



RESEARCH

THE PUZZLE OF THE ORIGIN OF ELEMENTS IN THE UNIVERSE

LUNA (Laboratory for Underground Nuclear Astrophysics) at the INFN Gran Sasso National Laboratory has recreated and observed a rare nuclear reaction that occurs in giant red stars, the type of star our Sun will eventually become. This is the first direct observation of sodium production in these stars, one of the nuclear reactions that is fundamental for the formation of the elements that make up the universe. Specifically, LUNA is the first experiment to have detected three "resonances" (an increase in the number of reactions observed over a small energy range) in a reaction in the neon-sodium cycle which leads to the production of sodium in giant red stars and the release of energy.

LUNA is a compact linear accelerator. It is the only one in the world installed in an underground facility, where it is shielded against cosmic rays and thus able to observe rare processes. The aim of this experiment is to recreate the energy ranges of nuclear reactions by going back in time to one hundred million years after the Big Bang, to the formation of the first stars and the start of those processes that, in a way we still do not fully understand, gave rise to the huge variety in the quantities of the elements in the universe. The experiment thus studies the nuclear reactions that take place inside stars where, like in an intriguing and amazing cosmic kitchen, the elements that make up matter are formed and then driven out by gigantic explosions and scattered as cosmic dust.

LUNA is an international collaboration involving some 50 Italian, German, Scottish and Hungarian researchers. This recent result was published in *Physical Review Letters* in December. ■