SCHEDA PER BORSE A TEMATICA VINCOLATA

Research Title: Microwave measurements for 6G and quantum technologies

Funded by	INRIM
Supervisor	Luca OBERTO (INRIM) - l.oberto@inrim.it
Contact	https://sites.google.com/inrim.it/superquelectronics

Context of the research	The rapid advancement of 6G wireless technology is expected to lead to its deployment in the early part of the next decade, featuring remarkable specifications. On the other hand, cutting-edge fields such as Quantum Technologies require the development of measurement and characterization capabilities at microwave frequencies in extreme cryogenic environments. Consequently, both industry and academia are demanding a significant extension of metrological capabilities and
Context of the research activity	significant extension of metrological capabilities and measurement technology for key RF quantities. Several European-funded projects in which INRiM is involved target these needs, since no microwave calibration capabilities currently exist at such temperatures, despite the dramatically increasing need for and availability of microwave quantum devices such as amplifiers and detectors. Moreover, traceability and existing room-temperature characterization methods, such as
	those for Vector Network Analyzers, are inadequate for 6G requirements.

Objectives	The candidate will contribute to the development of methods for the accurate calibration and characterization of Vector Network Analyzers at room temperature and to the design and implementation of cryogenic systems (down to 10 millikelvin) for SI-traceable measurements of S-parameters, power, and noise at RF and microwave frequencies in state-of-the-art laboratories at INRiM. When possible, methodologies developed at room temperature will be adapted and transferred to the cryogenic environment.

SCHEDA PER BORSE A TEMATICA VINCOLATA

The work will take place as part of multi-year research projects in collaboration with leading European research institutes. The candidate will join the INRiM RF&MW lab and work closely with the Superconductive Quantum Electronics research group in a young and stimulating international environment. She/he will contribute to the development of cryogenic measurement systems for S-parameters, power, and noise for quantum technologies, as well as the high-accuracy and precision room-temperature characterization and calibration of Vector
 Network Analyzers for 6G technology. [1] J. Hoffmann et al, "Measuring the Linearity of Receivers in a Vector Network Analyzer", CPEM 2022, conference Digest, 2022 [2] L. Oberto, E. Shokrolahzade, E. Enrico, L. Fasolo, A. Celotto, B. Galvano, A.
Alocco, F.A. Mubarak, and M. Spirito: Measurement and Calibration Approaches for Two-Port Scattering Parameters at mK Temperatures. Invited paper at Conference on Precision Electromagnetic Measurements CPEM2024, Special Session on methods and metrology for superconducting quantum computers, 6-11 July 2024, Denver (CO), USA; <u>http://dx.doi.org/10.1109/CPEM61406.2024.10646000</u> [3] L. Banzani, L. Spietz, Z. Popovic, L. Aumentado: Two-port microwave calibration at
[5] L. Kurizum, L. Spietz, Z. Popović, J. Aumentado: Two-port microwave calibration at millikelvin temperatures. Rev. Sci. Instr., 84, 034704 (2013); http://dx.doi.org/10.1063/1.4794910

Skills and competencies for the development of the activity	Appreciated Skills: microwave design and measurements (active and passive devices, S-parameters, power, noise, spectrum analysis), data acquisition and analysis, Python programming, cryogenics
-------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------