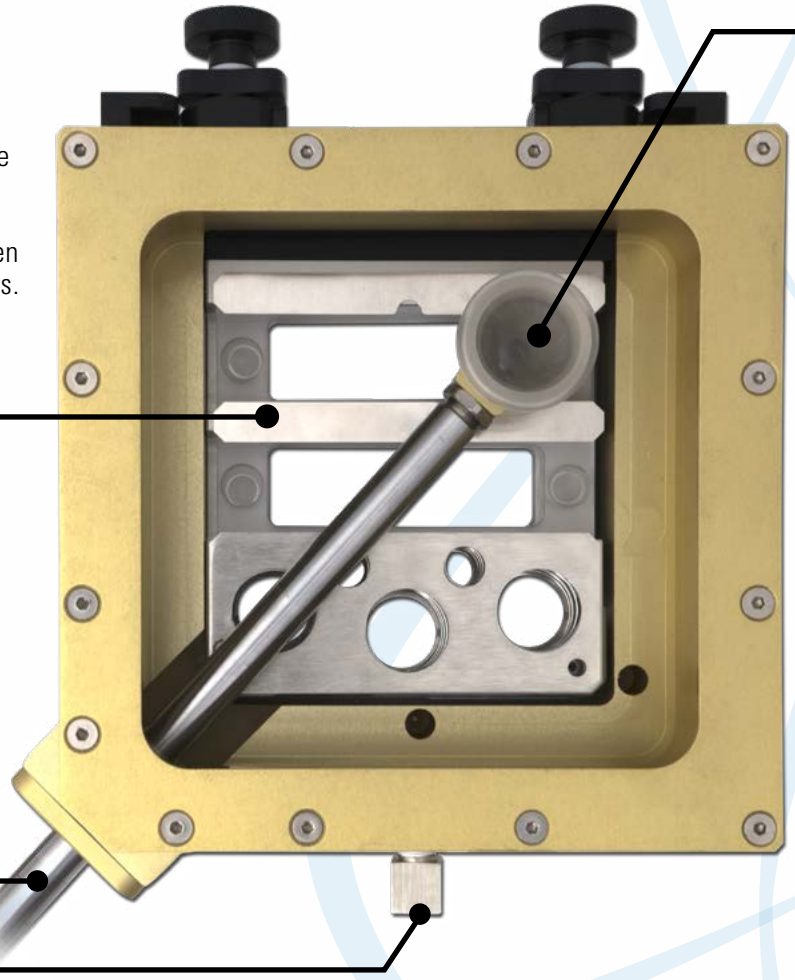
HelEx II

Tunable 2-Volume LA-ICP-MS Cell System

Customizable Sample Drawers

Allows flexibility in sample handling; either fixed positions for standard sample shapes or fully open for irregular sample shapes.



Exchangeable Active Cup Inserts

- Sealed inner cup for optimal flow control.
- Tunable active flow to control ablated aerosol: can be tuned for fast washout (imaging applications) or stable signals (nuclide ratio analysis).

Dual Independent Mass Flow Controllers

Separate inner and outer cell flow control allows the signal intensity and washout to be optimized to the application and the specific ICP-MS.

Unmatched Vacuum Purge Performance

Rids the cell of air when changing samples in less than 5 minutes.

One cell for all applications

Capacity, speed and precision are what drive sample cell R&D at Teledyne Photon Machines and define the HelEx II. We took the original HelEx, the industry's most peer reviewed and published cell developed and licensed by the Australian National University, in a new direction and made it better. The design improvements were vetted in Teledyne's extensive ICP-MS laboratory and its performance confirmed by experienced users worldwide.

Why? Recent demand for higher throughput, ranging in application from running a thousand or more zircons unattended to mapping (imaging) elemental concentrations over areas of tissues and rocks, calls for larger cells with faster washout and uniform signal intensity throughout. This allows the signal intensity and washout to be optimized to the type of analysis and to the specific make and model of ICP-MS.

TELEDYNE
PHOTON MACHINES
Everywhereyoulook™

Improvements That Deliver Industry-Leading Performance

- An **electro-polished, articulated arm** allows efficient aerosol transport with:
  - **No flexible or fixed curvature tubing** inside the cell to induce fractionation.
  - **No cup positioning leadscrews** with complex positioning system requiring lubricants and are subject to wear metal particulates.
- A new **leak-free**, ball seal that is tested under pressure with helium and factory certified.
- A wide variety of sample holders that accommodate various combinations of round mounts, fusions, slides and standards, a universal sample holder that holds irregular samples, and a cryo insert are available.

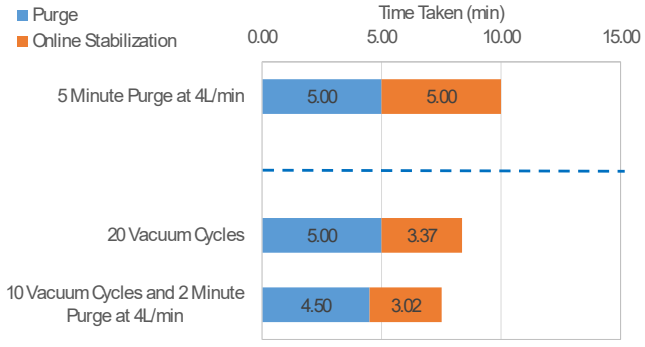
- **Precision leveling** of all sample holders for consistent focusing and ablation of all samples.
- Improved gas dynamics for **uniform signal response to < 2% RSD** throughout the sampling area.
- Proprietary interchangeable, **application specific inner cells** allow the HelEx II to be indisputably the most versatile 2-volume cell solution with the highest performance available. A specialized high-performance transport system yields optimal results for all applications, allowing:
  - Fastest possible washout speeds down to **< 20 ms** for the ultimate spatial resolution.
  - Flattest possible signal for precise ratio determination.

Class Leading Stabilization Time

WHAT WAS: Clearing a 2-volume cell of comparable size (100 x 100 mm useable area) after changing samples came at the high price of purging at 4 LPM of helium for 5 minutes, plus another 5 minutes to return to the original stabilized base line.

BETTER: This all-vacuum HELEX II strategy when the cost of purge gas is a concern.

BEST: A combination of vacuum cycles followed by a quick purge for the fastest possible sample exchange and signal stabilization.



Elapsed Time from Closing the HelEx II Sample Chamber to Acquiring Data (Return to Stable Background Levels)

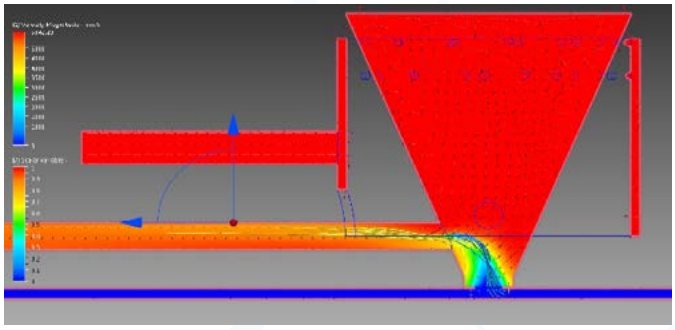
The HelEx II is equipped with the industry's strongest, oil-free vacuum pump, which is capable of pulling a deeper vacuum to rid the cell of trapped air and moisture under samples faster, cheaper and more thoroughly than other cell-clearing techniques that use weak pumps or high pressure, purge-only methods. The HelEx II is configured for rapid evacuation and back-fill, with or without a quick purge, and can be optimized for rapid "settling" of the user's particular ICP-MS, all under automated software control.

Enabling Technological Advancements

Close collaborations with leading academic institutions and pioneers in LA-ICP-MS, along with valued insights and feedback from our many users, have fueled recent advancements that led to the release of the HelEx II with its expanded capabilities and enhanced performance. Computational Fluid Dynamic (CFD) simulations, rapid 3-D prototyping, rigorous laboratory testing and other Teledyne resources were mobilized in its design and implementation. The unique, tunable inner cell of the HelEx II plays a critical role in transport efficiency, signal strength and fractionation.

CFD modeling reveals that the inner cup flow efficiently contains ablated aerosol, which reduces the effective inner cup volume. This means that the aerosol dispersion is low and cell washout is fast, making the system ideal for high spatial resolution applications such as mapping and depth profiling.

With alternative flow and transfer setups the dispersion/washout can be dramatically altered to offer pulse-free stable signals even at low repetition rates, enabling the HelEx II to be truly tunable for all applications.



One of many computer generated, gas dynamic models used to optimize the "tunable" cyclonic flow and rapid extraction of the HelEx II inner cup. (Courtesy of the University of Cambridge)

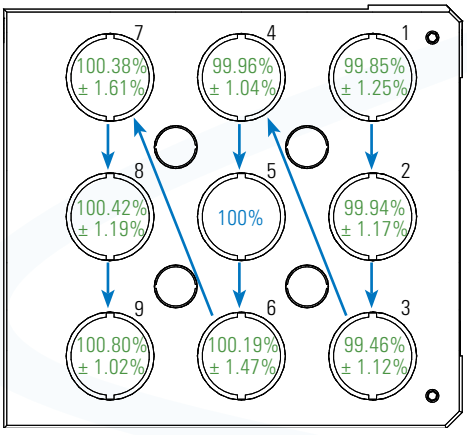
Signal Reproducibility

Using 40 µm spots and 4 J/cm^2 laser energy, a series of single-point ablations on nine separate NIST 612 glass samples at nine locations within the HelEx II cell demonstrate highly reproducible data* throughout the area of the cell. Using the central location as a reference point, calculated sample recoveries are shown to be 100%. Variation in signals across the entire cell can be shown to be **<2% RSD** over the entire mass range.

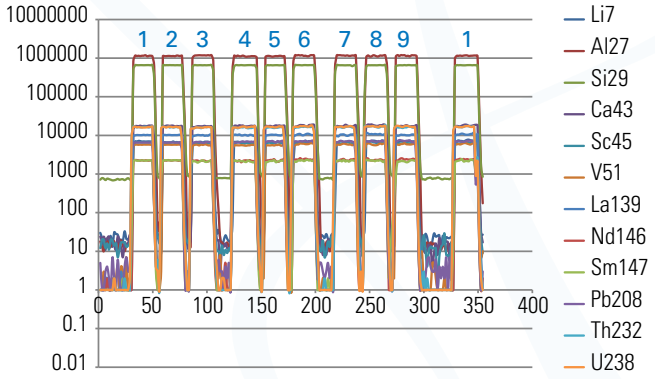
*Original dataset provided on request. Contact cetacsales@teledyne.com

	Li	Rb	Sr	Y	La	Ce	Ho	Hf	Pb	Th	U
Average Recovery (%)	99.9	99.8	99.8	100.1	100.1	99.8	99.9	100.0	100.0	99.6	99.5
Experimental Error (1σ %)	±7.2	±1.0	±0.6	±5.3	±1.2	±1.2	±2.8	±11.5	±1.6	±0.9	±0.8
RSD Across Cell (%)	0.79	0.78	0.58	0.63	0.50	0.59	0.88	1.06	1.55	0.85	0.81

Lack of signal bias across the cell can also be shown by normalizing the calculated concentration data to the central sample position. Average normalised data across the mass range shows that the HelEx II is **unbiased** as the concentrations calculated are within experimental error across the sampling area of the cell.



Normalized concentration across the HelEx II Cell showing variation within experimental error; therefore, no signal bias in the cell.

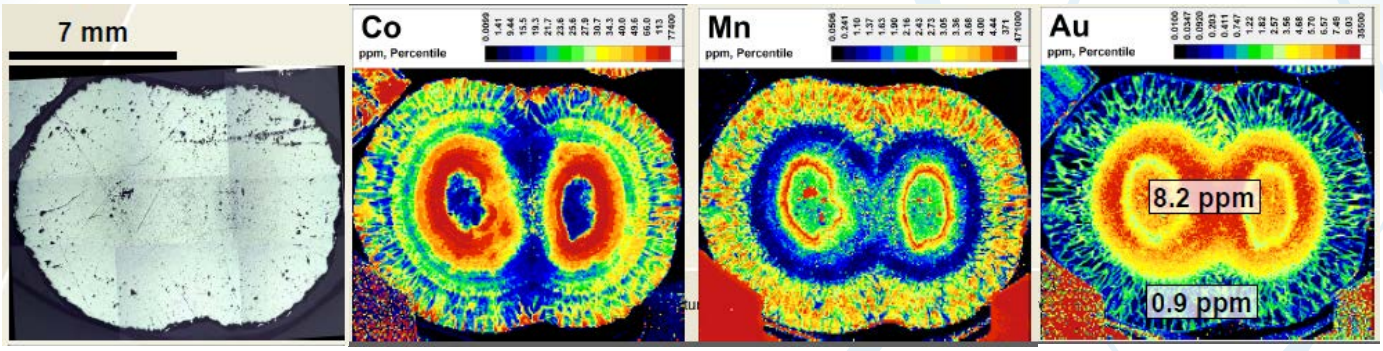


Line scans over nine areas of the HelEx II Cell, showing highly reproducible data.

Stage Position Reproducibility

Less than 1 micron positional reproducibility* within a 25 mm round mount without software correction is standard with the HelEx II 2-volume sample chamber on all Teledyne excimer and femtosecond lasers systems. This is made possible with custom, high-precision, German-made stages of superior stiffness, combined with sub-micron step resolution and minimal drag on the cell. This enables sample mapping (imaging) down to the 1 µm spot resolution provided with select models of Teledyne Photon Machines systems.

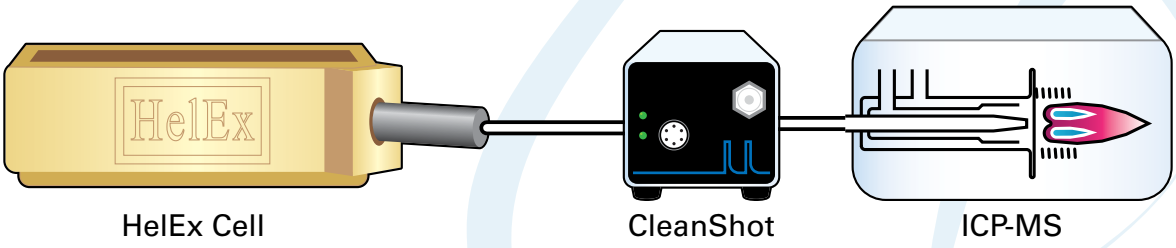
*Reproducibility measured as 0.7 ± 0.1 µm over 100 spots in a 25 mm round area.



Precision elemental concentration "imaging" of an Owl Creek Pyrite Nodule presented by Dr. Simon Jackson, Goldschmidt, 2015 (Courtesy of the Geological Survey of Canada)

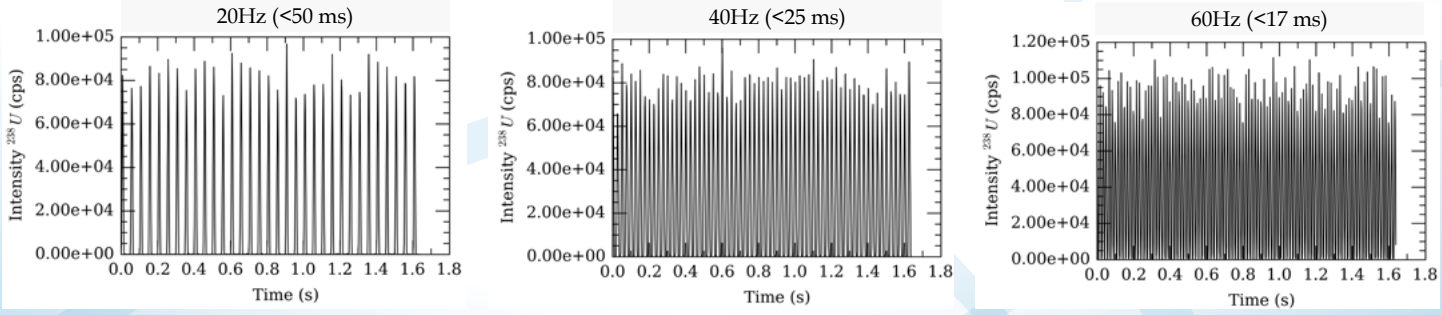
CleanShot Remote Solenoid Switch (Performance Option)

The CleanShot provides the shortest, straightest path from HelEx II sample cell to the torch for even faster washout and a clean extraction line to eliminate memory effects, and is fully automated with software control.



Fast Sampling Rates with an optional High Efficiency Transport Adapter

Combined wash-in and wash-out times of <20 ms allow sampling rates up to 60 Hz, making it possible to capture single-shot events and significantly increase throughput when "imaging" (mapping) elemental concentrations over areas of a sample by decreasing sampling time.



Compilation of raw transient signals of the laser firing while raster scanning an area at 20, 40 and 60 Hz, showing baseline separation of individual laser pulses using the HelEx II 2-volume cell (courtesy of the University of Ghent).

The most flexible, field proven sample cell on the market today

TELEDYNE CETAC TECHNOLOGIES
Everywhereyoulook™

TELEDYNE PHOTON MACHINES
Everywhereyoulook™

Teledyne CETAC Technologies, 14306 Industrial Road, Omaha, NE 68144 USA
+1 402.733.2829 | +1 800.369.2822 | cetacsales@teledyne.com | www.teledynecetac.com

Revised 2020 April 14