Patras 2019

Freiburg

Status and Update of the BRASS project

Le Hoang Nguyen

on behalf of the BRASS collaboration

Universität Hamburg

DER FORSCHUNG | DER LEHRE | DER BILDUNG

TUHH

Technische Universität Hamburg

Max-Planck-Institut für Radioastronomie

Light Dark Matter

- Axion and ALPs
- Hidden photons

- Mass < 1 eV
- Non thermal produced
- Motivated mass range of 10 μeV-10 meV (2.4 GHz -2.4 THz).

Experiments

Haloscope

- ADMX, CAST-RADES
- CULTASK, CASPEr,
- ABRACADABRA
- ORGAN,MADMAX, …

Light-shining through-wall

- OSQAR
- ALPS
- CROWS

Helioscope

- CAST
- SHIPS
- IAXO

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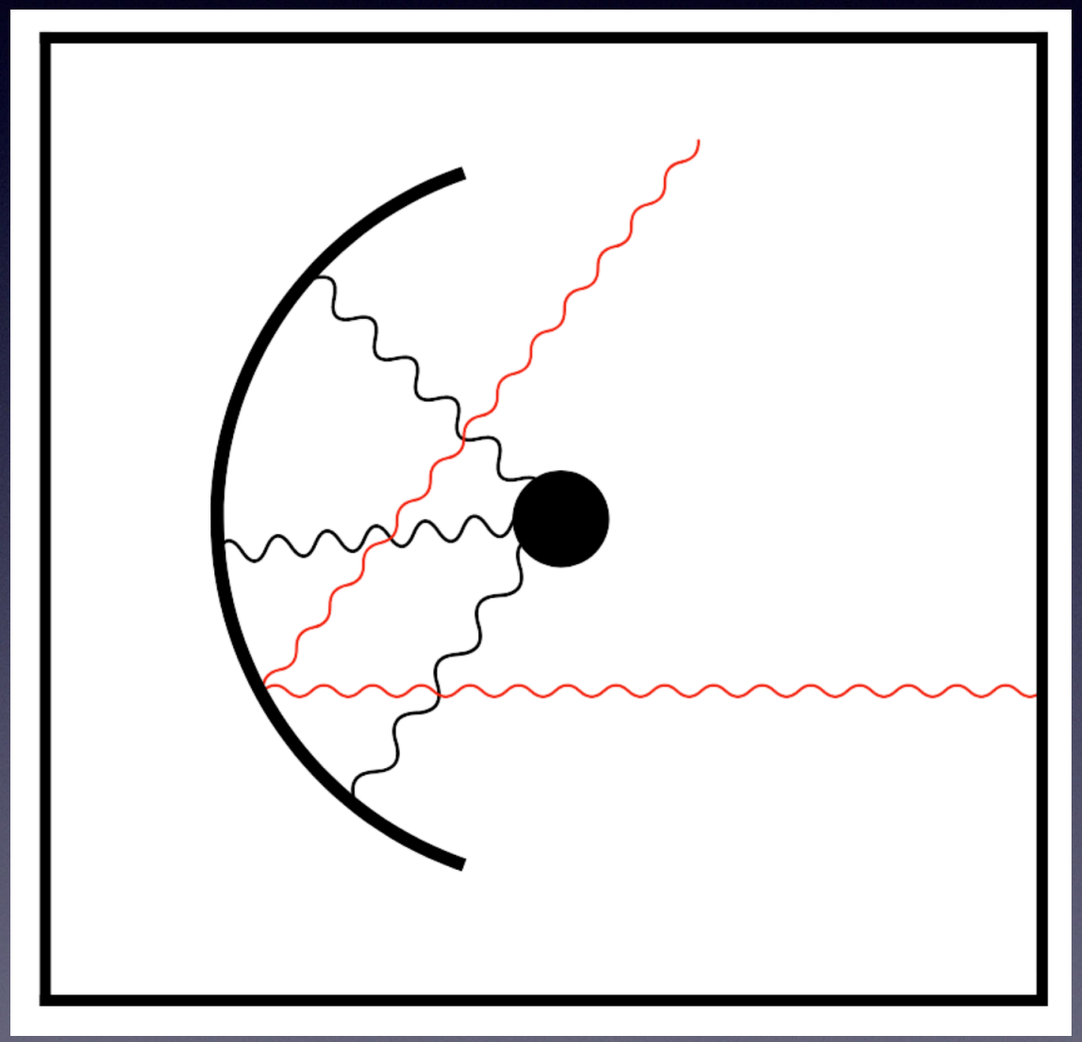
BRASS

Broadband
Radiometric
Axion **S**earche**S**

DM detection with dish antenna

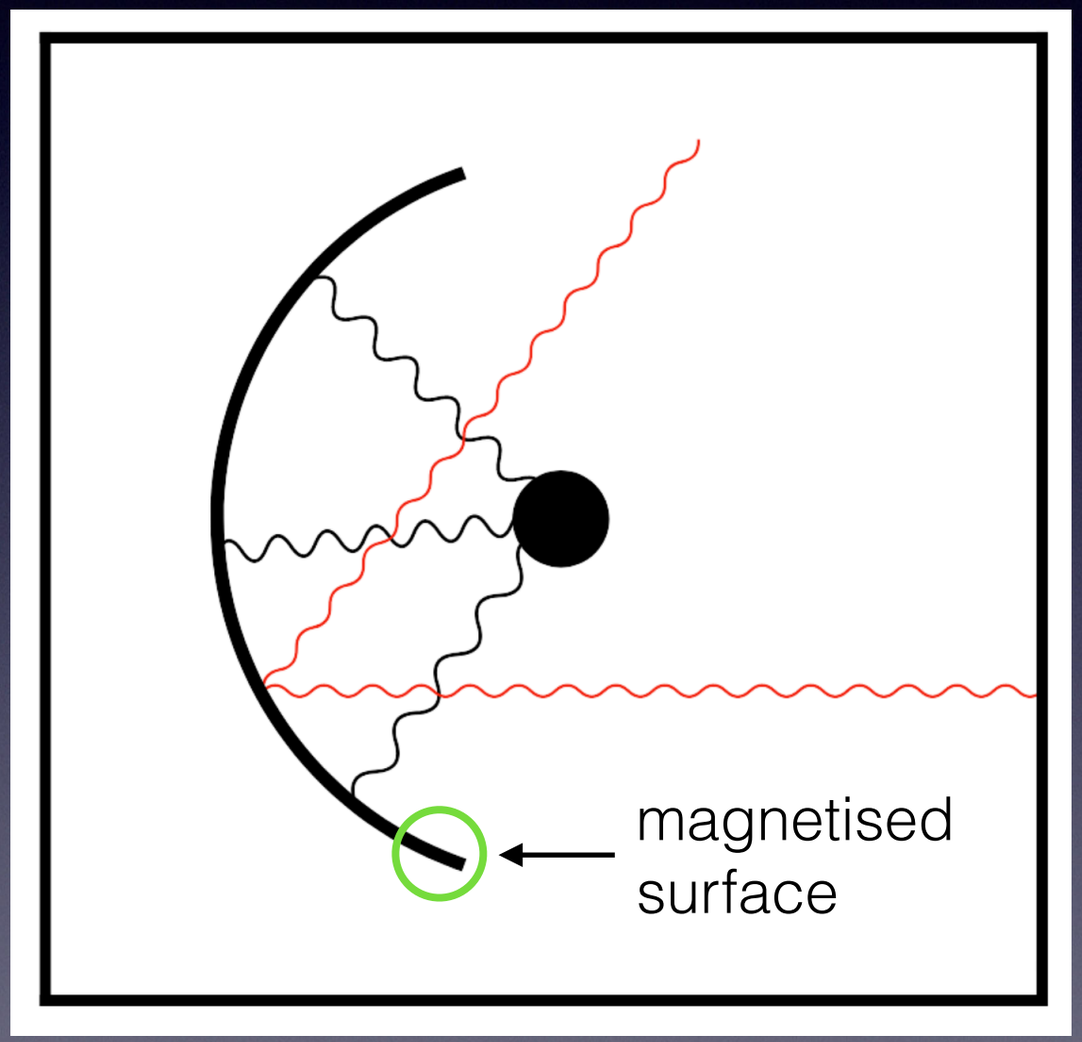


For Hidden Photon

$$\chi = 4.5 \times 10^{-14} \left(\frac{P_{\rm det}}{10^{-23}{\rm W}} \right) \left(\frac{0.3\ {\rm GeV/cm}^3}{\rho_{\rm CDM,\ halo}} \right)^{1/2} \times \left(\frac{1\ {\rm m}^2}{A_{\rm dish}} \right)^{1/2} \frac{\sqrt{2/3}}{\alpha}$$

[Horns et.al. 2013 arXiv:1212.2970]

DM detection with dish antenna

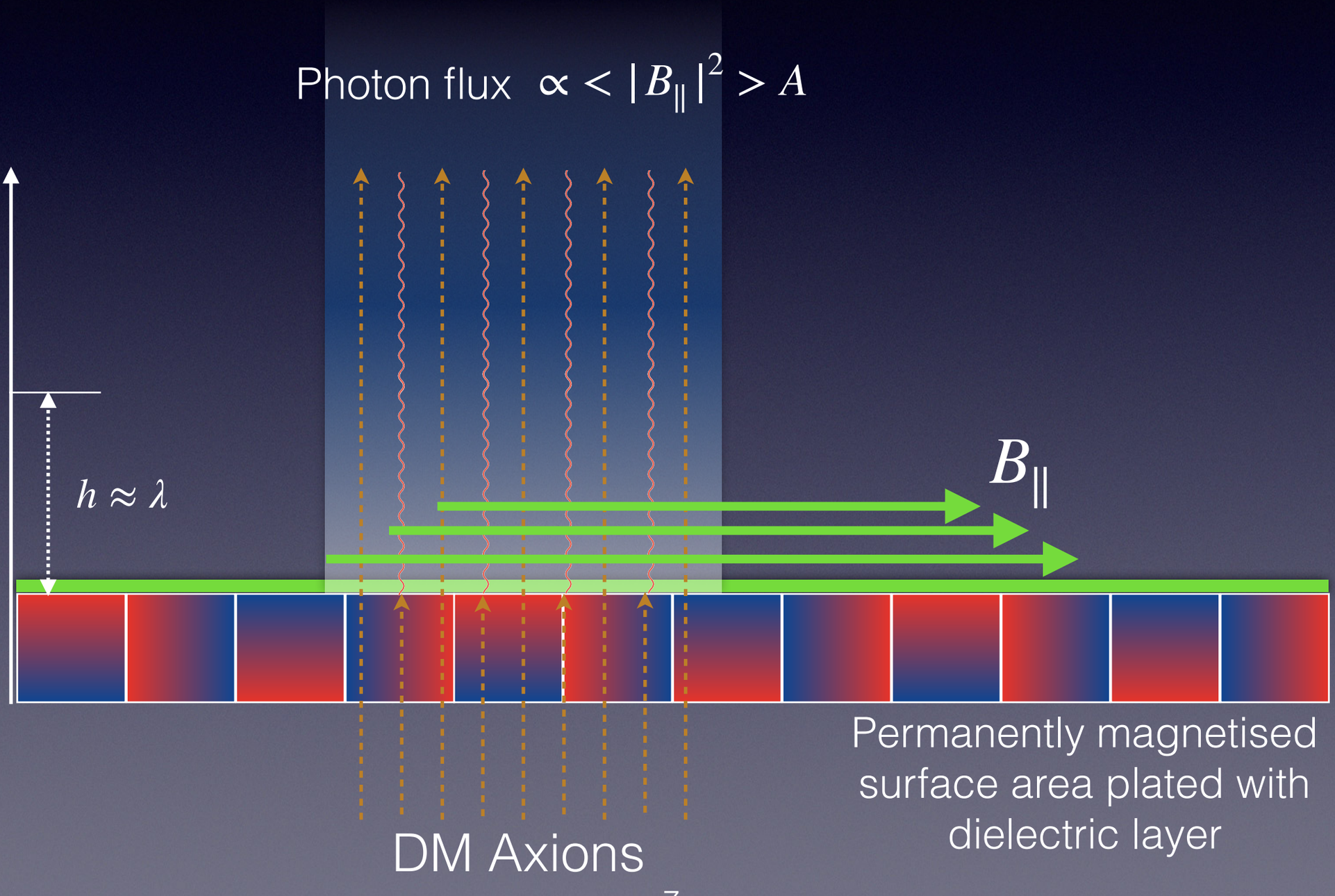


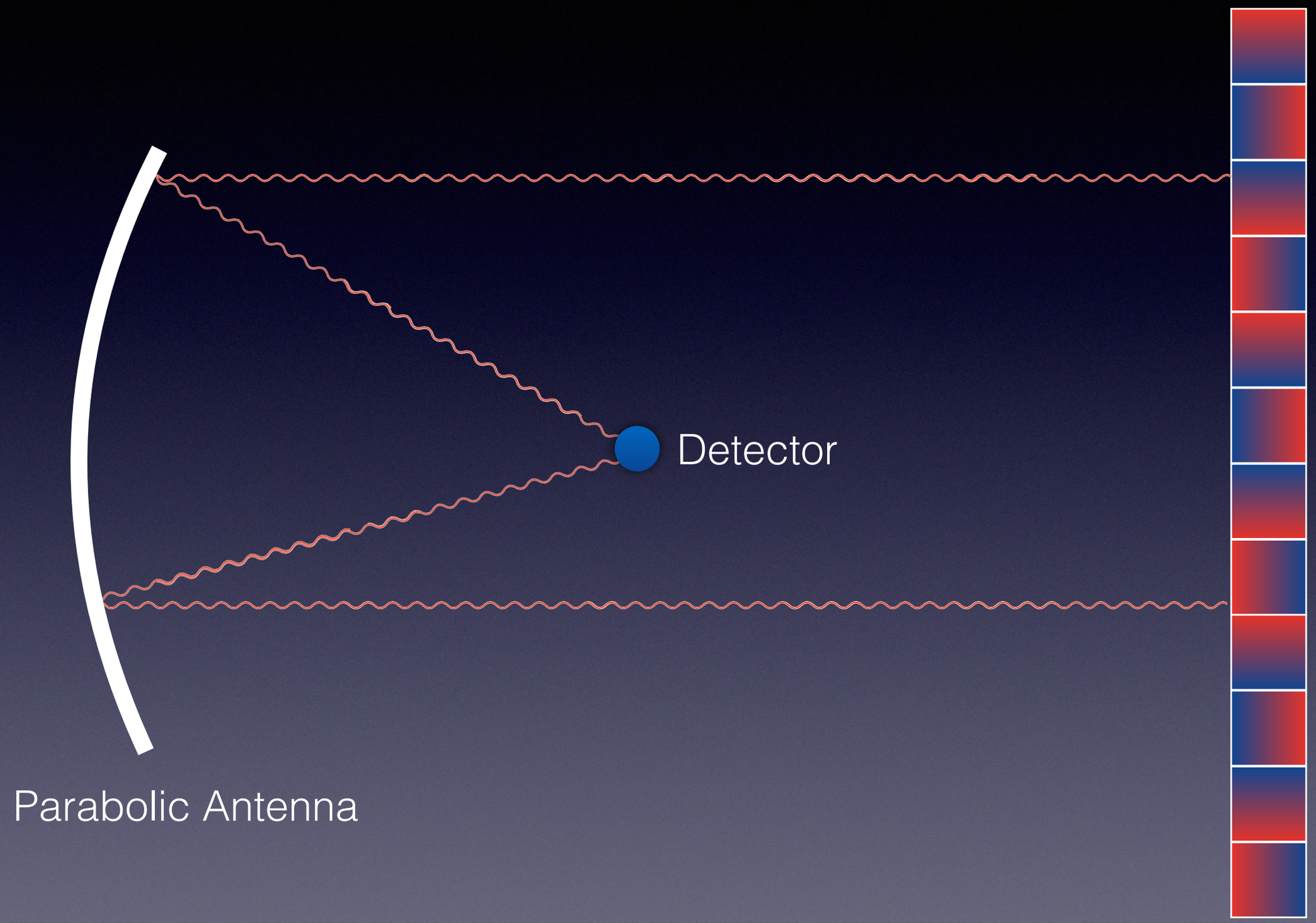
For Axion/ALPs

$$g_{a\gamma\gamma} = \frac{1.8\times10^{-7}}{\mathrm{GeV}} \frac{1\mathrm{T}}{\sqrt{|B_{\parallel}|^2}} \left(\frac{P_{\mathrm{det}}}{10^{-23}\mathrm{W}}\right)^{1/2} \times \left(\frac{m_a}{\mathrm{eV}}\right) \left(\frac{0.3\ \mathrm{GeV/cm}^3}{\rho_{\mathrm{CDM,\ halo}}}\right)^{1/2} \left(\frac{1\ \mathrm{m}^2}{A_{\mathrm{dish}}}\right)^{1/2}$$

[Horns et.al. 2013 arXiv:1212.2970]

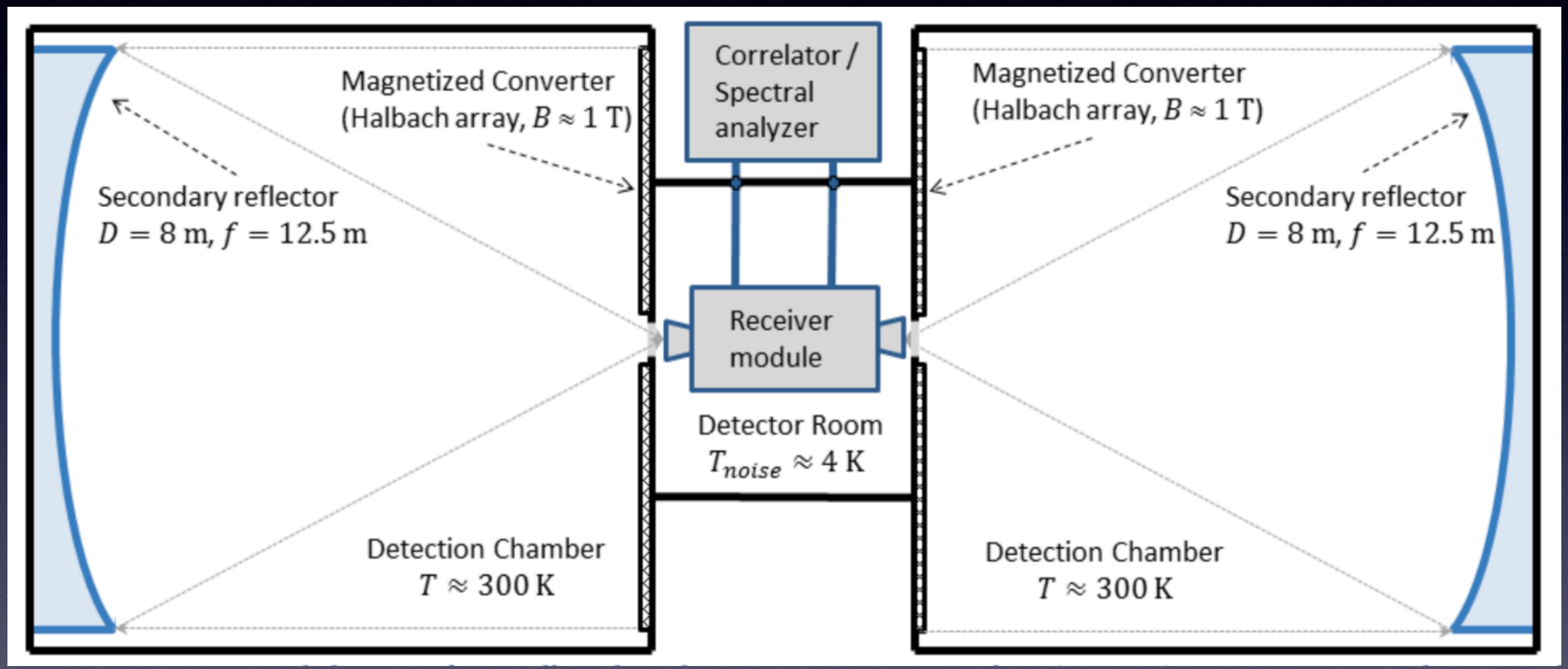
Flat Conversion Surface




Detector
Parabolic Antenna

BRASS

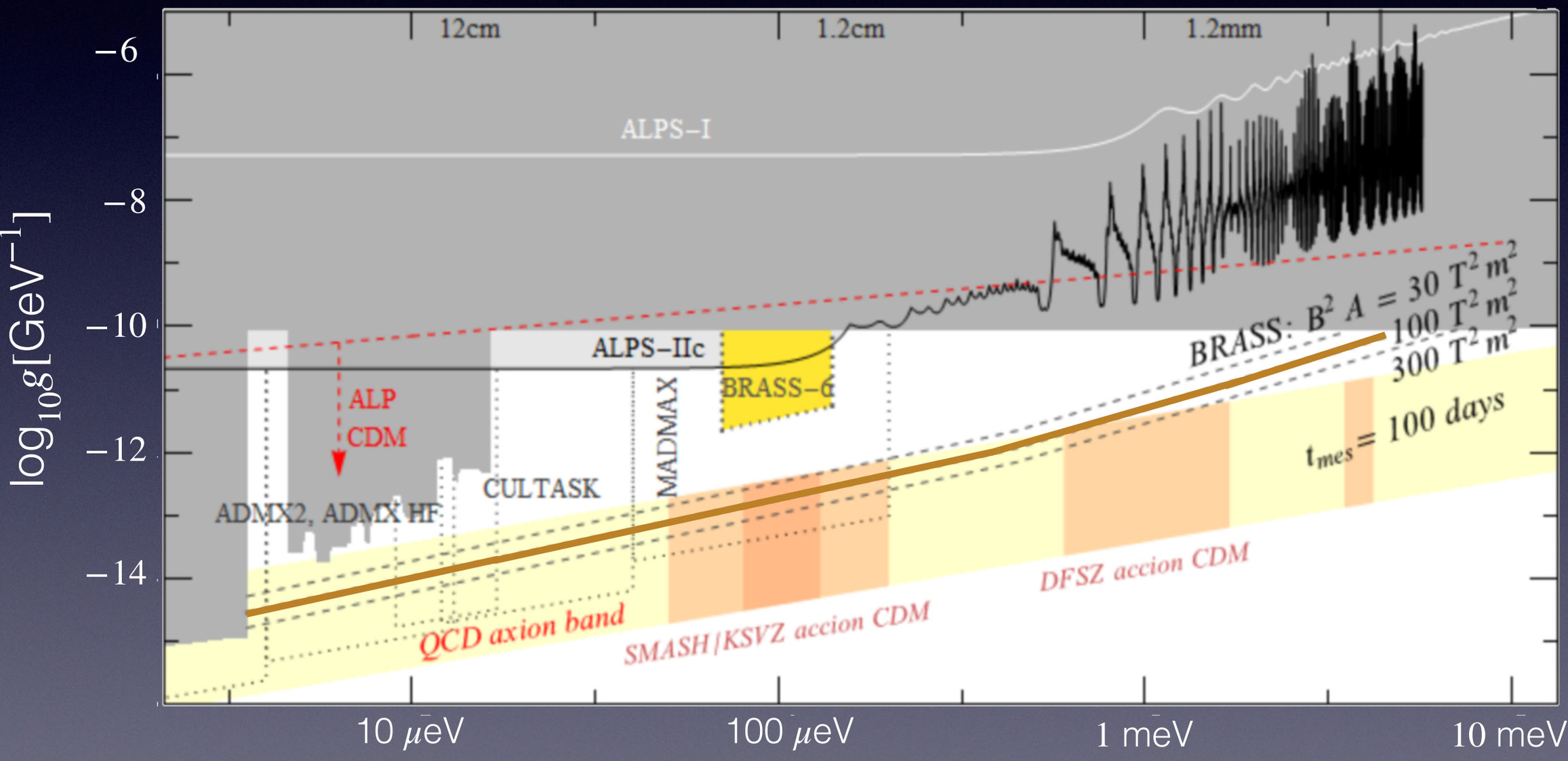
Schematic Design



1. Permanently magnetised surface.
2. Dish antenna for photon signal concentration.
3. Broadband acquisition (16 GHz BW, ~10^7channels).

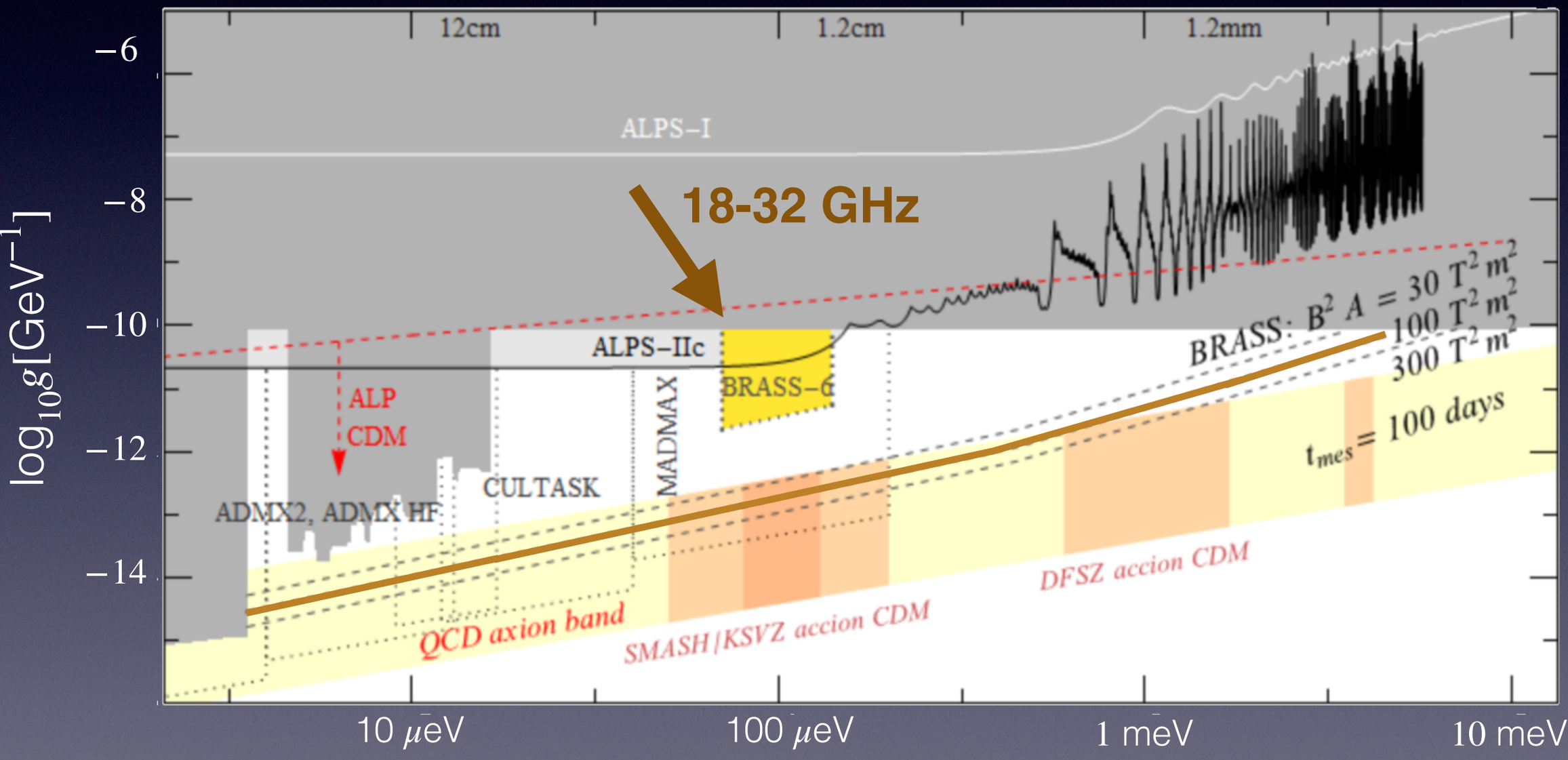
BRASS

Expected Sensitivity

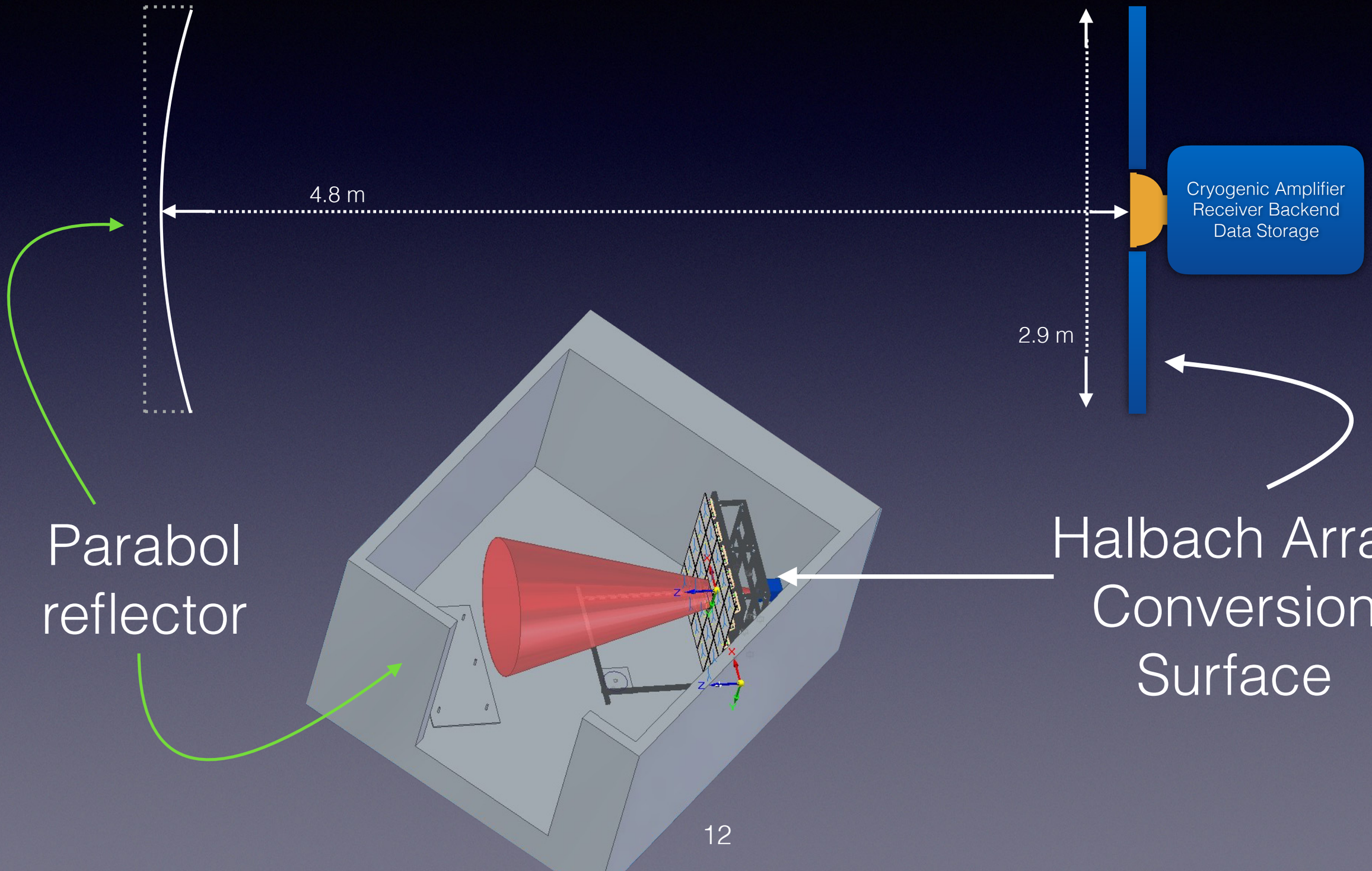


BRASS

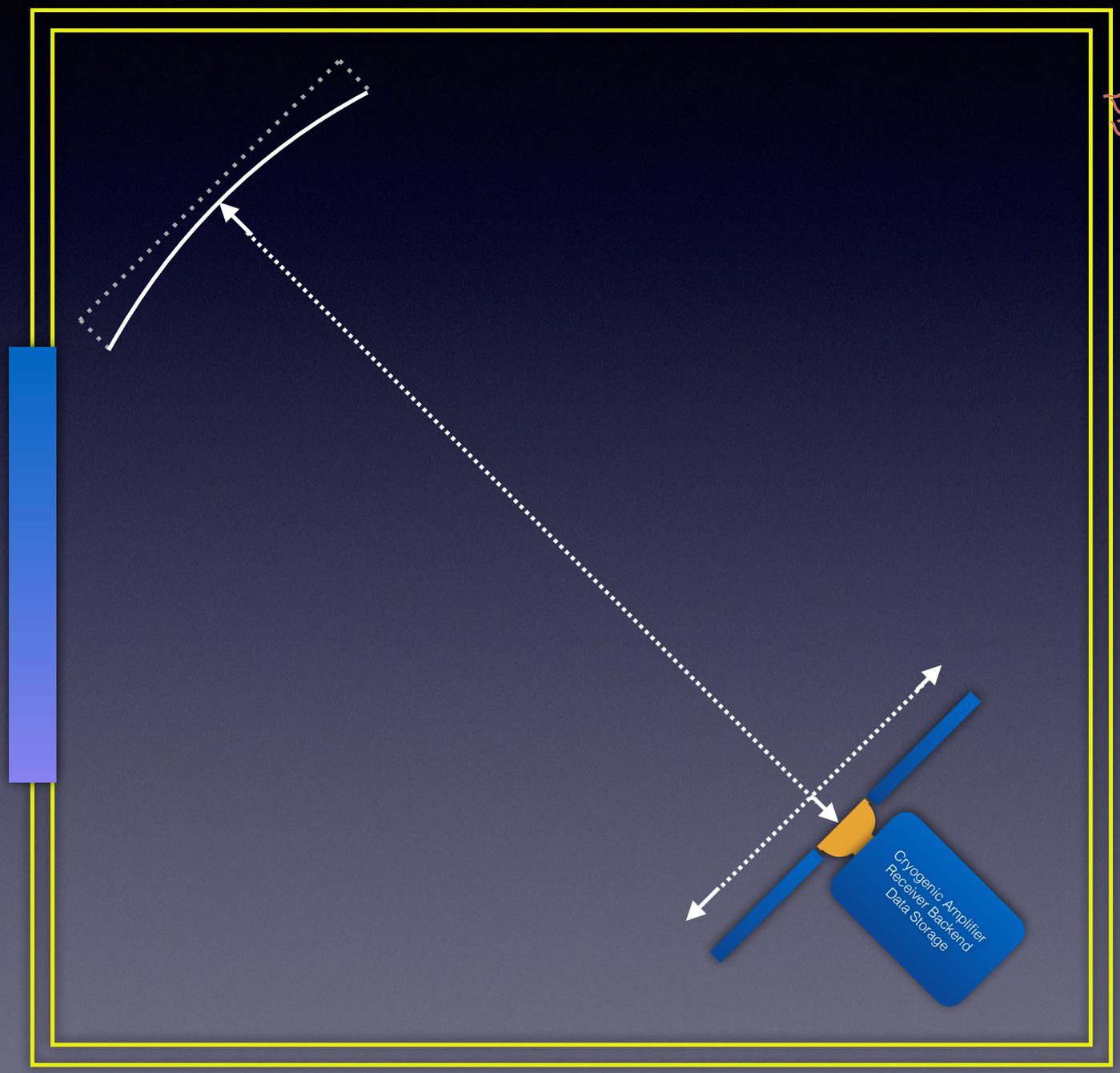
Expected Sensitivity



BRASS-6


4.8 m
2.9 m
Cryogenic Amplifier
Receiver Backend
Data Storage
Parabol
reflector
Halbach Array
Conversion
Surface

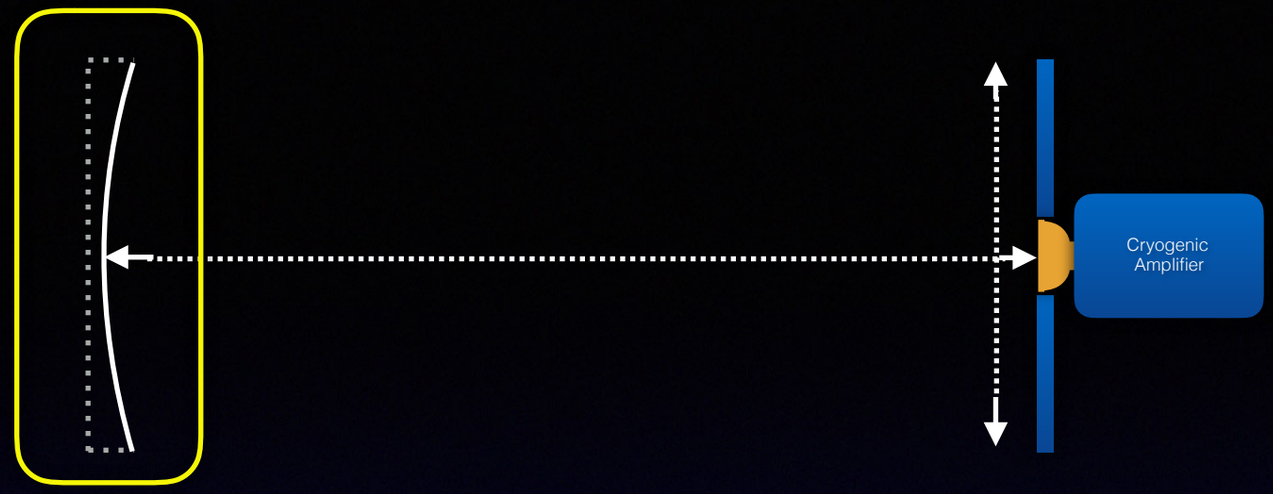
BRASS-6

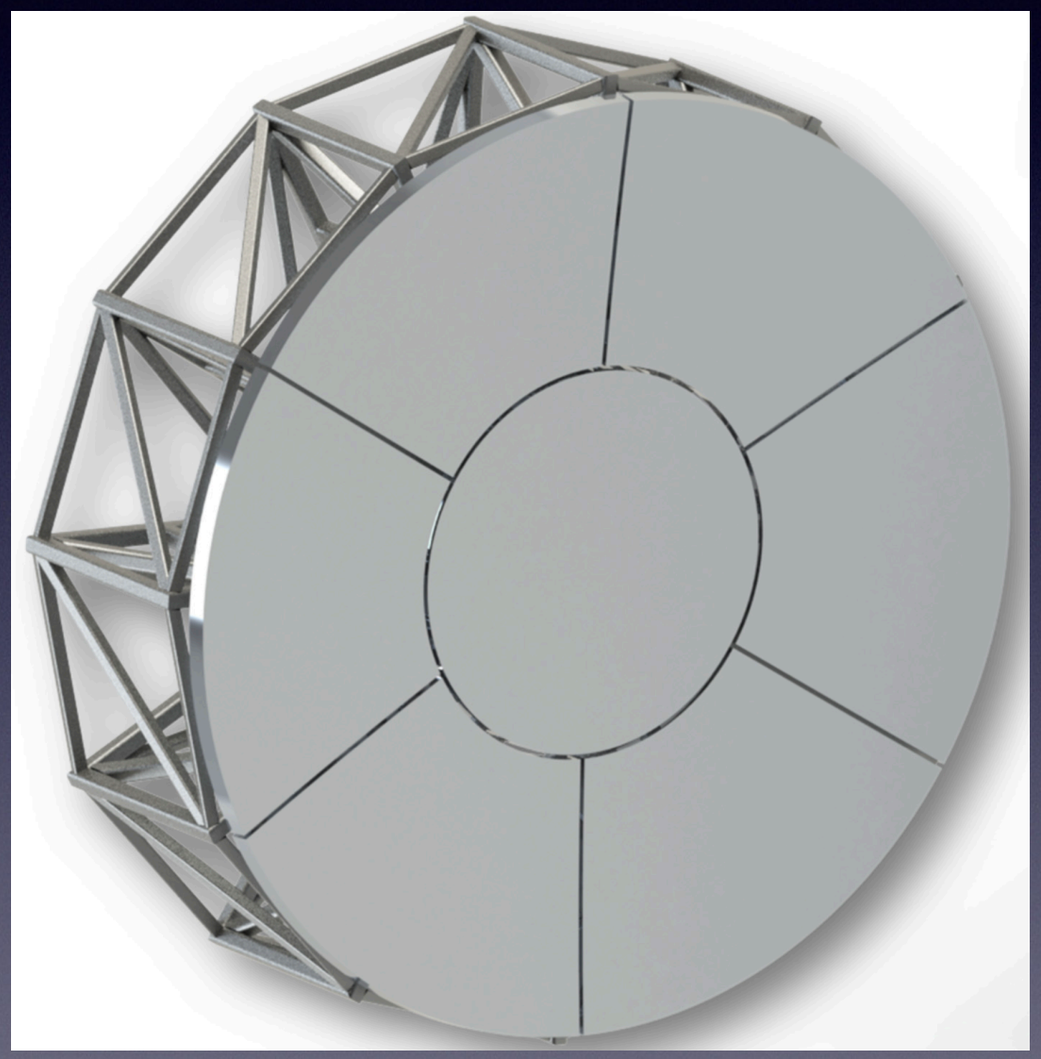


Radio shielded lab from 9 kHz to 8 GHz (-80 dB)

BRASS-6

Dish Reflector

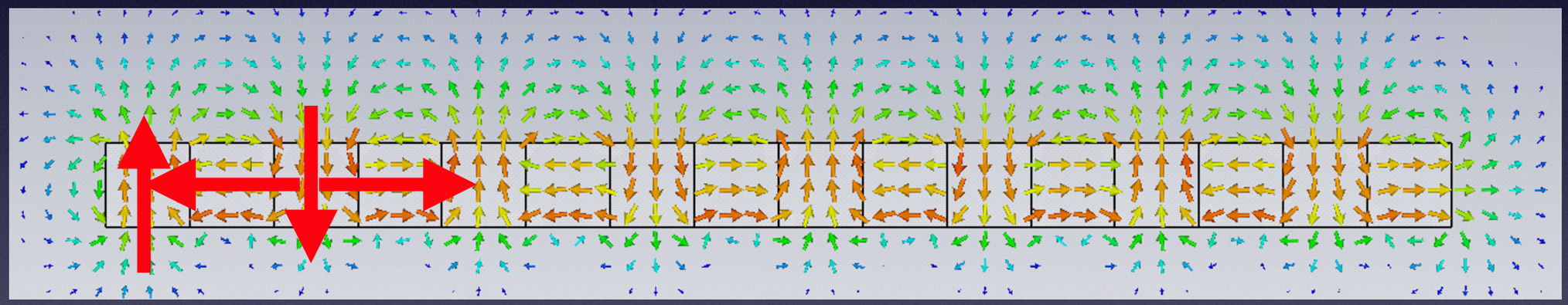




- Parabolic dish with d = 2 m.
- f = 4.8 m
- Installation in the next two weeks.

BRASS-6

Conversion Surface

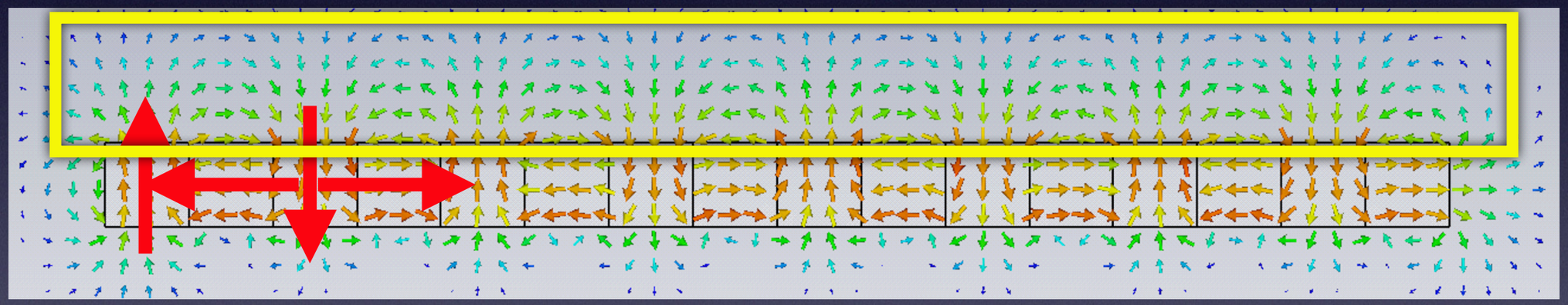


Halbach Array: 12 x 12 x 192 mm
4 Halbach Units

BRASS-6

Conversion Surface

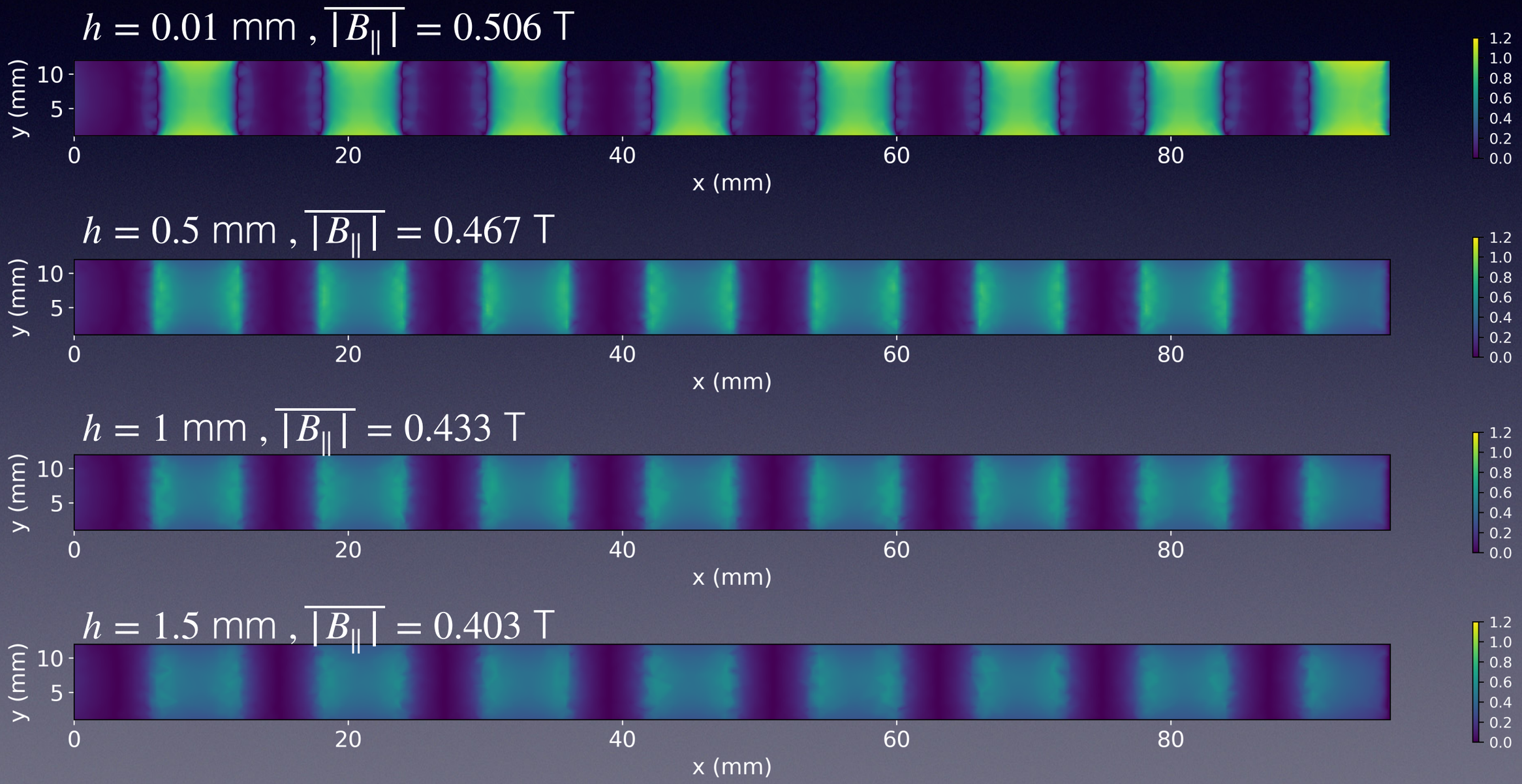
Concentrated Field



Only horizontal field components contributes to the photon conversion.

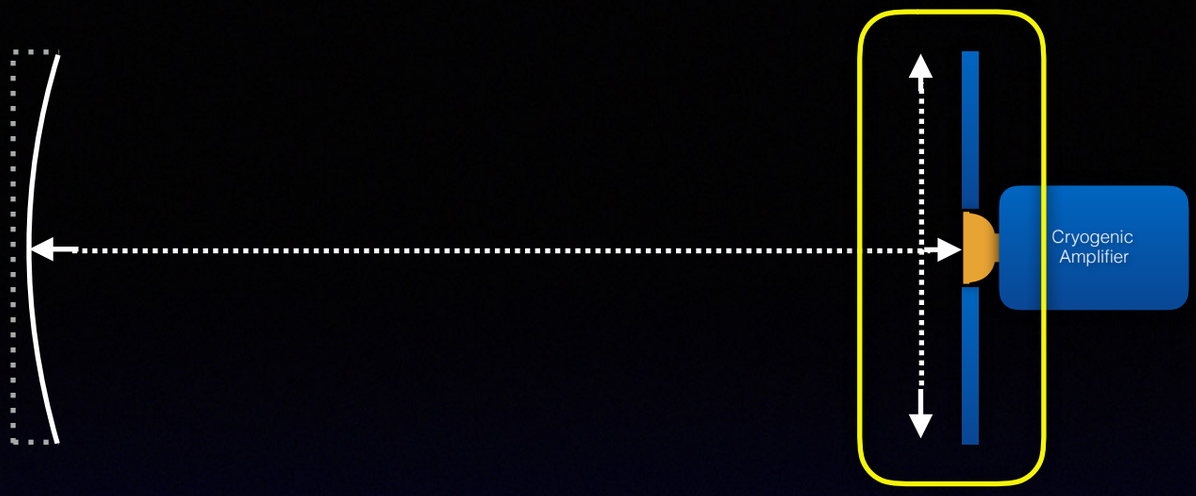
BRASS-6

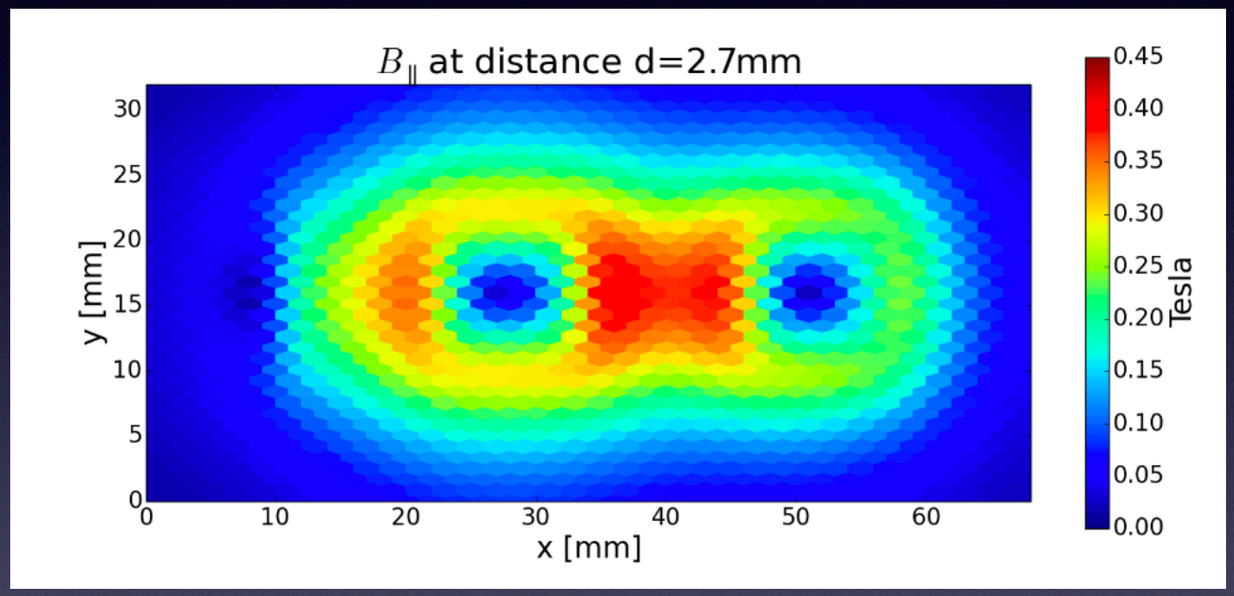
Conversion Surface

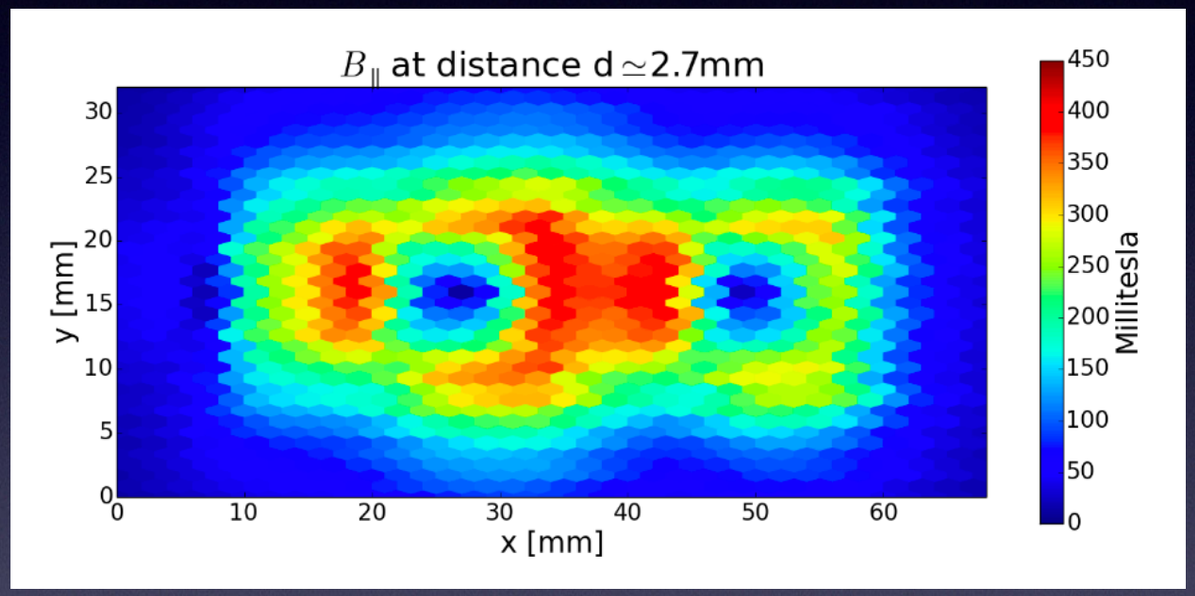


BRASS-6

Conversion Surface







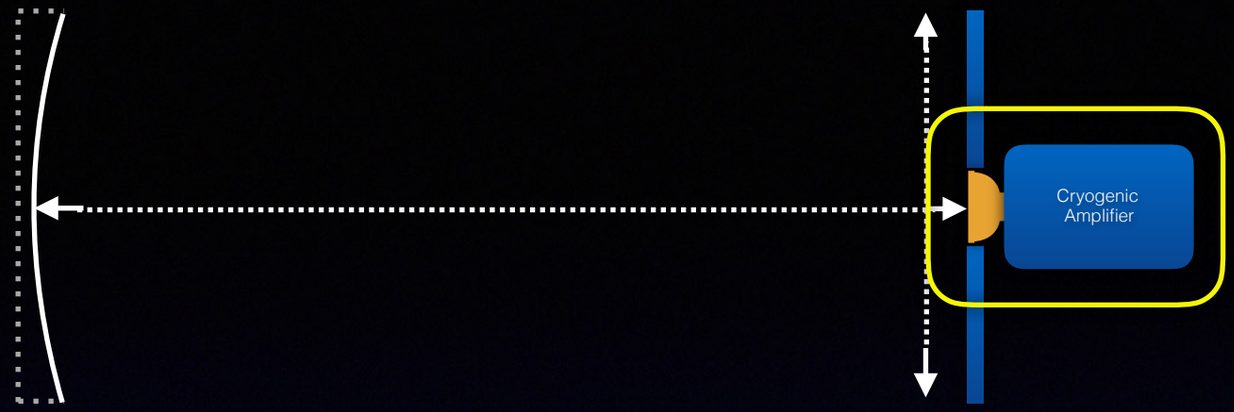
Simulation

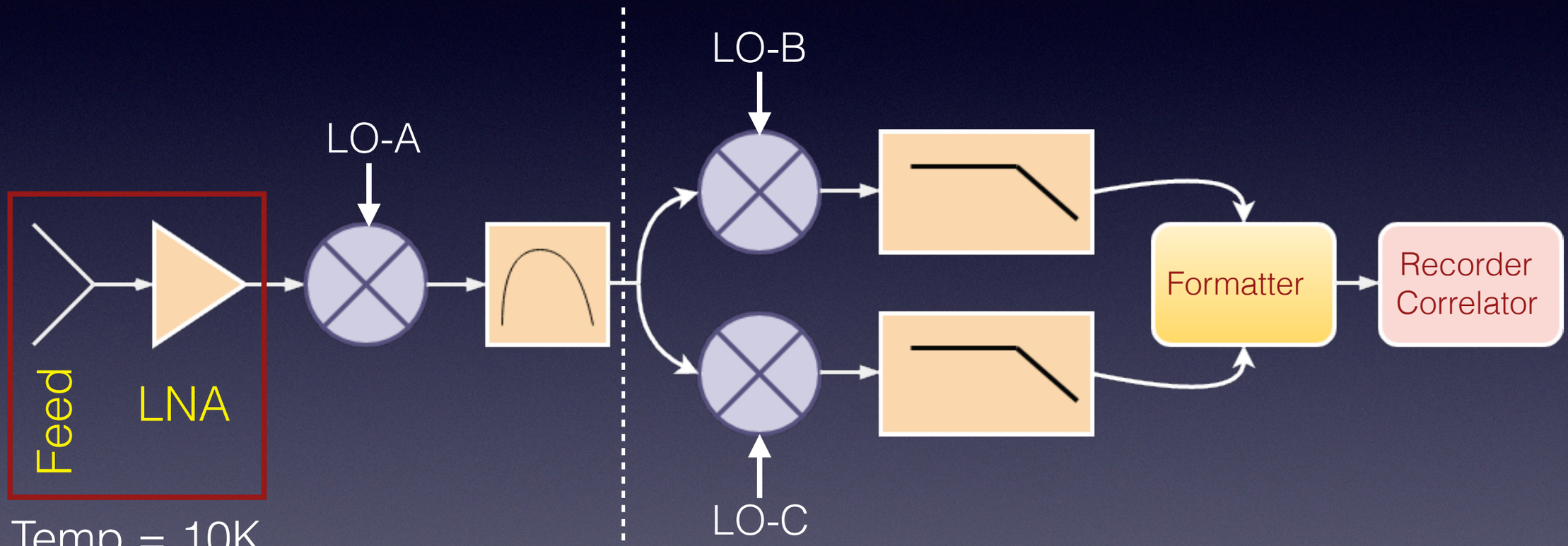
Measurement

- Design an optimal array via simulation.
- Contacting company for construction commission.

BRASS-6

Radio Receiver F/B-end





Receiver
arrive in Q4 2019

Digital Backend
arrive in Q3 2019

BRASS-6

- Reflector is ready for installation.
- Backend system arrives in Q3-4/2019
- Magnetic surface is ready in Q1/2020.

- Design of the conversion surface.
- Effect of the inhomogeneous field.
- Alignment calibration.
- Signal profile.

Conclusion

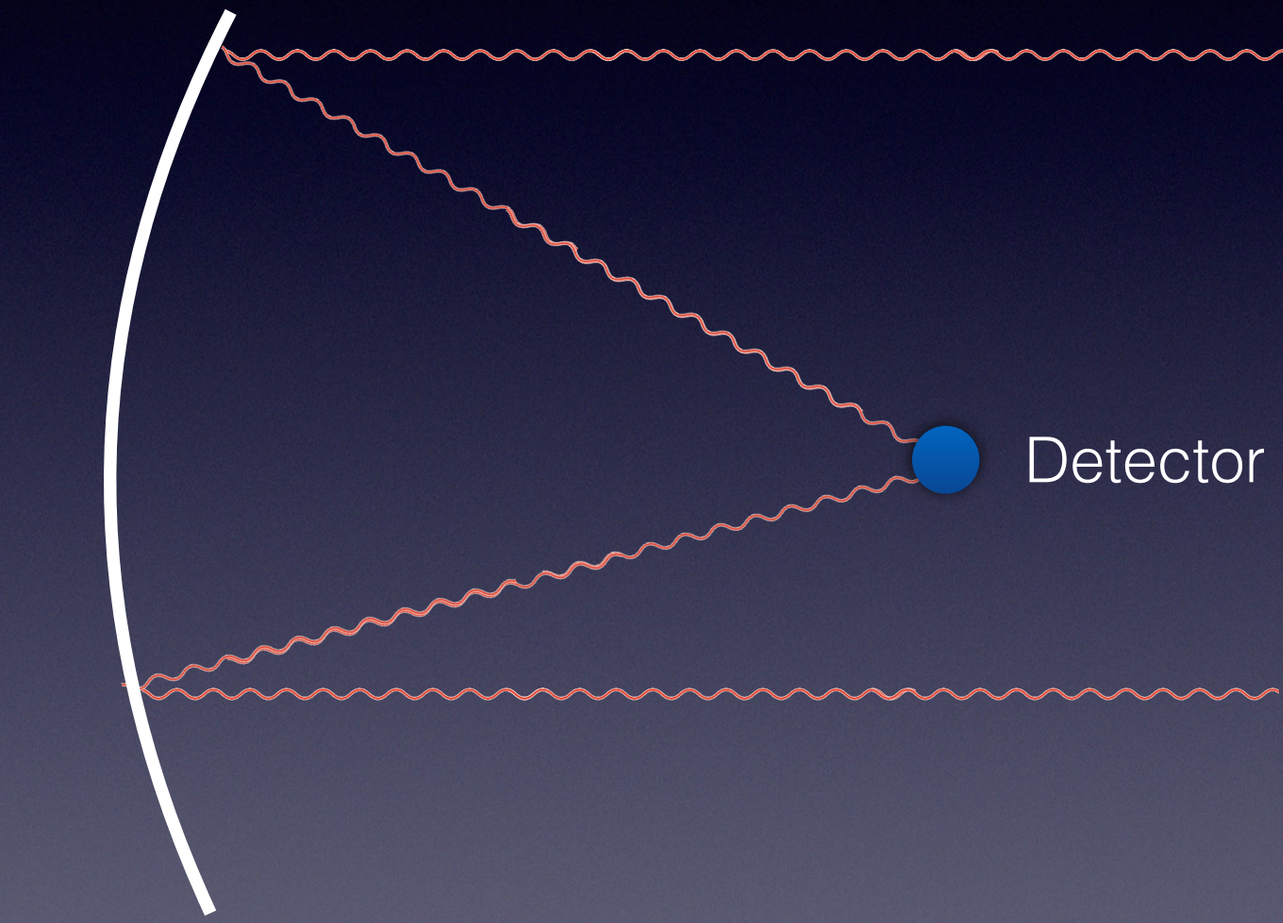
- BRASS is a haloscope experiment search for light dark matter in a wide mass range (10 μeV-10 meV).

- BRASS-6 is under construction 🔨 , data taking and calibration ⏰ in later 2019/ early 2020.

Thank you for attention!

BRASS

Broadband **R**adiometric **A**xion **S**earche**S**

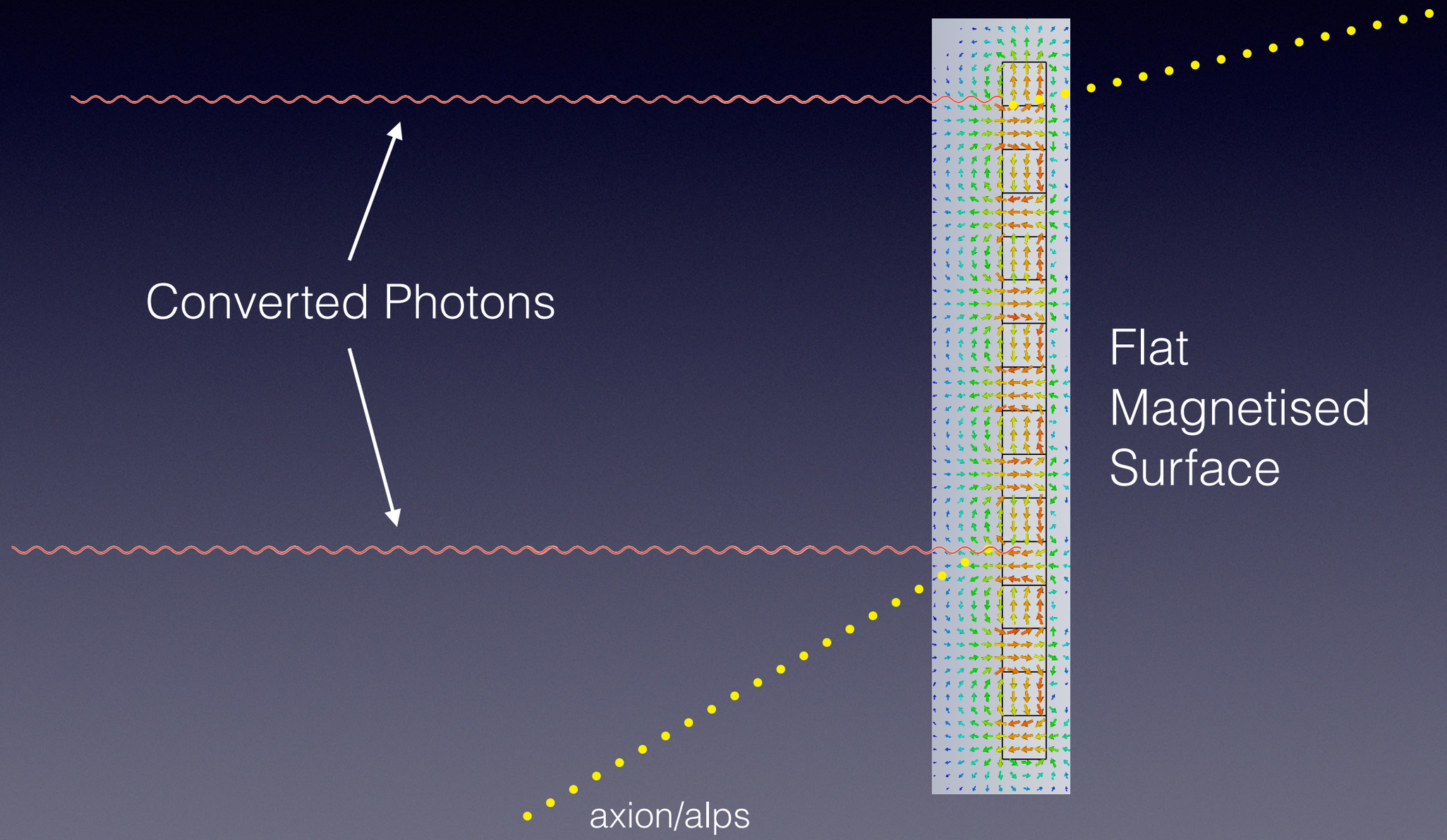


Parabolic Antenna

Magnetic field for
Axion-photon conversion

BRASS

Broadband **R**adiometric **A**xion **S**earche**S**



BRASS-6

Conversion Surface