EXECUTIVE SUMMARY [NON-CONFIDENTIAL, NON-TECHNICAL ABSTRACT FOR PUBLIC INFORMATION OR PROGRAM PROMOTION]: State the application's broad, long-term objectives and specific aims, making reference to the potential public benefits of the project relevant to California. Do not include proprietary or confidential information. This may be distributed before the funding decision has been finalized.

High-resolution nonlinear laser methods are proposed to measure and study stable, safe, non-radioactive isotopes as biotracers at trace-concentration levels. The main objectives include stable non-radioactive isotope measurements in commercially available gas-phase atomizers, including inductively coupled plasma atomizers, at orders-of-magnitude better detection sensitivity levels. Since our laser method can detect both radioactive and non-radioactive isotopes, biotracer studies can be performed using safe, stable, non-radioactive isotopes. Our detection sensitivity is comparable or better than other methods using radioactive isotopes or other fluorescence-based methods. We plan to compare and verify our isotope results with those of our new NSF-funded ($400k) high-resolution mass spectrometer. This high-resolution mass spectrometer is the only other comparable analytical technique for measuring stable isotopes. Our laser method offers several important advantages. It can resolve not only isotopes, but also different hyperfine lines of an isotope, i.e., the atomic spectroscopic fingerprints. Since no two hyperfine structures are identical, the method offers unambiguous isotope measurements while the most expensive mass spectrometers cannot resolve isotopes with similar m/z values (e.g., ^{87}Sr and ^{87}Rb). The effectiveness of our laser method will be investigated for some important isotopes without relying on radioactivity measurements.