CaNPAN

Canadian **N**uclear **P**hysics for **A**strophysics **N**etwork

About CaNPAN

The Canadian Nuclear Physics for Astrophysics Network is a collaboration of Canadian astrophysicists and experimental and theoretical nuclear physicists aligned with the common goal of using Canadian nuclear physics facilities, expertise and equipment, in conjunction with Canadian computational astrophysics resources, to provide education and advances in our understanding of the creation of the chemical elements, and the role of stars in our universe.

CaNPAN is eager to collaborate internationally with the other IReNA networks.

CaNPAN's focus

CaNPAN's emphasis is two-fold:

- on multi-disciplinary training and
- on computational simulation-based nuclear astrophysics impact studies.

Both areas of activity have the goal to bridge astrophysics with nuclear physics and to guide experiments for nuclear astrophysics discovery.

Since 2021 25 mostly graduate students from Canada, the USA, Croatia, India, France and Chile have participated in the program

The annual CaNPAN training school starting each year in the fall is open to IReNA students.

https:///canpan.ca

CaNPAN Home Team Training Program Projects Results & Publications Experiments Contact

Nuclear physics impact studies for i process:

Building on JINA work and using NuGrid tools

- Denissenkov et al. 2021. The impact of (n,γ) reaction rate uncertainties of unstable isotopes on the i-process nucleosynthesis of the elements from Ba to W. MNRAS. 503:3913.
- Denissenkov et al. 2018. The impact of (n, γ) reaction rate uncertainties of unstable isotopes near N = 50 on the i-process nucleosynthesis in He-shell flash white dwarfs. J. of Phys. G. 45:055203.
- McKay J. E. et al. 2020. The impact of (n,γ) reaction rate uncertainties on the predicted abundances of I-process elements with 32 ≤ Z ≤ 48 in the metal-poor star HD94028. MNRAS. 491:5179.

Experiments related to i-process impact studies

List from web page:

Proposal Number	PI	Title	Isotope(s) measured (n,g)
ANL-1734	Ann-Cecilie Larsen	The rare-earth r-process peak: 156-159Sm(n,γ) reaction rates constrained with the beta-Oslo method	
ANL-1742	Artemis Spyrou	Constraints on neutron-capture reactions around N=82	
ANL-1755	Sean Liddick	Neutron-capture cross section constraints in neutron-rich Sn and Sb isotopes	
ANL-1799	Stephanie Lyons	Constraining neutron-capture cross sections for the i-process	
ANL-1807	Mallory Smith	Investigating gamma-ray strength functions and nuclear level densities in neutron-rich Zr isotopes	
ANL-1928	Hannah Berg	Constraining neutron-capture cross section for the i-process around A=150	
ANL-1929	Andrea Richard	Neutron-capture constraints for the astrophysical i-process	
ANL-2018	Andrea Richard	Constraining I-Process Nucleosynthesis in the Nb-Ru Region	
ANL-e1928	Andrea Richard	Neutron-capture constraints for the Astrophysical i-process	140Ba, 144Ce, 146Ce
ANL-e1929	Hannah Berg	Constraining neutron-capture cross sections for the i-process around A=150	151-153Nd
ANL-e2018	Andrea Richard	Constraining I-Process Nucleosynthesis in the Nb-Ru Region	99-101Mo
ANL-submitted	Adriana Sweet	Neutron-capture cross sections for heavy-mass fission fragments constrained with the β-Oslo method	
ANL-submitted	Erin Good	Astrophysical i-process constraints via the β-Oslo method	
FRIB-23084	Steve Pain	Informing the i process: constraining the As/Ge abundance ratio in a metal poor star via 75Ga(d,pg)76Ga	75Ga
FRIB-e23004	Eleanor Ronning	The Last Piece of the Generalized Brink Axel Hypothesis	69Zn 96Zr
FRIB-e23056	Andrea Richard	Indirect 99Nb(n,g)100Nb Constraint for the Astrophysical i-process	99Nb
NSCL-15136	N. Scielzo	Determination of the 92Sr(n,g) cross section and fission product burn up	
NSCL-e16033	Artemis Spyrou	Study of Kr isotopes for astrophysical applications	
NSCL-e17014	Sean Liddick	Photon strength function following the decay of 70Cu	
TRIUMF-S1944	Denis Mücher	Constraining neutron capture rates for the astrophysical i process	
TRIUMF-S2303	Matthew Williams	Can an i-process explain high (As/Ge) ratios seen in metal-poor stars?	75Ga

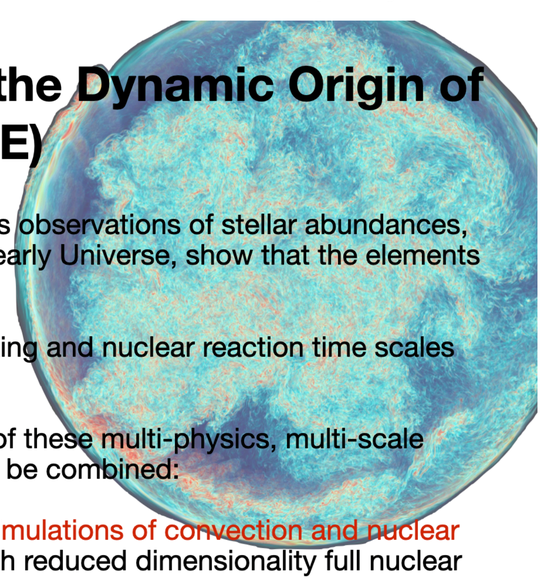
CaNPAN at Frontiers:

- Nicole Vash (TRIUMF)
- Malory Loria (TRIUMF/UVic)
- Falk Herwig (UVic)
- Guy Leckenby (TRIUMF)

IReNA student visitors to CaNPAN 2024

- Artemis Tsantiri (MSU/FRIB)
- Chirac Rathi (Ohio University)

CaNPAN's current NSERC-funded project:



Nuclear Physics for the Dynamic Origin of the Elements (NPDOE)

- Increasingly detailed and numerous observations of stellar abundances, especially those originating in the early Universe, show that the elements form under **dynamic conditions**
- In those conditions convective mixing and nuclear reaction time scales are similar, of the order of hours
- To understand the inner workings of these multi-physics, multi-scale processes two ingredients need to be combined:
  - Large-scale 3D hydrodynamic simulations of convection and nuclear energy generation combined with reduced dimensionality full nuclear network calculations
  - Nuclear reaction rates of unstable isotopes from nuclear experiments: *in the future through direct n-capture measurements in inverse kinematics involving a storage ring for radioactive particles at TRIUMF (TRISR) and a spallation neutron source being developed now at LANL*

CaNPAN Annual Meeting May 1 - 3, 2024

The three-day meeting fostered international multidisciplinary collaboration, with the first day dedicated to student and postdoc research presentations, professional development, and community building.

CaNPAN meeting program and links to slides

CaNPAN students