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Search for the Origins of the Elements and Their Isotopes

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Where did the atoms in our bodies originate? This is a kind of ultimate genealogical quest for our origins in the universe that begins shortly after the Big Bang when most of the hydrogen and helium were formed. Stars produced the remaining 88 elements found in nature, but the details of this production are not understood. We still do not know, for example, where more than half of the elements heavier than iron are produced, although modern telescopes provide clues. The solution is to observe elements in the cosmos and attempt to accurately model how they got there. A key to accurate modeling is an understanding of the properties of atomic nuclei that participate in the process. Often this involves properties of isotopes with far more neutrons than we are currently able to produce and study in the laboratory. This talk will discuss the quest to produce in the laboratory these isotopes, which previously only existed in the most extreme astrophysical environments. In the process we confront another question of the limits of the elements. We have made elements up to atomic number 118 and isotopes with twice the normal mass, but how far can we extend this process, and do the ultimate limits have observable consequences in nature?