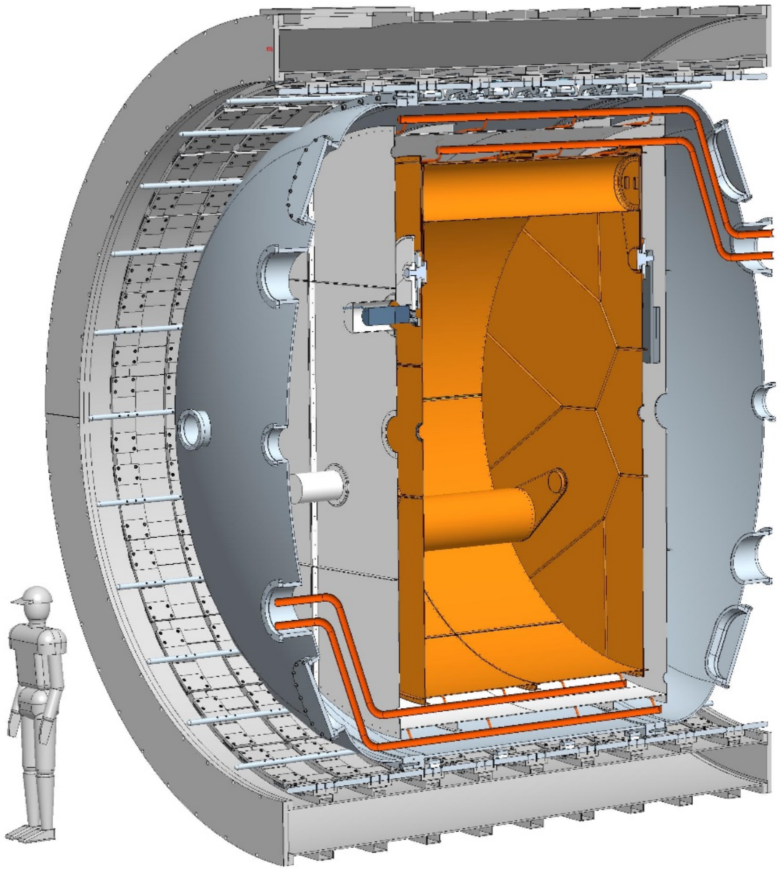


15/5/2024

FLASH TDR meeting

Today Agenda

14:30	→ 14:35	**Introduction**	**Speaker:** Claudio Gatti (Istituto Nazionale di Fisica Nucleare)	5m
14:35	→ 14:50	**Physics Reach**	**Speaker:** Prof. Luca Visinelli (Shanghai Jiao Tong University)	15m
14:50	→ 15:05	**Status of RF cavity design**	**Speaker:** Simone Tocci (Istituto Nazionale di Fisica Nucleare)	15m
15:05	→ 15:20	**Cryostat design**	**Speaker:** Carlo Ligi (Istituto Nazionale di Fisica Nucleare)	15m
15:20	→ 15:35	**Computing**	**Speaker:** Giovanni Mazzitelli (Istituto Nazionale di Fisica Nucleare)	15m
15:35	→ 15:50	**Mainz/Bonn**	**Speaker:** Kristof Schmieden (CERN)	15m
15:50	→ 16:05	**Uni Camerino**	**Speaker:** Seyed Javad Rezvani (LNF)	15m
16:05	→ 16:20	**Pisa**	**Speaker:** Gianluca Lamanna (Istituto Nazionale di Fisica Nucleare)	15m
16:20	→ 16:35	**Trento**	**Speaker:** Paolo Falferi (Istituto Nazionale di Fisica Nucleare)	15m
16:35	→ 16:50	**Valencia/Cartagena/Barcelona**	**Speaker:** Diaz Alejandro	15m
16:50	→ 17:05	**MiB**	**Speaker:** Lucia Canonica (Istituto Nazionale di Fisica Nucleare)	15m
17:05	→ 17:20	**LNF**	**Speaker:** Claudio Gatti (Istituto Nazionale di Fisica Nucleare)	15m
17:20	→ 17:35	**BAWs**	**Speaker:** Diego Blas Temiño	15m

Goals:

1. Review the activities to be carried out for the TDR and the contributions from variuos partners.
2. Identify needed R&D for the TDR

WPs

I. Physics Reach
   I. Axions
   II. Scalars
   III. Vector
   IV. HFGW
   V. GravNet
   VI. BAW (investigate synergies and physics reach)
   VII. Perspectives for future experiments with FLASH infrastructure.

II. Mechanical Design
   i. Cryostat and Vacuum vessel
   ii. Cryostat Support
   iii. Cavity
   iv. Tuning System
   v. Shield
   vi. Installation (Decommissioning FINUDA and commissioning)

III. Cryogenic Design
   i. Cryogenic plant
   ii. Service turret (consider both 4K and 2K)
   iii. Cryostat Cryogenics
   iv. Control and Diagnostic (including magnet and tuners)
   v. Feasibility assessment for Phase II at T at O(100) mK

IV. Radiofrequency
   i. Cavity and tuning RF design (Axion)
   ii. Antenna couplings for Axions GW etc.
   iii. Cavity design for HFGW

V. Signal Amplification and Acquisition
   i. SQUID (resonant (Axion) and broad band (GW)). Multiplexing.
   ii. Secondary Amplification
   iii. B Shielding
   iv. Calibration
   v. Test with/of BAWs

VI. DAQ, Computing and Data Analysis

VII. Safety

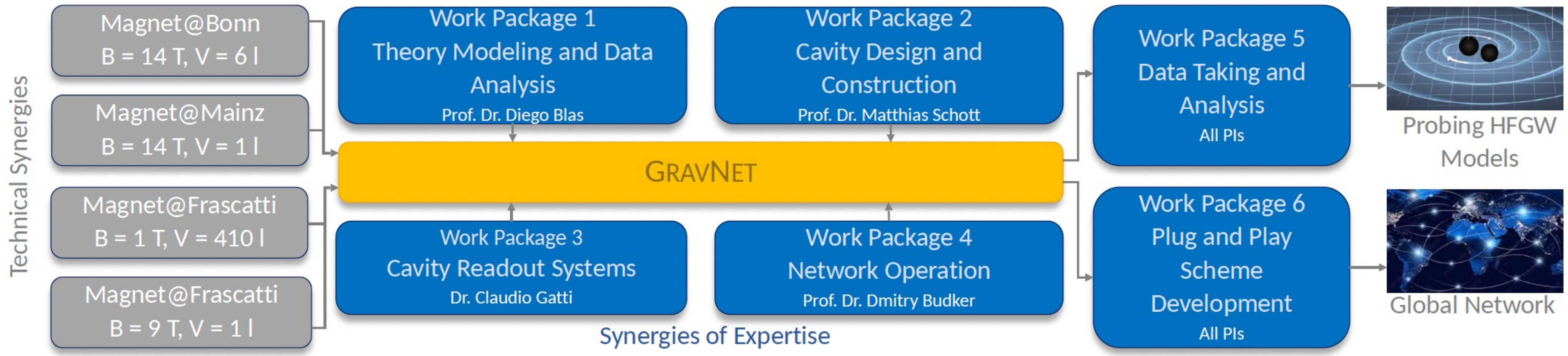
TDR

Outline (from INFN-PM-QA-504)

1. Physics Case
2. Results from R&D → Show results from R&D and list further R&D needed
3. Technical Description → Technical description of the systems and sub-systems
4. Validation → Results of studies that motivated the technical description
5. Installation and Commissioning
6. Safety
7. Management

https://www.pi.uni-bonn.de/gravnet/en

GravNet: A Global Network for the Search for High Frequency Gravitational Waves

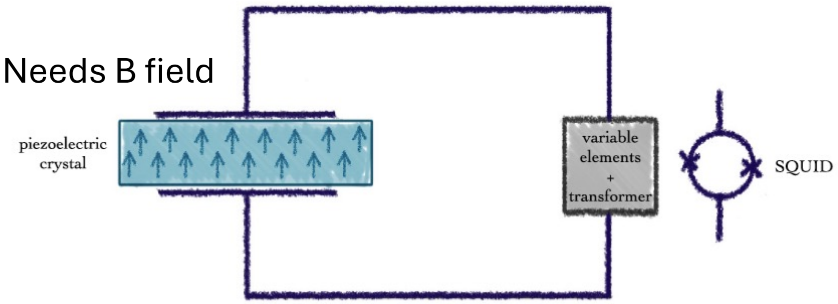


Bulk Acoustic Wave Resonators Well Suited for Light Dark Matter and HFGW Detection

AXIONS

Piezoaxionic effect PHYSICAL REVIEW D 109, 072009 (2024)

Needs B field

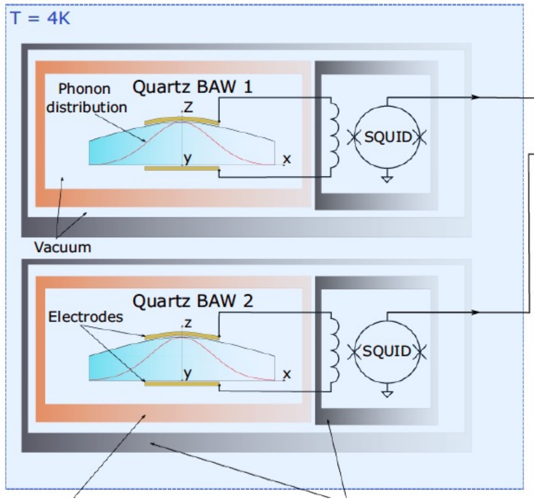


BAW radius from 1 to 50 cm
Use FLASH for larger devices/arrays
Smaller BAWs in other labs

HFGW

The multi-mode acoustic gravitational wave experiment: MAGE. *Sci Rep* **13**, 10638 (2023).

Needs network

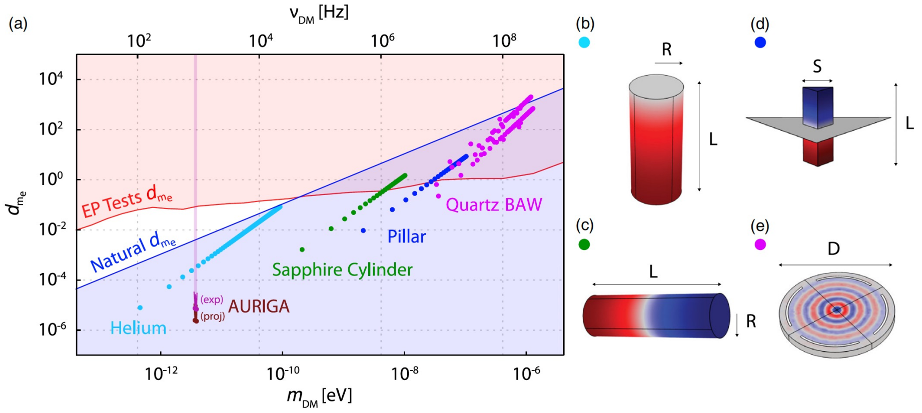


SCALAR DM

Sound of Dark Matter Phys. Rev. Lett. 116, 031102 (2016)

Searching for Scalar Dark Matter with Compact Mechanical Resonators PHYSICAL REVIEW LETTERS 124, 151301 (2020)

Needs array + tuning



Synergies: Physics case, cryogenics, radiofrequency, quantum amplifiers/quantum sensing, DAQ and Data Analysis … in some case also same research groups (e.g. M.Tobar's MAGE/ORGAN)

R&D

SQUID:

- Tnoise vs Tbath
- Wideband amplification
- Shielding
- Multiplexing

Cavity prototype:

- Q0
- Tuning
- Thermalization
- Vibrations

DAQ:

- FPGA multimode acquisition
- Qick firmware for DAQ

BAW:

- Test of MHz and kHz BAW at 4K and mK and in B field.

LNF Activity

LNF Activity

- RF cavity (See S Tocci talk)
- Cryostat (See C Ligi talk)
- Computing (see G Mazzitelli/A Calanca talk)
- Magnet control system (GP Di Pirro)
- Safety (S Gazzana)
- DAQ/Electronics (M Beretta/P Ciambrone)
- RF/Vacuum (L Piersanti, D Alesini)
- Infrastructure, decommissioning and commissioning (in collaboration with Research Technical and Accelerator Divisions)

Safety and Radioprotection (S Gazzana)

- Functional Requirements (we must ensure our ES&H program identifies, addresses, and manages safety, environmental hazards during the design, construction, assembly, commissioning, and operation of the FLASH experiment)
- Risk Analysis (In accordance with best practices in the field of prevention with the TDR we will provide a development of a Risk Analysis (RA) that considers the Health, Safety, and Environmental risks associated with FLASH Experiment.)
- Decommissionin, Assembly & Commissioning (apply existing laws)
- Technical Compliance (An assessment of the regulatory compliance of FINUDA's existing facilities with current legislative requirements will be conducted)
- Waste Management (management of waste materials from the decommissioning of FINUDA)
- Radioprotection (no risk)

Magnet Control System (GP Di Pirro)

The system allows:

- Control all valves
- Some valve can be controlled with PID
- Control the OCEM power supply
- Give all information on the temperature, vacuum status
- The system allows the verification of the parameters for the correct management of the magnet

Magnet Control System (GP Di Pirro)

The old control of the magnet is based on a mix of analog and digital controls.

This system is obsolet in all acquistion component.

The system allows to acquire:

- 73 signals from Digital voltmeter and multiplexer
- 16 ADC
- 16 DAC
- 16 Digital Inputs
- 8 Digital out
- Serial port to control OCEM power supply

Magnet Control System (GP Di Pirro)

- The new control system will be based on a digital system which will allow all parameters to be acquired and verified.
- The acquisition of the various signals will be based on National Instrument hardware with FPGA postentiality (Crio)
- This system will allow us to acquire signals faster and introduce PIDs on the FPGA.
- To allow this step, all types of signals used in the system and the type of sensors and actuators used will need to be verified.
- The estimated working time is approximately one person year