

## Cavity Ring-Down System for Measurement of Trace Gases in High Vibration Environments

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Cavity ring-down spectroscopy has established itself in the trace gas measurement community as a versatile and reliable measurement method. Field studies, as for studies of atmospheric chemistry and composition, often require mobile measurement platforms such as on-road vehicles or aircraft. These measurements add size, weight, and power restrictions to the instrument as a whole, but also subject the optical system to large mechanical vibrations within a broad frequency range. We present a custom-built cavity ring-down system adapted to these conditions, consisting of 4 separate 50 cm long optical cavities measuring NO, NO<sub>2</sub>, NO<sub>y</sub>, and O<sub>3</sub>. The optics are mounted on a custom-built cage system made of carbon fiber rods and aluminum plates as shown in the figure below (sections have been removed for ease of illustration). The mounting system for the cavity mirrors contains no moving parts, providing the necessary immunity to misalignment. We use a single 405 nm diode laser for all four cavities, and achieve ring-down times of approximately 26 μs with noise of 5 ns/sqrt(Hz) in the laboratory and 8 ns/sqrt(Hz) while measuring in-flight on the NOAA P3, a large propeller aircraft. This results in 20-30 parts per trillion/sqrt(Hz) of in-flight noise on NO<sub>2</sub> mixing ratio measurements. Additionally, the alignment of the cavity mirrors has not needed readjustment over the last two years, which included multiple field campaigns and cross-country shipments by truck.

