NUCLEAR ASTROPHYSICS

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PRE-REQUISITES : Nuclear Physics (basic)

INTENDED AUDIENCE : Physics, Engineering Physics

INDUSTRIES APPLICABLE TO : Companies involved in manufacturing of radiation detectors, pulse processing modules, photo sensors, target materials for nuclear reactions, data acquisition systems.

1.Electronic Enterprises (India) Private Limited
2.Saint Gobain crystals and detector
3.CAEN
4.Hamamatsu Photonics
5.ORTEC
6.Nucleonix Systems Pvt. India Ltd

COURSE OUTLINE :

Nuclear astrophysics is the union of nuclear physics and astronomy. The purpose of the course is to introduce the emerging field of nuclear astrophysics; a discipline that can identify new observational signatures probing our universe. This discipline has proved to have the potential to categorize the conditions at the core of stars and provide information of energy production from stars, nucleosynthesis and stellar evolution. New initiatives in this domain include the development of experimental facilities (Ex: FRENA in SINP Kolkata), that open new landscapes into the nuclear processes that take place at low energies during the evolutionary phases of stars and in explosive events in galaxies.

ABOUT INSTRUCTOR :

Prof. Anil Kumar Gourishetty is passionate about teaching at various levels of students. I have been shortlisted in top 15 at institute level (UG category) for outstanding teacher award in 2018, 2019 and 2020. The students strength was in the range of 30 to 180. The maximum faculty score I had obtained from a batch of the students was 4.57 out of 5. At IIT Roorkee, I have taught Nuclear Astrophysics (2 times), and Nuclear Physics and Applications (2 times) and Reactor Physics (2 times) which are related to the proposed course. As one of my research areas is Nuclear Astrophysics, I enjoy in teaching this course, which would be interest of many students who wants to know the role of nuclear physics in understanding the stellar evolution and synthesis of elements.

COURSE PLAN :

Week 1: Selected features of astronomy ‘observing the universe’ and of astrophysics ‘explaining the universe’

Week 2: General characteristics of thermonuclear reactions, sources of nuclear energy, Maxwell-Boltzmann velocity distribution

Week 3: Cross section, stellar reaction rates, mean lifetime; astrophysical s – factor, abundance evolution

Week 4: Neutron and charged particle induced non-resonant reactions, reactions through narrow and broad resonances

Week 5: p-p chain, CNO, NeNa and MgAl cycles

Week 6: Creation and survival of 12C, Nucleosynthesis beyond iron peak (s – process, r – process, p – process)

Week 7: General aspects of experiments: Accelerators for beams of charged particles, neutrons and gamma rays, detectors, target materials, electronic pulse processing modules

Week 8: Experimental methods to study nuclear astrophysics: Activity method, Coulomb dissociation, Trojan Horse and ANC methods; radioactive ion beams