Vincent Fischer, Ph.D. | Curriculum Vitae

Department of Physics, One Shields Avenue, Davis, CA 95616, USA

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Postdoctoral researcher in neutrino physics

Nuclear Science and Security Consortium fellow

Research interests

- Development and construction of innovative radiation detectors
- Improvement of signal detection in high background environments
- Design and development of nuclear non-proliferation technologies
- Radiological assays of low-background materials
- Consolidation of nuclear databases and models
- Particle and nuclear physics - Neutrino physics

Research experience and acquired skills

Postdoctoral scholar
University of California at Davis - Advisor: Prof. Robert Svoboda *January 2016–Now*

- **Nuclear Science and Security Consortium (NSSC) fellow since 2016**
  - Design and assembly of the gas system, data taking and data analysis for an experiment measuring the neutron capture cross section on argon at LANSCE (Los Alamos National Laboratory)
  - Data taking, data analysis and article writing for a calibration study of the LANSCE neutron beam in the thermal region, allowing precise absolute cross section measurements using the DANCE detector
  - Design, preliminary tests and feasibility studies for an experiment aiming at measuring the neutron scattering cross section on argon at intermediate energies using the LANSCE neutron beam
  - Good working knowledge of cryogenic, radiological and mechanical safety precautions and mitigations at LANL
  - Management and mentorship of several undergraduate and graduate students and junior technicians: Data analysis and simulation, hardware tests
  - Numerous oral and poster presentations at international conferences and Nuclear Security events
- **Neutrino Physics Center fellow at the Fermi National Accelerator Laboratory**
  - Nationally competitive fellowship awarded from September to December 2018 to perform detector construction work at Fermilab
  - Design, construction and installation of the Accelerator Neutrino Neutron Interaction Experiment (ANNIE), a gadolinium-loaded water Cherenkov detector measuring the neutron yield from neutrino interactions in water using a combination of fast photosensors and photomultiplier tubes
  - Run coordinator for the first neutron background measurement phase of the experiment (2016-2017)
  - Initiator and lead developer of a GEANT4 simulation framework in the RAT-PAC environment
  - Analysis of the ANNIE background phase data: Detecting neutron captures in gadolinium-doped liquid scintillator amidst high external backgrounds
  - Design, assembly, tests and operation of a novel and cost-effective filtration and purification system for gadolinium-loaded water: Removal of metal and ionic impurities using ion exchange and ultra-filtration, compatibility tests of different materials with Gd-loaded water
  - Design and development of an ion exchange resin specifically tuned to selectively remove impurities in gadolinium-loaded water: Applicable to any detector using gadolinium sulfate as a neutron detection dopant in water
  - Development of remote water quality monitoring tools and remote safety control systems
  - Design, simulations and tests of the active ANNIE/WATCHMAN neutron detection efficiency calibration source: Americium-Beryllium source coupled to a scintillating crystal and two photosensors
  - Procedural knowledge of the Fermi National Laboratory safety procedures, hazard and risk analysis and personal training, from experimental design to operation
- **Neutron Activation Analysis (NAA) Coordinator for the UC Davis group**
  - Radioassay of samples containing ultra-low levels of contamination

- Development of procedures for sample preparation and short and long-term irradiations at the McClellan Nuclear Research Reactor in Sacramento, CA
- Collaboration with reactor operators to enhance NAA sensitivity to different nuclear elements
- Optimization of data taking on High Purity Germanium detectors for several isotopes of interest
- Lead instructor at the NSSC-sponsored NAT (Nuclear Analytical Techniques) Summer Schools 2016 through 2019 - *'Neutron Activation Analysis'* activity
- Safety delegate of the UC Davis neutrino group laboratories: Improvement of air and water quality for experimental needs, development of safety procedures, stewardship and management of chemicals inventory, wastes and supplies

- **Leading member of the SNO+ data processing group**
  - SNO+ is a very low background liquid scintillator detector for double beta decay detection
  - Python and CouchDB framework development
  - Handling of large amount of data from and to different remote computing sites
  - Database manipulation and validation
  - Processing (data) and production (simulation) quality shifts and supervision/training of new members

Ph.D. student
Commissariat a l'Energie Atomique (CEA) at Saclay, FRANCE *Oct. 2012–Oct. 2015*

- Data analysis and simulation softwares development for reactor neutrino and nuclear non-proliferation experiments
- Assembly and deployment of the Nucifer neutrino detector for non-proliferation at the Osiris nuclear research reactor in CEA Saclay
- Extensive knowledge of the physics and experimental process of detecting reactor neutrinos
- Good working knowledge of design, fuel cycle and operations of commercial and research nuclear reactors
- Estimation and simulation of actinide impurities in spent nuclear fuel after reprocessing
- Design, simulation and dose estimation of high density tungsten shields for very high intensity gamma sources
- Simulation of gamma and neutron transport in highly attenuating environments
- Development of a standalone simulation framework for neutrino direction reconstruction using Inverse Beta Decay - Application to reactor and supernovae localization
- Stewardship and measurements on a High Purity Germanium detector
- Management and mentorship of several interns and other Ph.D. students

Research intern
CEA Saclay/RCNS Tohoku University (JAPAN) *May–Sept. 2012*

- Analysis of the first results of the Nucifer nuclear non-proliferation experiment
- First simulations of the dose attenuation of a tungsten shield for high intensity gamma sources

Research project
CEA Saclay *Sept. 2011*

Neutron-gamma discrimination using Pulse Shape Discrimination and Time-of-Flight techniques

Research intern
Laboratory of Nuclear and High Energy Physics (LPNHE) - University of Paris VI *June–July 2011*

Neutrino energy spectrum simulations in an « off-axis » beam for the T2K experiment

Research project
San Diego State University - Optics lecture *Fall 2010*

Long distance communication using an infrared Quantum Cascade Laser

Research intern
Linear Accelerator Laboratory (LAL), University of Orsay - Paris XI *June–July 2010*

Tests and building of the BiPo-3 detector, a low radioactivity alpha-beta coincidence detector for the SuperNEMO experiment

Education

- **Ph.D. in particle physics** — **Paris, FRANCE**
  CEA Saclay - University of Paris VI — *2012–2015*

"Beta-decay emitted electronic antineutrinos as a tool for unsolved problems in neutrino oscillation physics"
Advisor: Dr. Thierry LASSERRE
Manuscript (in English): `https://tel.archives-ouvertes.fr/tel-01231408`

- **Master degree in 'Nuclei, Particles, Astroparticles and Cosmology'** — **Paris, FRANCE**
  University of Orsay - Paris XI — *2010–2012*
  Particle physics major, additional courses in 'Neutrinos' and 'Detector instrumentation'

- **First year of Master degree/Senior year of Bachelor degree** — **San Diego, USA**
  San Diego State University — *2010–2011*
  Exchange year as a physics major, GPA: 3.74/4, Named to the College of Sciences 'Dean's Honor List' for the Fall and Spring semesters

- **Bachelor degree in fundamental physics** — **Orsay, FRANCE**
  University of Orsay - Paris XI — *2007–2010*
  Enlisted in the "Magistère" elite 3-year program

Skills

- **Programming Languages:** Proficient in: C, C++, Python, TeX, Bash
  Also basic ability with: Perl
- **Software Skills:** Matlab, Mathematica, MAESTRO for HPGe detectors, ROOT, GEANT4, Tripoli4 (equivalent of MCNP for the French Nuclear Agency)
- **Instrumentation Skills:** Extensive knowledge in: Photomultiplier tubes, scintillator materials, radioactive material handling, data acquisition setup
  Good working knowledge in: Semiconductors and gaseous detectors, cryogenics, lasers and optical fibers, basic electronics and electrical circuits, signal acquisition and data processing, water and gas systems assembly

Selected publications

- **Development of an ion exchange resin for gadolinium-loaded water**, V. Fischer *et al.*, *arXiv:2004.04629*, Submitted for publication in Journal of Instrumentation (JINST)
- **Measurement of neutron-proton capture in the SNO+ water phase**, SNO+ collaboration, *arXiv:2002.10351*
- **Water-based Liquid Scintillator Detector as a New Technology Testbed for Neutrino Studies in Turkey**, V. Fischer *et al.*, Nuclear Inst and Methods in Physics Research, A 969 (2020) 163931
- **Measurement of Beam-Correlated Background Neutrons from the Fermilab Booster Neutrino Beam in ANNIE Phase-I**, ANNIE collaboration, *JINST 15 (2020) 03, P03011*
- **Theia: An advanced optical neutrino detector**, Theia collaboration, *arXiv:1911.03501*, Accepted for publication in European Physical Journal C
- **Measurement of the neutron capture cross-section on argon**, V. Fischer *et al.*, *Phys.Rev. D99 (2019) no.10, 103021*
- **Absolute calibration of the DANCE thermal neutron beam using sodium activation**, V. Fischer *et al.*, *Nuclear Inst. and Methods in Physics Research, A 929 (2019) 97-100*
- **Accelerator Neutrino Neutron Interaction Experiment (ANNIE): Preliminary Results and Physics Phase Proposal**, ANNIE collaboration, *arXiv:1707.08222*
- **Measurement of θ_{13} in Double Chooz using neutron captures on hydrogen with novel background rejection techniques**, Double Chooz collaboration, *JHEP 1601, 163 (2016)*
- **Online Monitoring of the Osiris Reactor with the Nucifer Neutrino Detector**, Nucifer collaboration, *Phys.Rev. D93 (2016) no.11, 112006*
- **Prompt directional detection of galactic supernova by combining large liquid scintillator neutrino detectors**, V. Fischer *et al.*, *JCAP 08 (2015) 032*
- **Experimental Parameters for a Cerium-144 Based Intense Electron Antineutrino Generator Experiment at Very Short Baselines**, J. Gaffiot *et al.*, *Phys.Rev. D91 (2015) no.7, 072005*
- **Improved measurements of the neutrino mixing angle θ_{13} with the Double Chooz detector**, Double Chooz collaboration, *JHEP 10 (2014) 086*

- **Proposal - CeLAND: search for a 4th light neutrino state with a 3 PBq ^{144}Ce-^{144}Pr electron antineutrino generator in KamLAND**, CeLAND collaboration, *arXiv:1312.0896*
- **First Measurement of θ_{13} from Delayed Neutron Capture on Hydrogen in the Double Chooz Experiment**, Double Chooz collaboration, *Phys.Lett. B723 (2013) 66-70*
- **Direct Measurement of Backgrounds using Reactor-Off Data in Double Chooz**, Double Chooz collaboration, *Phys. Rev. D 86, 112009 (2012)*

Selected presentations (last 3 years)

- **ACED and ARTIE: Improving neutron cross section databases on argon** – NSSC Fall Workshop 2019 - *Lawrence Livermore National Laboratory*
- **ANNIE: The Accelerator Neutrino Neutron Interaction Experiment** – Lake Louise Winter Institute 2019 - *Lake Louise / University of Alberta*
- **The ANNIE experiment** – NNN 2018 - *Vancouver / TRIUMF*
- **Search for neutrinoless double beta decay with SNO+** – CIPANP 2018 - *UC Berkeley / Palm Springs*
- **Theia: A multi-purpose water-based liquid scintillator detector** – CIPANP 2018 - *UC Berkeley / Palm Springs*
- **R&D for WATCHMAN and the UCD Nuclear Data effort at LANL** – Nuclear Science and Security Consortium Program Review 2018 - *Lawrence Berkeley National Laboratory*
- **Research and development for WATCHMAN (AIT)** – Nuclear Science and Security Consortium Review Meeting 2017 - *Lawrence Berkeley National Laboratory*
- **ANNIE: the Accelerator Neutrino Neutron Interaction Experiment - Status and perspectives** – The 26th International Workshop on Weak Interactions and Neutrinos (WIN) 2017 - *UC Irvine*

Teaching experience

- Lecturer at the NAT Summer School 2019 - *'Inorganic scintillator detectors'*
- Lecturer for the Physics 130B 'Elementary Particle Physics' class - *'Neutrinos'* lecture - May 2019
- Lecturer for the Physics 9D 'Modern Physics' class - *'Particle Waves, 3D Schrodinger Wave Equation'* lecture - May 2018
- Lecturer for the Physics 245C 'Collider Physics' class - *'Introduction to Neutrinoless Double Beta Decay'* lecture - May 2018 - 2020
- Lecturer at the NAT Summer School 2018 - *'Scintillator detectors'*
- Lecturer at the NAT Summer School 2016 - *'Reactor physics and neutrinos'*

Outreach activities

- Interview for Fermilab News - `https://news.fnal.gov/2019/11/annie-poised-to-take-data-on-neutrino-nucleus-inte` - 2019
- Scientific press article 'Les neutrinos au service de la geophysique'/'Neutrinos for geophysics' published in the French journal 'Les reflets de la Physique', the official French Physical Society journal, *Issue number 54, August 2017*
- Invited speaker of the first broadcast of the 'Science Mavericks' radio show (88.3 FM in Toledo) - `https://www.mixcloud.com/sciencemavericks/the-ghost-particle-of-physics-neutrinos/` - 2016
- Guide/Lecturer for the neutrino physics laboratory during the 'Open Doors 2015' at CEA Saclay - 2015

References

- Prof. Robert Svoboda (rsvoboda@physics.ucdavis.edu), UC Davis - Postdoc advisor
- Prof. Mayly Sanchez (mayly.sanchez@iastate.edu), Iowa State University - ANNIE spokesperson
- Dr. Thierry Lasserre (thierry.lasserre@cea.fr), CEA Saclay - PhD advisor
- Dr. Matthew Malek (m.malek@sheffield.ac.uk), University of Sheffield - ANNIE analysis convener and WATCHMAN UK academic spokesperson