Introduction to the RADES project at CAST, an axion detector using microwave filters

Sergio Arguedas Cuendis, on behalf of the RADES group

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Motivation

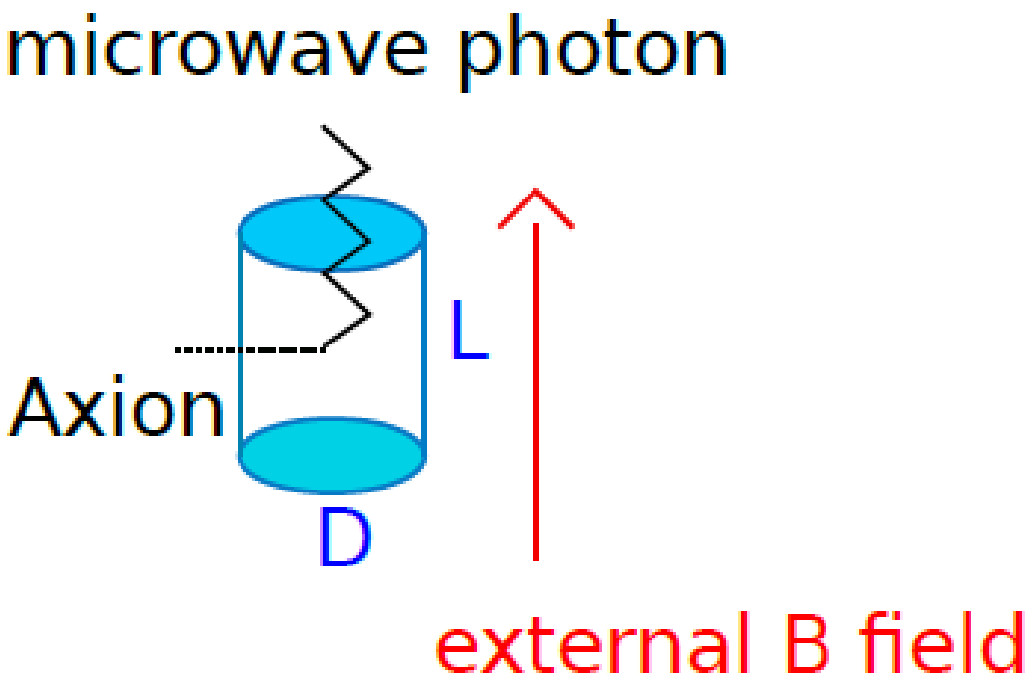
- For axion models with PQ transition happening after inflation, one can set a lower bound to the axion mass of at least $m_A^2 > 25$ μeV.

- The RADES group is designing and constructing a haloscope type experiment to have competitive sensitivity to axion masses in the 10 – 100 μeV decade.

Measurement principle

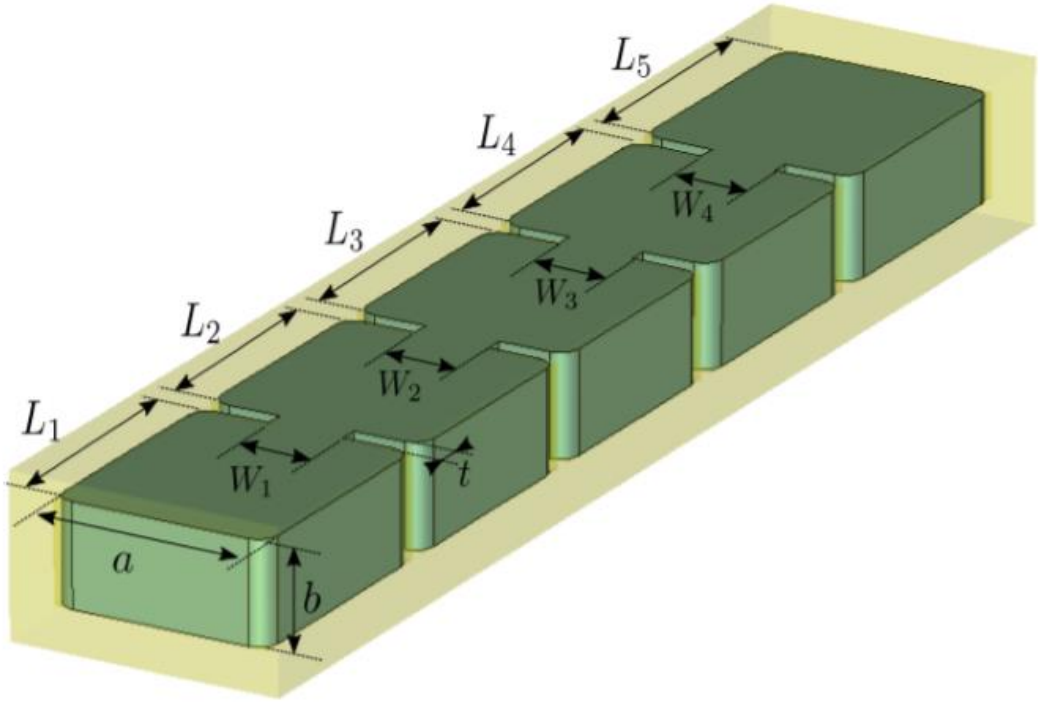
- In the presence of a magnetic field, the conversion of axions into photons is triggered.
- A cavity resonating at the frequency of the expected axion mass will increase its output power.
- A figure of merit for our experiment is given by:

$$F \sim g_{A\alpha}^4 m_A^2 B^4 V^2 T_{sys}^{-2} G^4 Q$$

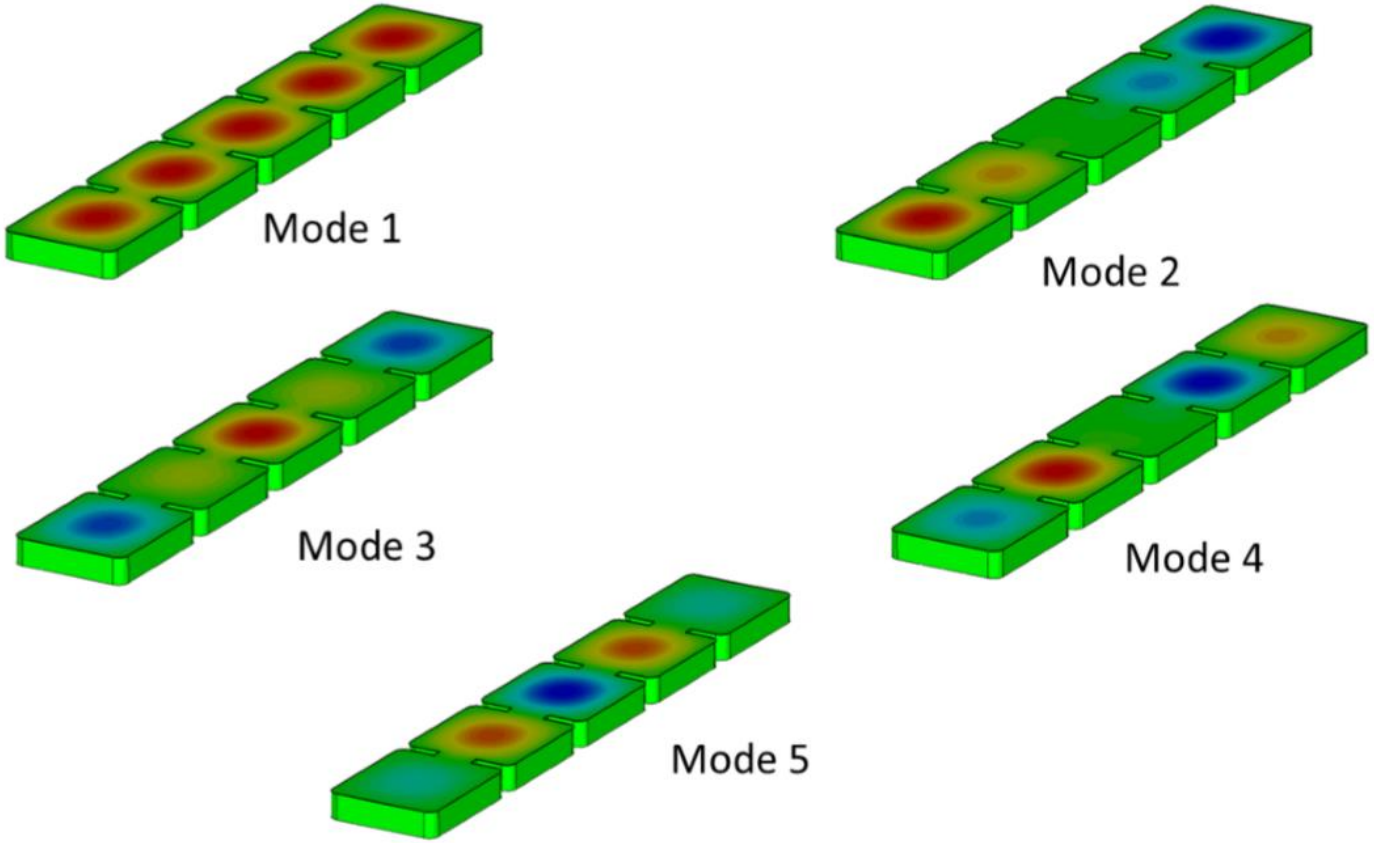


The RADES cavity

- Increasing mass means shorter cavities and smaller volume.
- Therefore, RADES designed and built an array of 5 cavities connected through irises resonating at the same frequency.
- For the first prototype a fix frequency was chosen and the G factor was maximized.

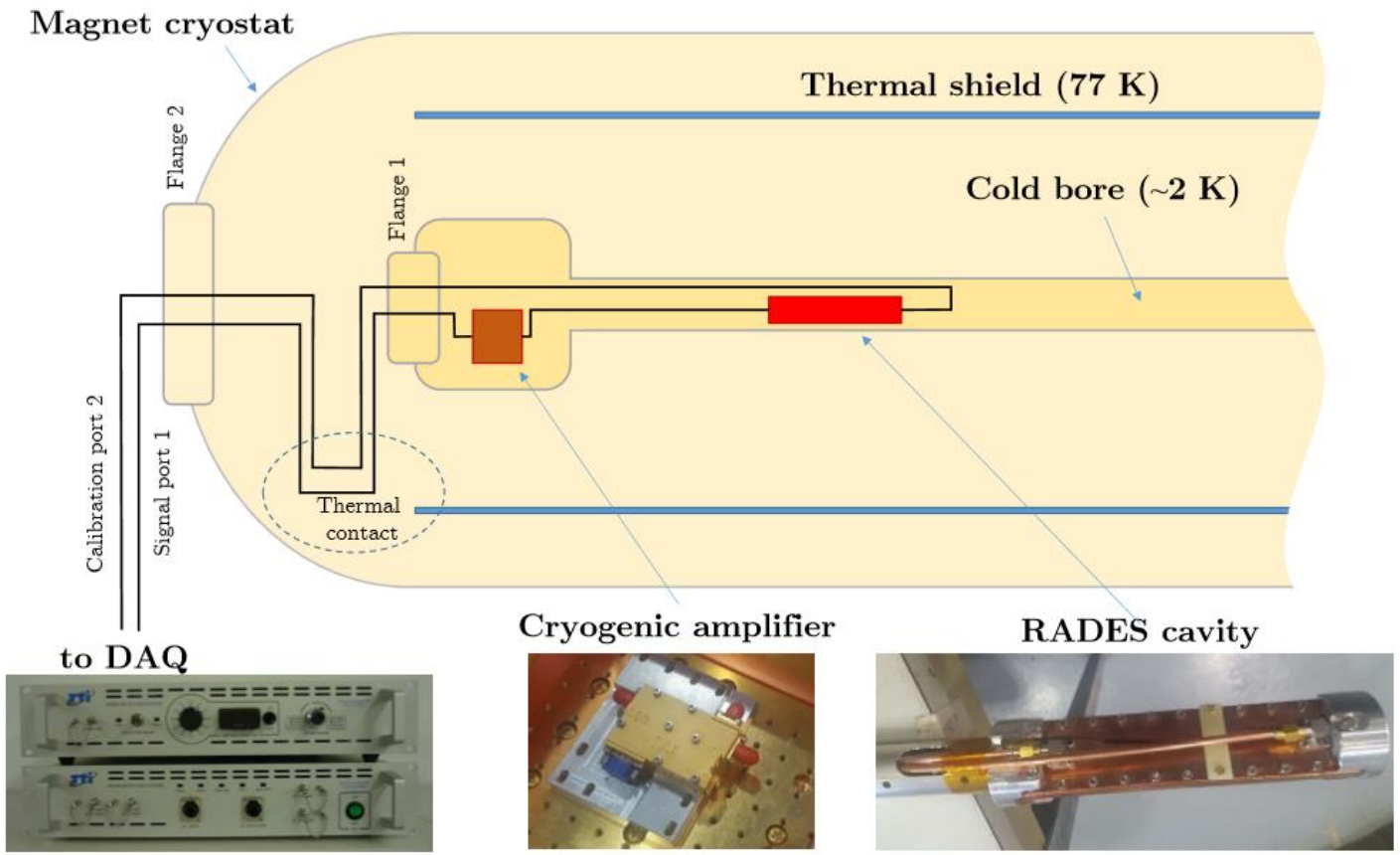


Cavity modes

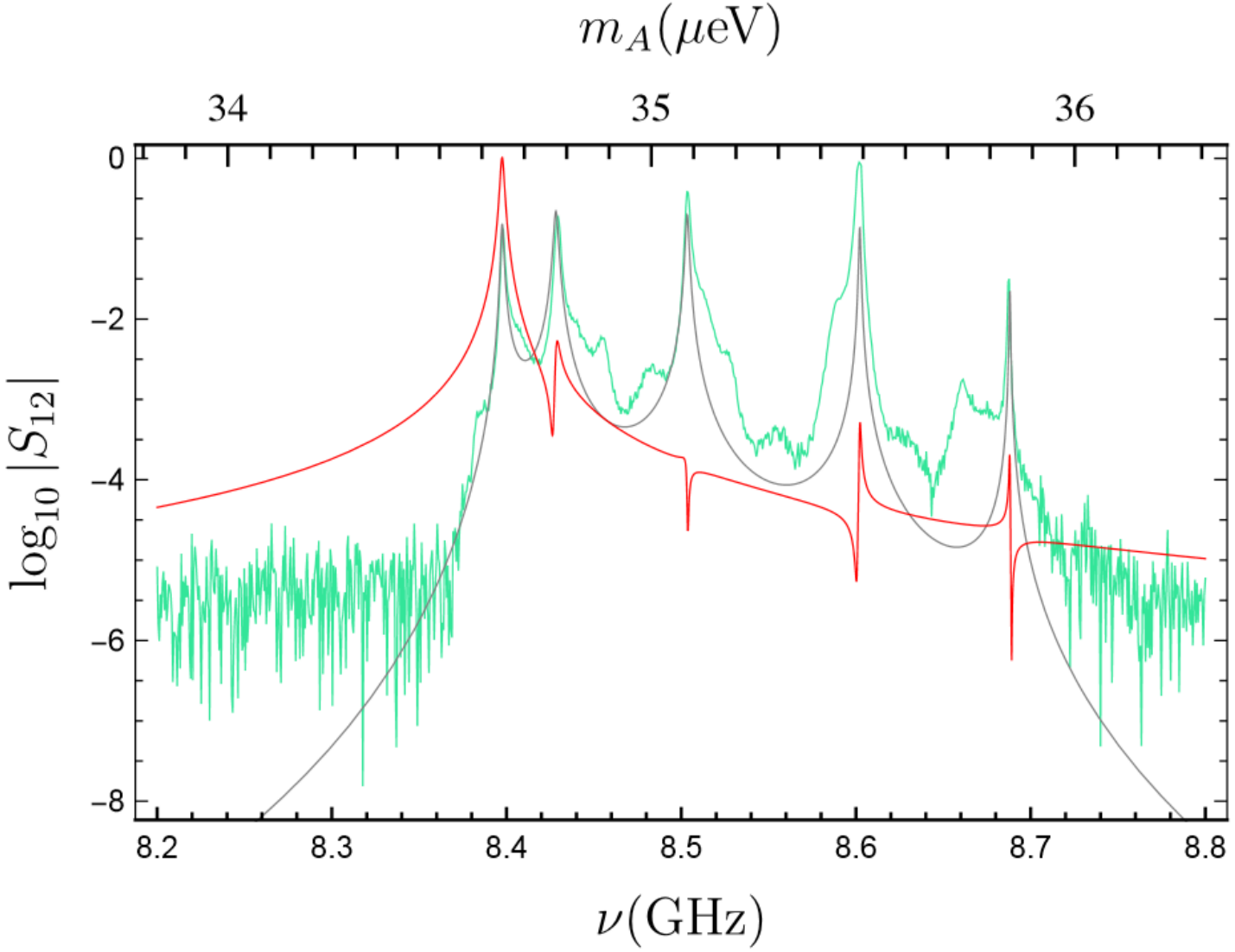


RADES at CAST

RADES at CAST

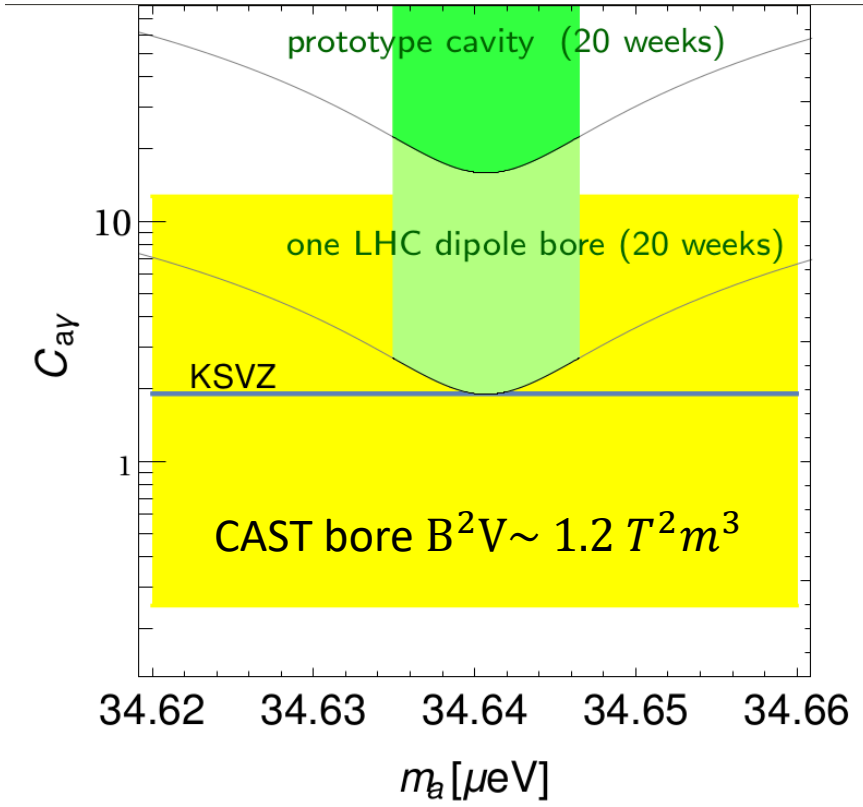


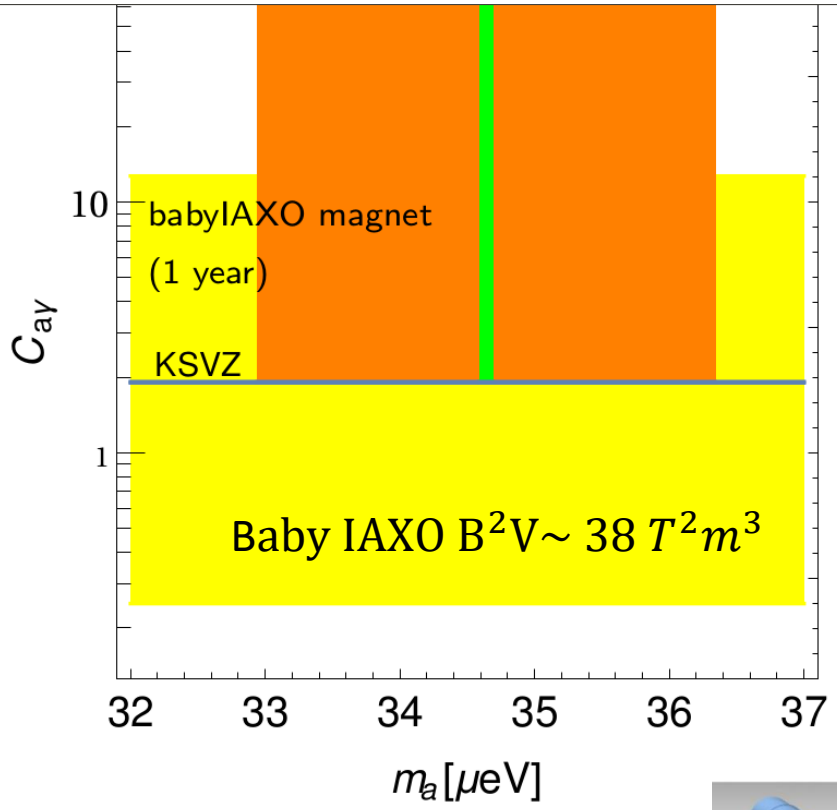
Measurements of the cavity property



- Green: Measured scattering transmission parameter
- Gray: analytical model
- Red: axion DM power normalized to the peak

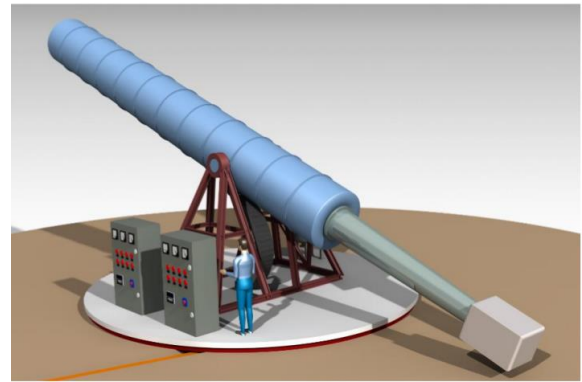
Sensitivity projection





→ QCD Axion relation: $g_{a\gamma} \equiv 2 \times 10^{-16}\ C_{a\gamma}\ \frac{\mathrm{m_a}}{\mu eV}\ \mathrm{GeV}^{-1}$

KSVZ and yellow band: Axion models



Conclusions

- RADES designed and built its first cavity resonating at ~ 8.4 GHz
- The cavity was successfully installed at the CAST magnet
- For more information please visit my poster