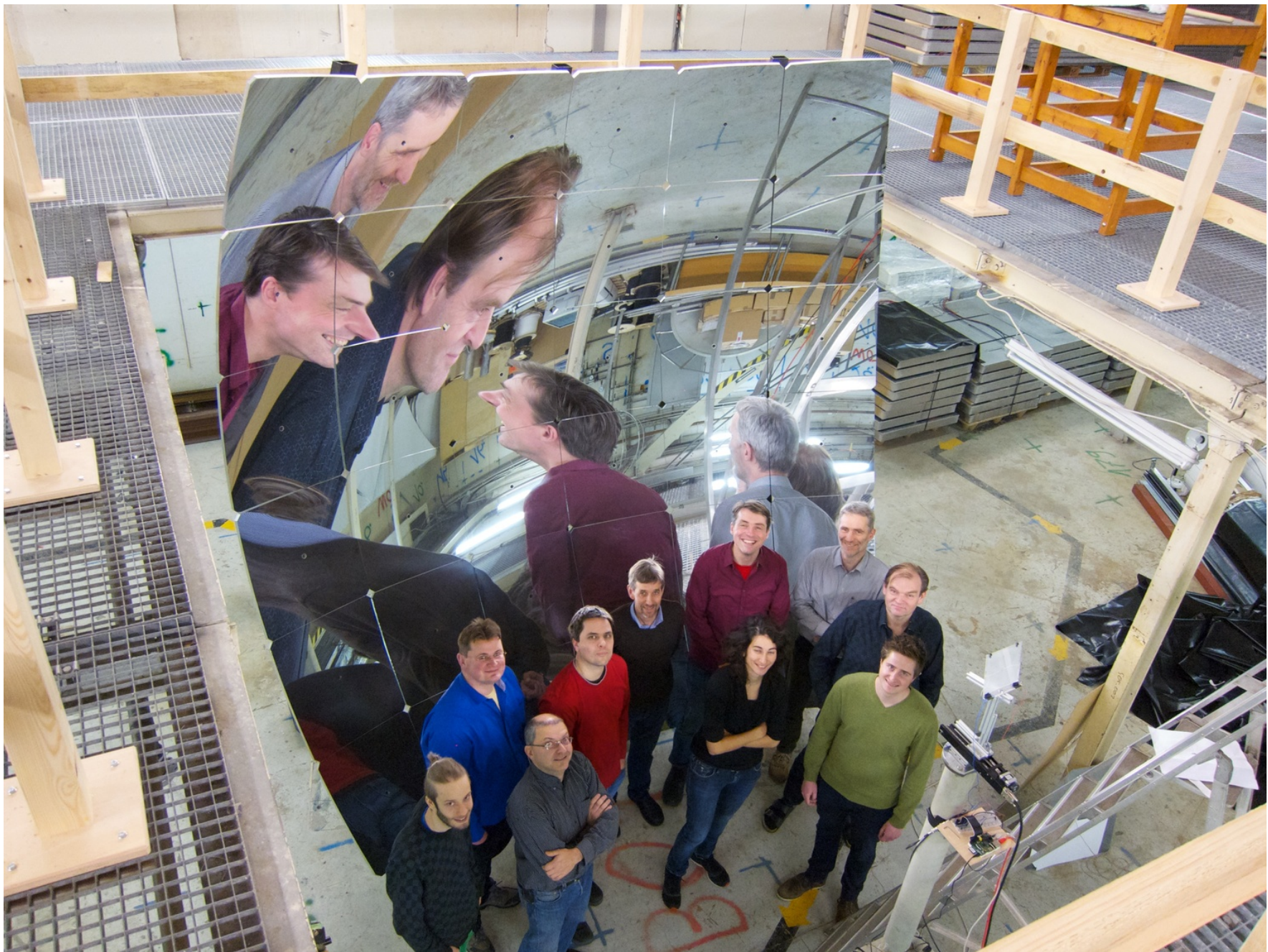
**YBCO KIT-IMS
liquid nitrogen cooled THz detector**

GHz Band

1 – 20 GHz (UHF-SHF band)



**CROME experiment
(detection of EAS in GHz)
PRL 113 (2014) 221101**



Thank you!

Backup

Funk People

