QUAX

QUaerere Axion

Detection of **cosmological axions** through their **coupling to photons**

Sezioni/Centri INFN partecipanti
- Laboratori Nazionali di Frascati (LNF)
- Laboratori Nazionali di Legnaro (LNL)
- Sezione di Padova (PD)
- Sezione di Napoli, Gruppo Collegato di Salerno (SA)
- Trento Institute for Fundamental Physics and Applications (TIFPA)

Personale afferente 2025 in totale 10,85 FTE - 30 persone

Personale afferente 2025 al TIFPA 0,6 FTE – 2 persone

P. Falferi 30%, R. Mezzena 30%

Durata esperimento 3 (R&D) +3 anni (data taking) (2021-2026)

Finanziamento QUAX totale (k€)

	2022	2023	2024	2025
Richieste	546	426	271	256
Assegnazioni	429	320	170	204

Finanziamento QUAX TIFPA (k€)

	2022	2023	2024	2025
Richieste	9	10	10	10
Assegnazioni	7	9	5,5	4,5

Responsabile nazionale

Giovanni Carugno (PD)

Responsabili locali

Giuseppe Ruoso (LNL)

Claudio Gatti (LNF)

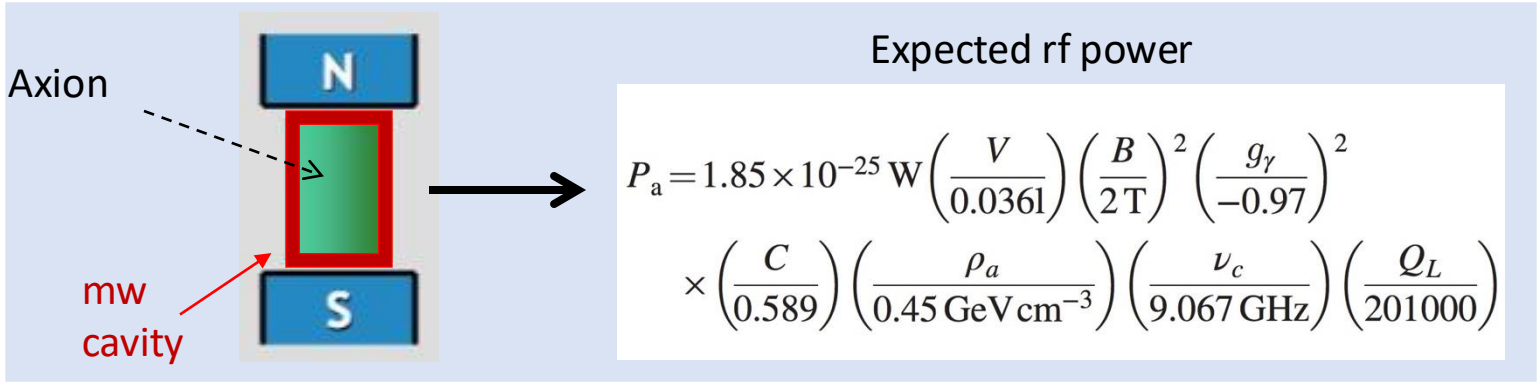
Domenico D'Agostino (SA)

Paolo Falferi (TIFPA)

QUAX – QUaerere AXion

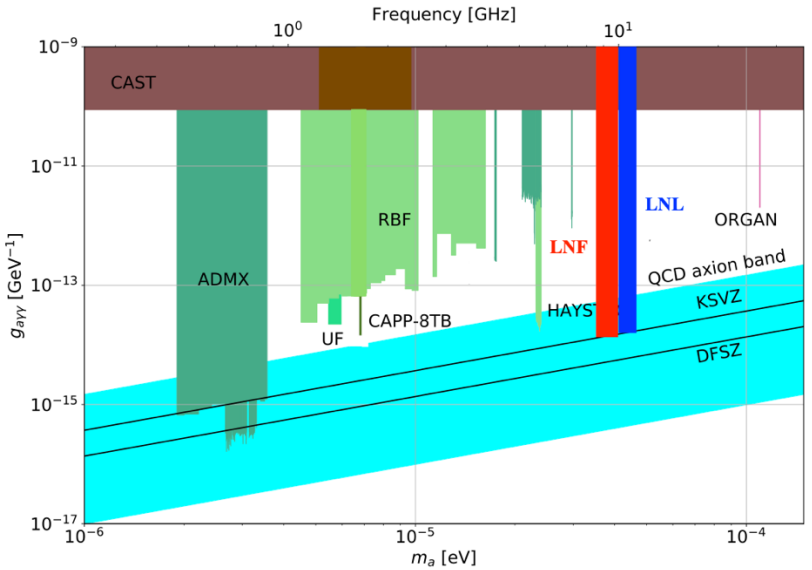
The axion is a hypothetical particle introduced to solve the so-called strong CP problem.
It is a neutral, very light (1 μeV < m < 10 meV) particle having negligible interaction with the ordinary matter.
It is an interesting candidate as a main component of dark matter.

- **Photon coupling: Due to the motion of the solar system in the galaxy, Dark Matter axions** are converted into **rf photons** inside a **resonant cavity** immersed in a **strong magnetic field** (inverse Primakoff effect)



QUAX HALOSCOPES (@LNL @LNF)

	LNF	**LNL**
Magnetic field	9 T	14 T
Magnet length	40 cm	50 cm
Magnet inner diameter	9 cm	12 cm
Frequency range	8.5 - 10 GHz	9.5 - 11 GHz
Cavity type	Hybrid SC	Dielectric
Scanning type	Inserted rod	Mobile cylinder
Number of cavities	7	1
Cavity length	0.3 m	0.4 m
Cavity diameter	25.5 mm	58 mm
Cavity mode	TM010	pseudoTM030
Single volume	$1.5 \cdot 10^{-4}$ m^3	$1.5 \cdot 10^{-4}$ m^3
Total volume	7⊗0.15 liters	0.15 liters
Q_0	300 000	1 000 000
Single scan bandwidth	630 kHz	30 kHz
Axion power	$7 \otimes 1.2 \cdot 10^{-23}$ W	$0.99 \cdot 10^{-22}$ W
Preamplifier	TWJPA/INRIM	DJJAA/Grenoble
Operating temperature	30 mK	30 mK



Quax 2025 projection: 2 GHz scan to the KSVZ line

QUAX ACTIVITY IN 2025 @ LNL

- Dilution Unit Refrigerator to be Implemented via PLC
- Install New magnet 14 Tesla, 0,5 m Length, 0,1 m inner bore diameter: under construction at the manufacturer
- Install New Photonic Cavity with tunable frequency: currently testing on a different setup
- New Dilution Machine for Quantum Counter based on Trasmon Qubit: under construction
- Complete the set up for axion photon coupling high sensitivity search: under construction, completed in 2026
- Continue R&D on axion electron coupling: tested new cavity with 12 YIG spheres

QUAX ACTIVITY IN 2026 @ LNL

- Installazione nuova cavità a tuning ampliato e svolgimento di un paio di run di misura
- Automazione della ottimizzazione della catena di ricezione rf (TWPA)
- Test del nuovo magnete 14 T in consegna a febbraio 2026
- Studio per nuovo sistema refrigeratore con magnete wet e cavità dry
- Misure con photon counter (forse già da quest'anno) su assione elettrone e successivamente assione fotone

Activity at TIFPA in 2026

- Development of KI-TWPA (Kinetic Inductance - Traveling Wave Parametric Amplifier) to be applied in Quax haloscopes
- Noise characterization of cryogenic amplifiers
- Superconducting shielding

TIFPA REQUESTS 2026 (Dotazioni)

Expenditures	Description	K€
Consumables	Cryospares, rf components, cryoperm shields, liquid helium	7
Missions	Experimental Runs	3
	Totale	10