Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **4579** Type: **Invited Speaker / Conférencier(ère) invité(e)**

Computational Nuclear Astrophysics of the Dynamic Origin of the Elements in the Early Universe

Wednesday 29 May 2024 14:30 (30 minutes)

Nuclear astrophysics combines astronomical observations, computational astrophysics simulations and nuclear physics experiments to reveal how the elements formed in stars and stellar explosions. One of the key problems at the centre of nuclear astrophysics is to understand why the most metal-poor stars that formed in the early universe show enigmatic anomalies, such as two-order magnitude enhancements of C as well as many heavy elements, such as Sr, Zr, Ba, Eu and Pb compared to the solar system abundance distribution. Large observational survey-based campaigns have revealed the statistics of different types of enhancements of these C-enhanced metal-poor stars. These can be related to different dynamic astrophysical origin events in which neutron-capture nucleosynthesis can be induced with a range of high neutron densities. Large-scale stellar hydrodynamics simulations of the dynamic origin of n-capture elements characterize the astrophysical context of this nucleosynthesis and prompted the discovery of a new intermediate n-capture regime in merging H and He-shell convection zones. However, due to the high neutron-densities involved the reaction pathways involve dominantly unstable species for which the required (n,γ) cross sections are only known from rather uncertain Hauser-Feshbach models. This severely limits our ability to validate our simulations with the astronomical abundance observations. I will briefly describe how we organize the necessary multi-disciplinary interactions between observers, computational astrophysicists and nuclear physics experimenters in the Canadian Nuclear Physics for Astrophysics Network (CaNPAN), and how future measurements of n-capture cross sections in inverse kinematics with a storage ring at TRIUMF would allow us to understand how the elements are made in the first generations of stars.

Keyword-1

nuclear astrophysics

Keyword-2

stellar hydrodynamics

Keyword-3

early universe nucleosynthesis

Primary author: Prof. HERWIG, Falk (University of Victoria)

Presenter: Prof. HERWIG, Falk (University of Victoria)

Session Classification: (DTP/DNP) W3-1 Computational Advances in Astrophysics and Cosmology II | Avancées informatiques en astrophysique et en cosmologie II (DPT/DPN)

Track Classification: Symposia Day (Wed May 29) / Journée de symposiums (Mercredi 29 mai): Symposia Day (DTP/DNP - DPT/DPN) - Computational Advances in Astrophysics and Cosmology / Avancées informatiques en astrophysique et en cosmologie