Contribution ID: **374** Type: **Invited Presentation**

Nucleosynthesis in First Stars and Other Puzzles: Experimental Prospects at LUNA

First stars played a key role in shaping the chemical evolution of the universe, acting as the earliest sites of nucleosynthesis beyond the Big Bang. Yet, key aspects of their nuclear burning processes—particularly the formation of CNO nuclei from primordial material—remain among the long-standing puzzles in nuclear astrophysics.

Recent studies suggest that previously overlooked reaction paths, involving alpha-induced reactions on lithium and boron isotopes, may provide a crucial link. If enhanced by nuclear clustering effects, these reactions could also shed light on the persistent cosmological lithium problem and the anomalous electron screening observed in laboratory experiments.

In this talk, I will present ongoing efforts at the Laboratory for Underground Nuclear Astrophysics (LUNA), located deep underground at LNGS, Italy, to measure alpha-induced reactions at astrophysical energies. Thanks to LUNA's ultra-low background environment, these studies can achieve unprecedented precision, offering new insights into stellar evolution and the nuclear processes that shaped the cosmos.

This work is part of the NUCLEAR research programme supported by an ERC Advanced Grant (UKRI-funded, EP/Z534626/1), aimed at addressing open questions about the origin of the elements and the early universe.

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Session Classification: Parallel session

Track Classification: Nuclear Astrophysics