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ΣΧΟΛΗ ΘΕΤΙΚΩΝ ΕΠΙΣΤΗΜΩΝ
ΤΜΗΜΑ ΦΥΣΙΚΗΣ

ΕΚΤΑΚΤΗ ΟΜΙΛΙΑ
ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

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«Unveiling the Origin of Elements: n_TOF Collaboration and the Quest for Precise Nuclear Cross Sections»

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Abstract

Astrophysics is on the cusp of definitively addressing fundamental questions about our Universe using a consistent and quantitative approach. The Standard Model, combining General Relativity, nuclear physics, and particle physics, successfully describes the hot Big Bang cosmology. The observed neutron-to-proton ratio (13% n, 87% p) was established during the weak interaction freeze-out (around 1 second after the Big Bang).

In this context, understanding the origin of chemical elements is crucial. Light element abundances (H, He, Li) produced during the Big Bang (200 seconds) have significant implications for cosmology and particle physics. Heavy elements (beyond iron) are formed through ongoing neutron capture nucleosynthesis in stars and supernovae, shaping galactic chemical evolution.

The key challenge lies in comprehending heavy element formation. Nuclear physics plays a complex role, and the underlying mechanisms and thermodynamics remain incompletely understood. Advancing our understanding requires precise laboratory measurements of neutron capture cross sections, which are critical inputs for astrophysical models.

The n_TOF collaboration at CERN has embarked on an ambitious program of nuclear capture measurements. The goal is to reduce existing uncertainties in cross section data to below 3%, significantly improving astrophysical models. This program leverages the n_TOF facility's unique features, including high neutron flux, excellent energy resolution, and low background, allowing for accurate cross-section determinations for radioactive and low-cross-section samples.

This talk will present the results and astrophysical implications of the n_TOF collaboration's program.