Antoine Amy

Postdoctoral Scholar in Physics, Stanford University

Mössbauer spectroscopy • *precision measurements* • *cryogenic instrumentation*

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Research Interests: Mössbauer spectroscopy and related nuclear transitions for fundamental physics, precision measurements, cryogenic instrumentation, liquid-xenon detector R&D, and low-background rare-event searches.

Education

PhD in Subatomic Physics 10/2023–09/2026
IMT Atlantique, Nantes, France; SUBATECH / UMass Amherst (nEXO collaboration)

Defended on 09/28/2026.
Thesis: *Impurities & Radioactive Background Control in a Cryogenic Liquid-Xenon* $0\nu\beta\beta$ *Rare-Event Detector*.
Advisors: Julien Masbou (Nantes Université), Andrea Pocar (UMass Amherst).

Master in Fundamental Physics and Applications 09/2021–09/2023
Nantes Université, Nantes, France

Specialization: Research in Subatomic Physics (RPS). With high honors.
Final degree validation: 09/05/2023; focus on astroparticle physics, instrumentation, and analysis.

GraSPA Summer School 08/2021
LAPP, Annecy, France

Courses in particle and astroparticle physics.

Plas@Par Summer School 08/2021–09/2021
Sorbonne Université, Roscoff, France

Simulations, mathematical modeling, and experimental plasma physics.

Bachelor of Science in Fundamental Physics (Licence) 09/2018–06/2021
Nantes Université, Nantes, France

Includes CUPGE (selective reinforced scientific program) with advanced chemistry, computer science, mathematics, and physics. With high honors.

Research Experience

Postdoctoral Scholar in Physics 12/2026–present
Stanford University, Stanford, CA, USA; advisor: Giorgio Gratta

Research on Mössbauer spectroscopy for fundamental physics and related nuclear transitions, with a focus on experimental apparatus development.

Research: liquid-xenon $0\nu\beta\beta$ **detector (nEXO)** 10/2023–12/2026
SUBATECH (Nantes, France) / UMass Amherst (Amherst, MA, USA)

IMT Atlantique / SUBATECH: 10/2023–03/2025.
UMass Amherst: 04/2025–12/2026; doctoral research through 09/2026, followed by continued research.

- Developed purification and outgassing models for electronegative impurities in ultra-high-vacuum systems and liquid xenon, and used them to define impurity-budget, mitigation, and electron-lifetime targets.
- Performed Monte Carlo studies of radiogenic backgrounds, shielding performance, and γ attenuation in cryogenic detector geometries; compared analytic calculations with full simulation and reconstruction.
- Built automated pipelines for large-scale background simulation and reconstruction workflows.
- Contributed to the statistical treatment of the collaboration background budget using truncated-Gaussian mean/spread.

- Designed, assembled, and led the operation of a cryogenic HFE recirculation and cooling system for detector-related R&D, including piping, fluid transfer and storage, insulation, and system integration.
- Designed and tested an LN_2 heat exchanger; quantified cooldown behavior, cooling power, heat leaks, pressure losses, pump performance, and recirculation stability from operational data.
- Developed instrumentation, DAQ, and slow controls using thermocouples, pressure sensors, and flow meters; implemented Arduino-based readout, a web-based control and monitoring interface, and automation scripts to optimize cooling performance through LN_2-valve control.
- Integrated cryogenic and vacuum hardware including stainless-steel tubing, CF/KF/VCR/NPT fittings, valves, pressure-relief devices, and sensor interfaces; carried out leak testing, pressurization, purge, and commissioning procedures.
- Performed low-temperature HFE thermal-property studies, including DSC-like measurements, phase-transition identification, low-temperature behavior, and viscosity-related flow estimates to support cryogenic operation and system design.
- Designed PCBs and integrated power, relay, and valve-control electronics.
- Supervised and mentored four undergraduate students (two in chemical engineering and two in physics) on operation and development of the HFE setup, including non-invasive in-pipe HFE detection, pump-performance studies using Fourier-transform noise analysis, and PID-based cooling optimization.
- Authored collaboration notes and presented results in collaboration seminars.

Research internship: Virgo (Advanced Virgo) 03/2023–08/2023
LAPP (Annecy, France)

- Mode-cleaner cavity R&D: optical bench assembly, alignment, and Python/MATLAB simulation.

Research internship: XENON/DARWIN 04/2022–07/2022
Università dell'Aquila / LNGS-INFN (L'Aquila, Italy)

- Characterized ABALONE hybrid photosensors through gain/noise studies and DAQ measurements.
- Performed Geant4 optical modeling and comparison to bench measurements.

Research internship: KM3NeT 01/2021
SUBATECH (Nantes, France)

- Geant4 simulation of Cherenkov signals and ROOT/C++ analysis of radiation–matter interactions.

Publications

- nEXO Collaboration (incl. A. Amy), *The nEXO Radioassay Program*, arXiv:2604.15406 (2026), preprint.
- nEXO Collaboration (incl. A. Amy), *Design of a high voltage delivery system for noble liquid time projection chambers*, Nucl. Instrum. Meth. A 1091, 171718 (2026); arXiv:2602.23564.
- nEXO Collaboration (incl. A. Amy), *Characterization of CRYO ASIC for charge readout in the nEXO experiment*, arXiv:2512.11116 (2025; revised 09/2026), preprint.
- nEXO Collaboration (incl. A. Amy), *Ultra-pure Nickel for Structural Components of Low-Radioactivity Instruments*, Nucl. Instrum. Meth. A 1087, 171402 (2026); arXiv:2508.08230.
- nEXO Collaboration (incl. A. Amy), *Sensitivity of nEXO to ^{136}Xe Charged-Current Interactions: Background-free Searches for Solar Neutrinos and Fermionic Dark Matter*, Phys. Rev. D 112, 103010 (2025); arXiv:2506.22586.
- nEXO Collaboration (incl. A. Amy), *Ultra-sensitive radon assay using an electrostatic chamber in a recirculating system*, Nucl. Instrum. Meth. A 1081, 170876 (2026); arXiv:2504.15464.
- nEXO Collaboration (incl. A. Amy), *Overcoming photobleaching in imaging of single barium atoms in a solid xenon matrix*, Phys. Rev. Research 6, 043193 (2024); arXiv:2407.00285.
- nEXO Collaboration (incl. A. Amy), *Supernova electron-neutrino interactions with xenon in the nEXO detector*, Phys. Rev. D 110, 093002 (2024); arXiv:2405.19419.

Selected Presentations

- Low-Background Shielding and Cryogenic Design for Future Liquid-Xenon Detectors, Physics Seminar, Stanford University, Stanford, CA, USA (06/05/2026).
- Low-Background Shielding and Cryogenic Design for Future Liquid-Xenon Detectors, HEAP Seminar, UCLA, Los Angeles, CA, USA (05/27/2026).
- Probing the Neutrino Mass Mystery: Scale, Ordering, and Majorana Nature with ^{136}Xe $0\nu\beta\beta$, Observational Cosmology Seminars, Caltech, Pasadena, CA, USA (03/2026).
- Poster: Impurities & Radioactive Background Control in Rare-Event Detectors, UMass CNS Symposium (03/2026).
- Lab tests of HFE fluid and thermal properties, nEXO Collaboration Meeting, Online (01/2026).
- Background in Ultra-Clean Nickel HFE-Cooled Cryostat, nEXO Collaboration Meeting, Online (01/2026).
- Impact of Nickel Cryostats in the nEXO Detector, Heures thésardes SUBATECH/IMT Atlantique, Nantes, France (02/2025).
- Impact of Nickel Cryostats in the nEXO Detector, JRJC 2024, Saint-Jacut-de-la-Mer, France (11/2024).
- Impact of Nickel Cryostats in the nEXO Detector, GDR DUPhy, Lyon, France (10/2024).
- Impact of Nickel Cryostats in the nEXO Detector, nEXO Collaboration Meeting, Stanford, CA, USA (07/2024).
- Poster: Impurities & Radioactivity Control in the nEXO $0\nu\beta\beta$ Detector, JED Angers, France (06/2024).

Outreach

- Outreach talk: Comment est-on arrivé là ?, talk for middle-school interns, SUBATECH, Nantes, France (12/2024).
- Detector demonstrations, *Fête de la Science*, Nantes, France (10/2024).
- Outreach talk: Comment est-on arrivé là ?, *Femmes en Science L'Oréal*, SUBATECH, Nantes, France (06/2024).
- Cloud chamber presentation, *Rayons Cosmiques* conference day, Lycée Joliot-Curie, Rennes, France (04/2024).

Teaching

- IMT Atlantique: C++ and Geant4/ROOT lectures and computer labs, 09/2024–12/2024.
- IMT Atlantique, CODEVSI: supervision of the nuclear power plant model practical course, 02/2024–06/2024.
- Nantes Université: grading of third-year physics internship reports and oral presentations; teaching appointment 09/2023–08/2024 (jury on 03/01/2024).

Languages & Skills

- Languages: French (native); English (fluent, C1).
- Programming: Python, C++.
- Simulation & analysis: Geant4, ROOT, MCNP, MATLAB, Mathematica, NumPy, SciPy, pandas, Matplotlib, strax.
- Data & computing: Git, SLURM, workflow automation, reproducible data pipelines.
- Vacuum, cryogenics & instrumentation: UHV practices, throughput measurements, cryogenic fluid systems, thermocouples, pressure sensors, cryogenic flow meters, leak testing, purge/pressurization, Arduino-based DAQ and slow controls.
- Hardware & lab systems: stainless-steel tubing, CF/KF/VCR/NPT fittings, all-metal valves, pressure-relief devices, PCB design, soldering, relays, valve control, sensor integration.
- Tools: Bash, csh, HTML, LaTeX, Markdown.
- Operating systems: Linux, macOS, Windows.