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Laser spectrometer for CO_2 clumped isotope analysis

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Carbon dioxide clumped isotope thermometry has proven to be a reliable method for biogeochemical and atmospheric research. We present a new laser spectroscopic instrument for doubly-substituted isotopologues analysis. In contrast to a conventional isotope ratio mass spectrometry (IRMS), tunable laser direct absorption spectroscopy (TLDAS) has the advantage of isotopologue-specific determination free of isobaric interferences.

Tunable infrared laser based spectrometer for clumped isotope analysis is being developed in collaboration between Heidelberg University, Germany, and LERMA-IPSL, CNRS, France. The instrument employs two continuous intraband cascade lasers (ICL) tuned at 4439 and 4329 nm. The spectral windows covered by the lasers contain absorption lines of the six most abundant CO_2 isotopologues, including the two doubly substituted species $^{16}O^{13}C^{18}O$ and $^{16}O^{13}C^{17}O$, and all singly substituted isotopologues with ^{13}C, ^{18}O and ^{17}O. A Herriott-type multi-pass cell provides two different absorption pathlengths to compensate the abundance difference between singly- and doubly-substituted isotopologues. We have reached the sub-permill precision required for clumped isotope measurements within the integration time of several seconds.

The test version of the instrument demonstrates a performance comparable to state of the art IRMS. We highlight the following features of the instrument that are strong advantages compared to conventional mass spectrometry: measurement cycle in the minute range, simplified sample preparation routine, table-top layout with a potential for *in-situ* applications.