

# **Multielement Measurements Without Isobaric Interferences in Stardust Grains by Resonance Ionization Mass Spectroscopy**

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Micrometer-sized particles condense in the atmosphere of exploding stars and their isotopic composition records the nucleosynthesis processes in the star. These particles, called stardust or presolar grains, formed before the formation of our sun and solar system. These stardust grains were ultimately incorporated in the cloud of matter that our solar system formed from. Because isotopic systems in stardust grains represent the ground truth values as inputs for nucleosynthesis models, studying isotopic systems in stardust is important for understanding the formation of *p*- and *s*-process nuclei. After separating stardust grains from their meteorite matrix, these grains are the only material older than the solar system that can be analyzed in a laboratory setting. However, stardust grains are difficult to analyze because the average grain size is  $\sim 1 \mu\text{m}$  diameter and analytes of interest (e.g., Ti, Sr, Zr, Mo, Ru, Ba, W) are atom limited. Resonance ionization mass spectrometry (RIMS) is ideal for analyzing stardust grains because of the high spatial resolution and sensitivity, low sample utilization, and the ability of RIMS to discriminate against isobaric interferences by selectively ionizing only the elements of interest. We present data from  $\sim 100$  stardust (silicon carbide and graphite grains) using newly developed RIMS methods for simultaneously collecting multielement measurements (up to 19 isotopes of 3 elements, such as Zr, Mo, Ru) on the LION instrument at Lawrence Livermore National Laboratory. To achieve this, ionization lasers of elements with isobaric interferences (e.g., Mo, Zr) are offset by 200 ns to discriminate isobaric interferences. Ultimately, this method allows for elemental analysis, regardless of isobaric interferences, of micron-sized particles for isotopes without performing chemical separation. We apply these multielement analyses of stardust grains to analyzing spent fuel and intentionally tagged fuel elements.