

Cryogenic Microelectronics for Quantum Computing and Particle Detectors

Expression of interest in joining EU project consortia
→ **Horizon Europe and related EU calls 2026/27**

Interest in contributing to the fields of:

EU Calls Keywords: Quantum Computing, Research Infrastructure, Research Instrumentation, Chips, Digital, Semiconductor Technologies

Interest in further developing expertise in the areas:

Research Keywords: Analog Design, Mixed-Signal, CMOS, MOSFET Characterization, Modeling, Cryogenic, IC Reliability, IC Variability, Detector Readout

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Expertise summary and background

The team has experience designing analog integrated circuits and test structures in various process nodes down to 28 nm CMOS. Having gained experience in device characterization and experiment-based tuning of MOSFET models for circuit simulations, we are interested in expanding our expertise in cryogenic ICs, an area that is currently rapidly gaining importance. We have created cryogenic CMOS device models, which enable IC design down to 4K. We are currently working on their improvement and on IC validation. These activities have begun with the *DRD7 Collaboration* on future particle detectors, and we are now also seeking to contribute to the field of cryogenic instrumentation for quantum computing and for other research fields.

Institution and Research Environment

Graz University of Technology is located in the “Silicon Valley of Austria” with numerous IC design and semiconductor processing companies located in our direct proximity. The three decades of teaching and research collaboration in CMOS and power devices have shaped the Institute of Electronics (IFE) into an important actor in microelectronics education and research. The established scientific profile at IFE focuses on reliable integrated circuits and systems across various aspects: electromagnetic compatibility/susceptibility/emissions with conducted as well as radiated aspects, electrostatic discharge, aging, radiation hardness and other environmental aspects, including cryogenic.

Selected references

“Cryogenic modeling at TUGraz” CERN DRD7 Workshop 2025
<https://indico.cern.ch/event/1556239/contributions/6708351/>

“Impact of Random Telegraph Noise on the Precision of a Sub-20ps Cyclic Vernier Time-to-Digital Converter” Austrochip 2024
<https://repository.tugraz.at/publications/0j0xj-5xk62>

Core competences

- Analog CMOS IC design, simulation, layout
- Regular IC tapeout submissions
- IC characterization: data converters, I/O, sensor interfaces, radiation detectors
- Experience with nano-CMOS processes
- Characterization of CMOS devices
- 1/f and random telegraph noise analysis
- Device modelling for circuit simulations
- Physical device modeling using TCAD
- CMOS device handling with ESD safety
- CMOS reliability testing and modeling: aging, ionizing radiation effects, transient RF and pulse injection, ESD

Research infrastructure

IC Design Lab: workstations, IC design and verification software, TCAD simulation software

IC Verification & Analytics Lab: parameter analyzers, SMUs, oscilloscopes, basic instruments

Reliability Lab: climate chamber -50°C to 200°C, unistat -50°C to 200°C, X-ray stress cabinet, access to X-ray failure analysis instrument

Cryogenics: passive cryostat down to 77K, access to closed-cycle cryostat down to 4K

Electromagnetic Compatibility Lab: network vector analyzers, signal generators for direct power injection, E- and H- near and far field surface scanning equipment, transmission line pulse system, CDM and HBM ESD test equipment

Machine Workshop, also equipped with a wire bonder and a reflow oven for PCB assembly