

# SQMS-Italia: due anni dopo...

Valter Bonvicini – INFN Trieste

SQMS-Italia meeting

Padova, 15 dicembre 2022

# The timeline

- March 2020: SQMS project presented to DOE
- September 2020: DOE “informal” approval
- October 2020: Official start of SQMS
- February 2021: MoU between FNAL and INFN
  - First contacts and discussions between us and Anna during the workshop “[Quantum Technologies within INFN: status and perspectives](#)”, Padova, 20-21 January 2020
- April 2021: SQMS officially recognized by INFN
- ..... (a lot of exciting work!)
- September 2025: formal closing of the project

# In the meantime, during 2021/2022...

- INFN developed its strategy for QC/QT within the PNRR funding opportunities, leading to:
  - Spoke dedicated to Quantum Computing within the **National Centre for High Performance Computing** (PNRR funding)
    - INFN leader of WP1 (Software): Development and application of high-level quantum software for algorithms solving general purpose problems, scientific and industrial applications
    - INFN actively involved in WP3 (Firmware and hardware platforms): Development and support of the quantum computer hardware chain.
  - INFN involved in the **National Quantum Science and Technology Institute (NQSTI)** (Extended Partnerships, PNRR funding)
    - Focus on **low-TRL R&D** in the field of QST, for innovative applications in sensing, safe communication, processing of quantum information; development of concepts, new materials and devices (photonic, solid state and cold).
    - INFN involved in spokes 3 (cold atoms), 4 (photonics), 6 (integration), 8 (technology transfer) and 9 (outreach)

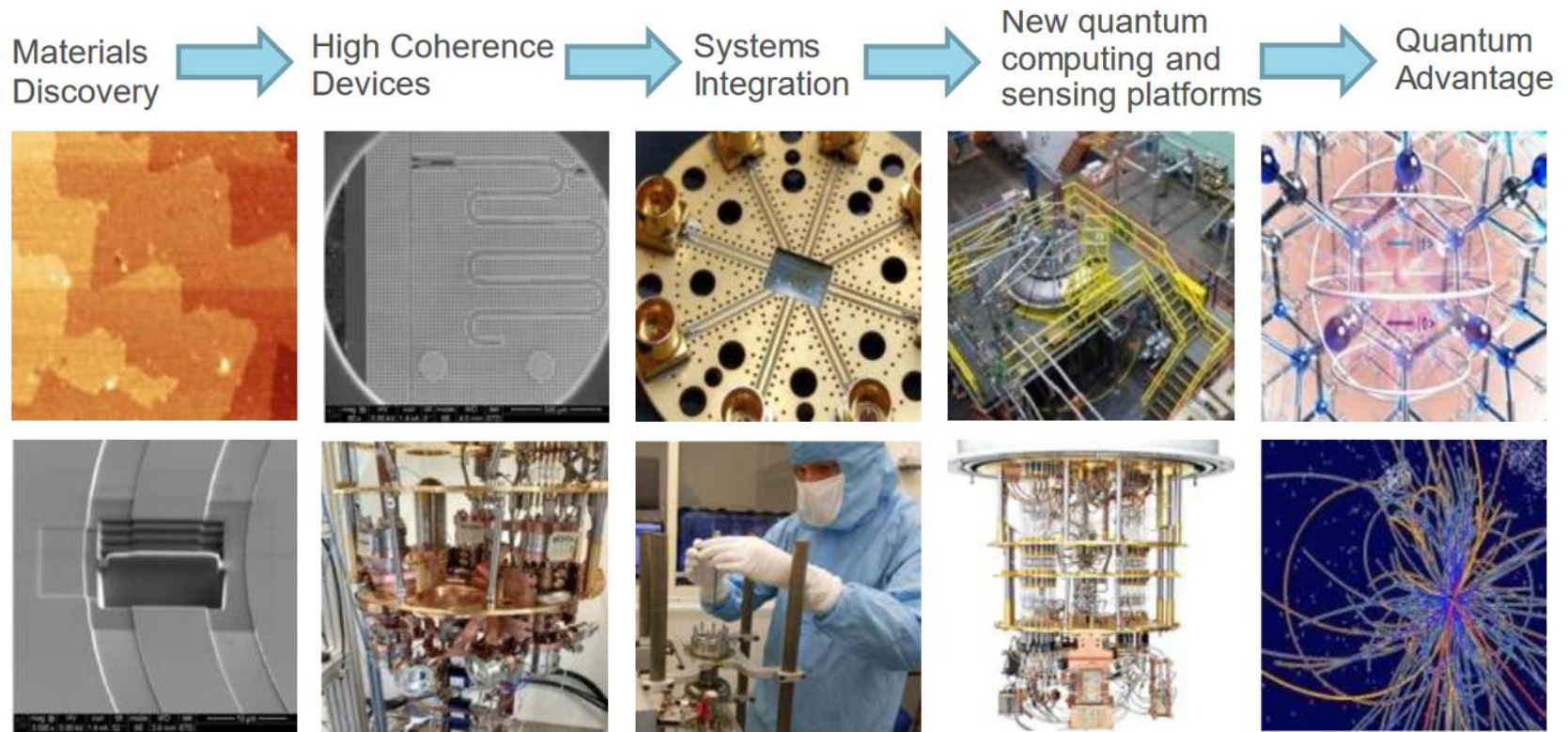
# People and budget

Structure	Local coordinator
GGI	S. De Curtis
LNGS	C. Bucci
LNL	G. Ruoso
LNF	C. Gatti
Sezione di Firenze	L. Banchi
Sezione di Padova	C. Braggio
Sezione di Pavia	L. Maccone
Sezione di Roma 1	L. Cardani
Sezione di Trieste	V. Bonvicini
Sezione di Ferrara	P. Fabbri (Administrative support)

- SQMS: \$ 16719000
- SQMS\_FOE: € 237250

# The DOE-SQMS Center

SQMS Roadmap: from material discovery to quantum advantage



Potential for discovery lays at every step of the chain

# What we want to do

- Our view: team with a large/high level community, learn & contribute
- Our contributions/expectations:
  - Theory at the foundational/metrological levels
  - Theory and algorithms for quantum applications
  - Measure and mitigate the negative impact of radioactive background
  - Contribute/improve our expertise in superconducting cavities
  - Couple transmons and (B-friendly) cavities
  - Find the axion...😊
  - Make LNGS (and other places?) a test/characterization facility for quantum devices
  - Ph.D. schools/workshops/conferences at GGI (and elsewhere)
  - Help young people enter this field

# Milestones 2021 & 2022

- 2021

- Commissioning of a characterization station at LNGS 😊
- Radio-pure Cu shields 😐
- mK testbed for Axion DM search 😊

- 2022

- SQMS/GGI Summer School on Quantum Simulation of Field Theories 😊
- Delivery to FNAL of a 4 GHz NbTi sputtered cavity 😊
- Characterization of the performance of a qubit in the low-radioactivity environment of LNGS 😐



# The SQMS-GGI summer school (July 2022)

- Topic: Quantum Simulation of Field Theories, 25 – 29 July 2022, Galileo Galilei Institute (Florence)
- 35 students in person + 35 on-line



12/15/2022

V. Bonvicini - SQMS Italia - Padova



# On-going activities

- Today and tomorrow extensive progress reports on the ongoing scientific activities (experimental and theory)
- Three invited talks
  - A. Gardikiotis  $\Rightarrow$  open challenges in axion detection
  - R.T. D'Agnolo  $\Rightarrow$  SC cavities for GW detection
  - S. Carrazza  $\Rightarrow$  Qibo platform for quantum devices control
- To do:
  - SQMS Workshop in Erice, 19 – 25 marzo 2023, focus on Physics and sensing
  - Fully exploit the opportunity to finance post-doc positions
  - Start the student exchange program with the U.S.

- Remembering prof. Raffaele Tripiccione one year after his untimely passing
- Lele's enthusiasm and vision was the driving force that started the INFN-SQMS collaboration (besides many other initiatives and contacts in the QC/QT field)



# Grazie Lele!