MAX-PLANCK-INSTITUT FÜR PHYSIK

RADES

AXION SEARCH WITH RADES

Dr. Jose María García Barceló

Dark Matter 2025: From the Smallest to the Largest Scale

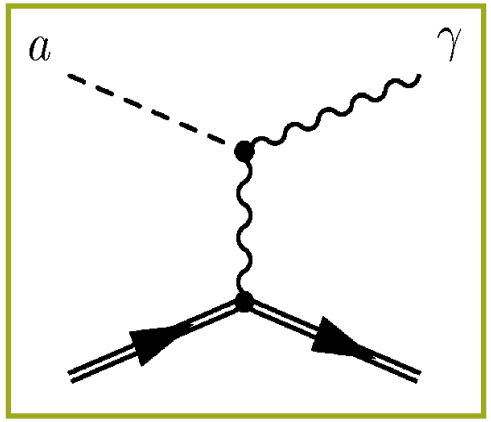
3rd June/2025

DARK MATTER AXION DETECTION

Axions are hypothetical pseudoscalar particles that could:

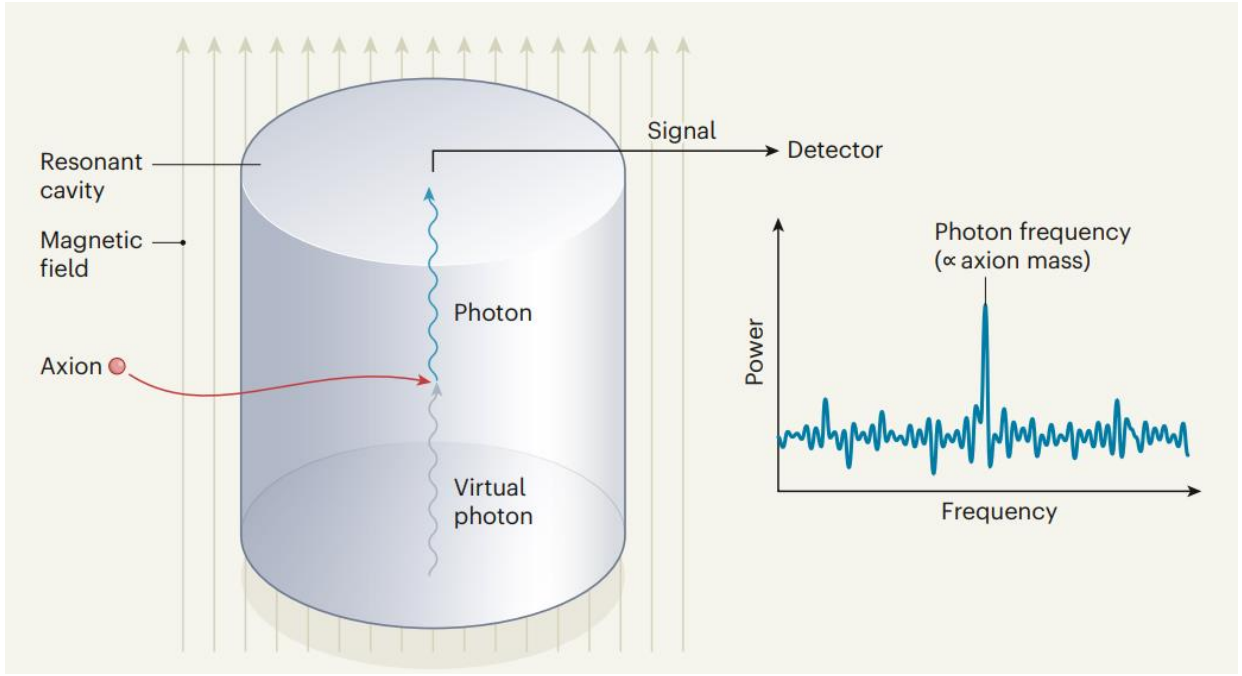
- Solve the strong CP problem of QCD
- Account for the Dark Matter (DM) content of the universe

Main detection strategy:
Conversion of axions into photons
under a strong magnetic field
(Primakoff conversion)



$$\mathcal{L}_{a\gamma} = g_{a\gamma\gamma}(\mathbf{E}\cdot\mathbf{B})a$$

Haloscope setup to detect DM axions



Signal power $\longrightarrow$ $$P_s = \kappa g_{a\gamma}^2 V B_e^2 \mathcal{C}_m^2 Q_m \frac{\rho_{DM}}{m_a}$$

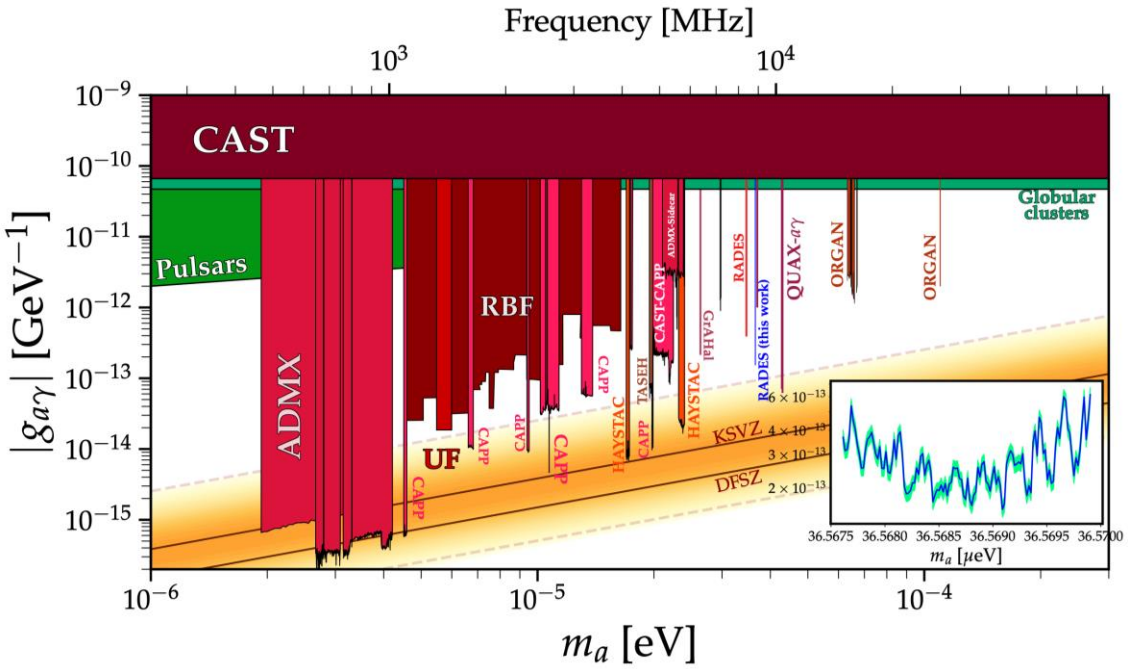
THE RADES COLLABORATION

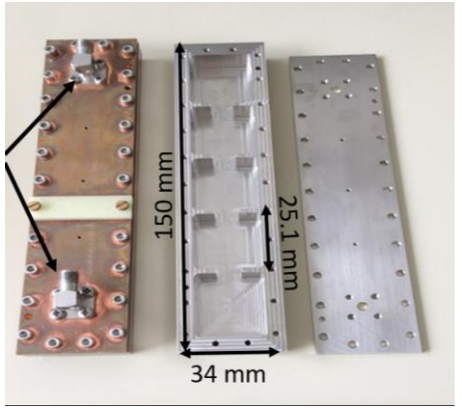
Started as a haloscope experiment exploring the use of multi cavity structures for bigger detection volumes at higher frequencies.

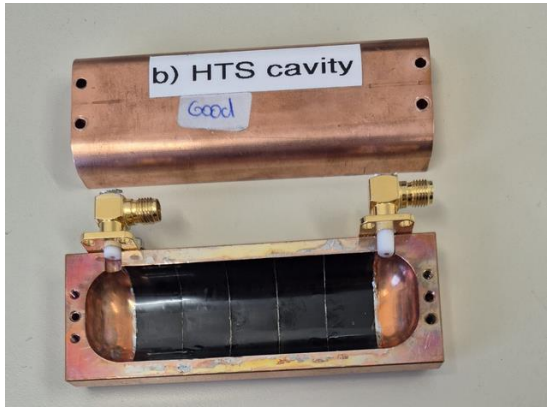
A first run inside of the CAST magnet served as a proof of principle and allowed us to extract exclusion limits for a mass of 34.67 μeV.

In 2021 we performed 27h of data taking with a high-temperature superconducting cavity (HTS) that led to competitive results at higher masses.

Currently we are more than 30 collaborators from more than 10 different institutions working on cutting-edge technologies for high-frequency axion searches.







CURRENT STATUS

Recent release of results for the first run with the HTS cavity at the SM18 magnet testing facility at CERN: 10.1007/JHEP04(2025)113

We did a 2nd run with an improved data taking system whose results are still under analysis.

Dilfridge with T<7mK and B = 12T installed at MPP in early November 2024

Ready for exploring new and promising technologies!