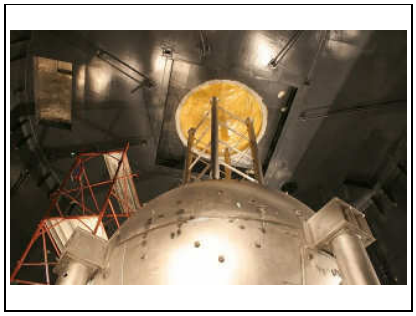
"Big Physics"

Products: HALO 3, LaserTrace 3, Prismatic, VROOM

Tiger Optics Overview

Tiger Optics introduced the world's first commercial "Continuous Wave Cavity Ring-Down Spectroscopy" (CW-CRDS) analyzer in 2001. Today, our instruments monitor thousands of critical points for industrial and scientific applications. They also serve the world's national metrology institutes, where they function as transfer standards for the qualification of calibration and zero gases, as well as research tools for such critical issues as global warming and urban air quality.



CW-CRDS is ideally suited to laboratory applications where factors such as accuracy, sensitivity, low detection limits, speed of response, long-term stability, low maintenance, and low gas throughput are all essential when the efficient analysis of multiple samples is required. This report details the use of our CW-CRDS analyzers for "Big Physics" applications.

Big Physics

"Big Physics" is a catch-all term describing large-scale, high-energy experiments designed to unravel the very nature of our universe. Such experiments are probing the building blocks of the atom and revealing an array of exotic particles such as the neutrino and Higgs boson. These particles make headline news in both the scientific and popular press, not least due to the awe inspiring apparatus required to expose their presence and determine their properties.

Alongside the complex electronic detectors and the huge magnets that make up the now familiar particle accelerators, ultra-high-purity gases are often a key component of the systems designed to smash atoms and detect the resulting fragments, or to detect incoming particles from deep space, so called cosmic rays. For example, the neutrino can travel great distances, and at great speed, through ordinary matter, making it extremely difficult to detect. The larger the detector, the more chance of observing an interaction. One neutrino detection method involves the use of a network of detector wires surrounded by an electric field, submerged in vast quantities of liquid argon.

These liquid argon time-projection chambers (LArTPC) are located at a suitable depth beneath the earth's surface, with the intention of reducing interference from cosmic rays and background radiation. The unwelcome presence of trace impurities – such as water and oxygen in the liquid argon, even at extremely low concentration – has an adverse effect on the measurement. For this reason, Tiger's instruments are being pressed into service. Several particle physics laboratories, including the Fermi Accelerator Laboratory in Illinois, are using Tiger Optics' LaserTrace and Halo instruments to optimize detector performance.

CW-CRDS for Purity Analysis

Tiger Optics manufactures a range of instruments for purity analysis applications. The HALO 3 is ideally suited to ensure that moisture levels are minimized and controlled while lower levels of both water and other impurities call for the power and sensitivity of the LaserTrace 3. Multi-component applications are also addressed by both our innovative Prismatic platform and our multi-species mirror-based analyzer, the VROOM.

HALO 3 and LaserTrace 3

Prismatic and VROOM

All Tiger Optics instruments are based on Continuous Wave Cavity Ring-Down Spectroscopy (CW CRDS). The key components of the CW-CRDS system are shown in Figure 1 below.

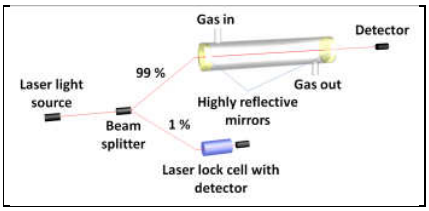


Figure 1. Schematic of CW-CRDS Analyzer

CW-CRDS works by tuning light rays to a unique molecular fingerprint of the sample species. By measuring the time it takes the light to fade or "ring-down", you receive an accurate molecular count in milliseconds.

The time of light decay, in essence, provides an exact, non-invasive, and rapid means to detect contaminants. Figure 2 below shows just how sensitive our analyzers are to very small changes in moisture concentration.

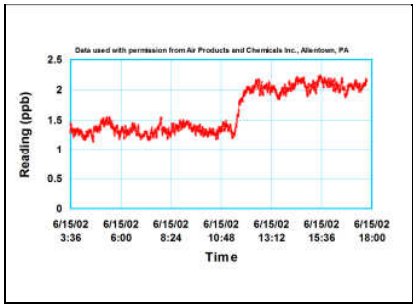


Figure 2. Sensitivity to moisture

The LaserTrace 3 offers detection limits for water and oxygen at ppt (parts per trillion) level, with other components in the low ppb range. Up to four independent sensor modules can be connected to the PC driven electronics module, providing a standard MS Windows environment controlled via an integrated touch-screen.

Both the Prismatic and VROOM provide a similar package and user interface, offering the possibility of measuring up to four components in a single gas stream from ppb up to high ppm.

The HALO 3 features a touch-screen interface, including integrated trending features, plus on-board data logging – five days @ 15 second logging interval, three weeks @ 1 minute logging interval – provides additional benefits for operation at remote locations. Data is retrievable via an RS232 or Ethernet interface. Real-time data collection to an external data logger or PC is available via the same two options, or the 4-20 mA signal output.

Tiger Optics CW-CRDS analyzers bring powerful benefits to purity analysis applications, including:

- Accuracy traceable to the world's major national reference labs
- Sub-ppb detection capability
- No zero or span required
- Nano-second speed of response
- Low maintenance

The maintenance-free and calibration-free properties of CW-CRDS also mean low cost-of-ownership and allow users to operate with confidence and ease in field and laboratory alike.

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