FY 2014 PHASE I AWARD WINNER

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AWARD: $94,992.00

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TITLE OF PROJECT: Ultra-High Precision Laser Isotope Monitor for 13CO2, CO18O and CO17O

SUBTOPIC NUMBER: 8.3.1R,C

TECHNICAL ABSTRACT:

Greenhouse gas (GHG) emissions to the atmosphere are primary drivers of global climate change and hence there is a crucial need to quantify their sources and sinks. A general technique to constrain source and sink strengths is the analysis of the relative proportions of isotopic variants of GHG's. These measurements must be performed with extremely high precision. The gold standard technique, isotope ratio mass spectrometry, is limited by laborious sample processing requirements, high capital cost and impracticality of field deployment. Aerodyne Research has developed an alternative approach based on tunable laser infrared spectroscopy that avoids these limitations. Our commercial isotope monitor for the most important GHG gas, carbon dioxide, very nearly meets the measurement precision specified in Sub-Topic 8.3.1 for 513C (0.01%0) and 5180 (0.02%0). The current instrument is designed for fast response continuous flow measurements whereas the solicitation calls for the measurement of discreet samples with ultra-high precision. We will improve the measurement precision to routinely exceed the solicitation requirements while measuring small discreet samples (60 ml or less). This will be accomplished with two innovations: a small volume, high vacuum multiple-pass cell and a rapid sample switching method to promote long term signal averaging without drift.

SUMMARY OF ANTICIPATED RESULTS:

The proposed instrument will have an immediate technical impact in several research fields which utilize isotope ratio mass spectrometry of C02: atmospheric chemistry, ecology, climate change and geochemistry. An instrument with equivalent precision but with lower capital and operating costs will increase productivity and encourage wider use of C02 isotope measurements, thus promoting commercialization within these research communities. Additional commercial opportunities exist in oil and gas prospecting (already in use) and in human breath analysis as a medical diagnostic. Development of this technology will also lead to additional laser isotope monitors including monitors for the clumped isotopes of C02.