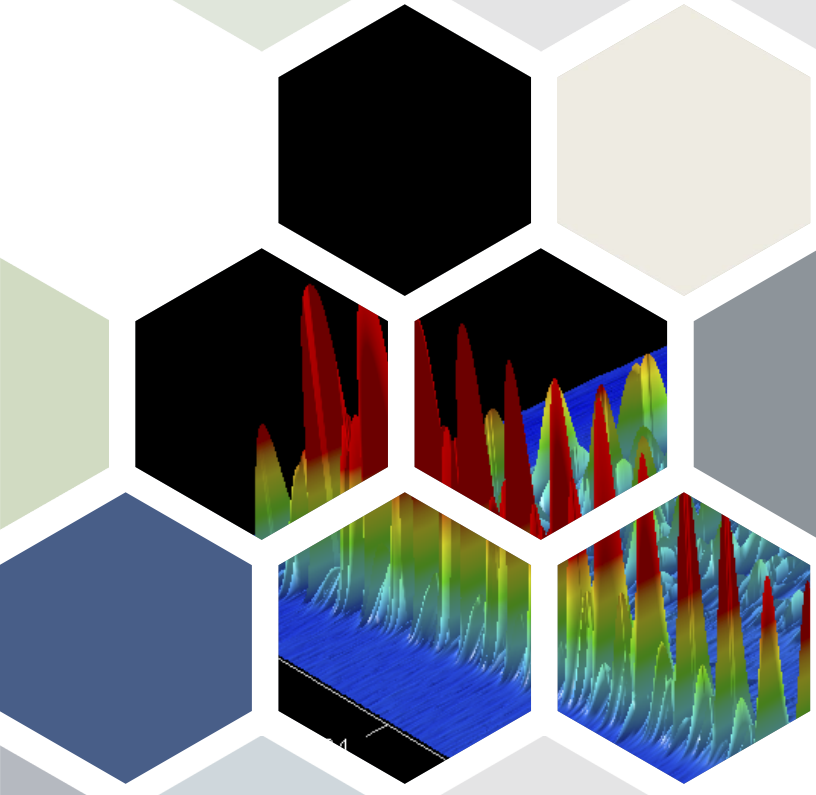
PEGASUS® HRT+ 4D



LECO

EMPOWERING RESULTS

The Ultimate GCxGC Game Changing Technology

The solution for complex sample analysis has arrived. LECO's *Pegasus* GC-HRT$^+$ 4D combines the highest performance Time-of-Flight Mass Spectrometer with industry leading GCxGC, giving analytical scientists the ability to identify components with more confidence, convert unknowns to real knowns, and find out what else is in their sample. The *Pegasus* GC-HRT$^+$ 4D takes advantage of four dimensions of separation and resolution.

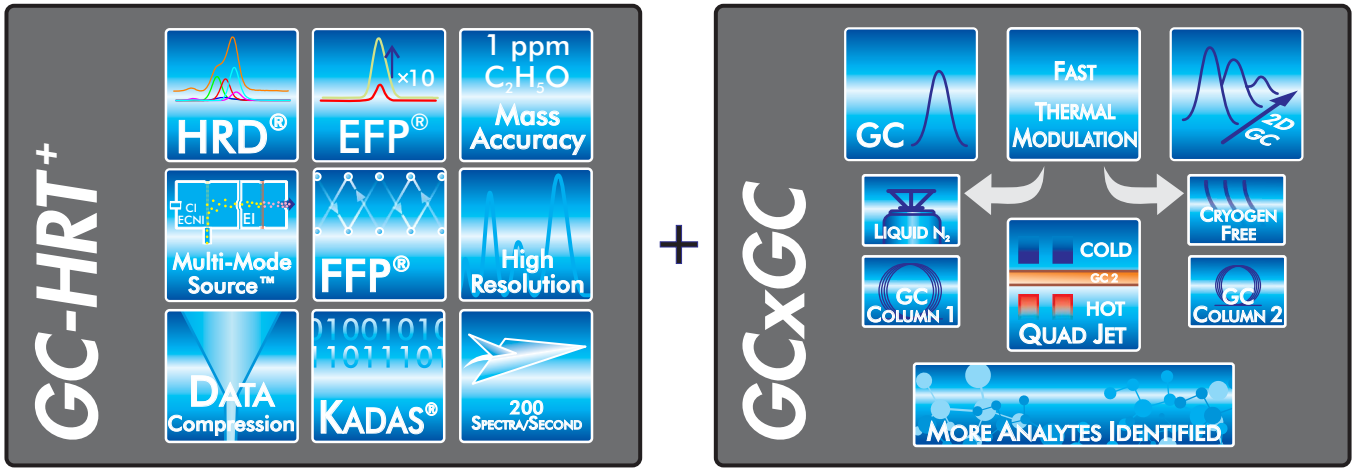
1. 1st dimension chromatographic resolution

2. 2nd dimension chromatographic resolution

3. High mass resolution and exceptional mass accuracy

4. High Resolution Deconvolution® (HRD®) from the leaders in deconvolution

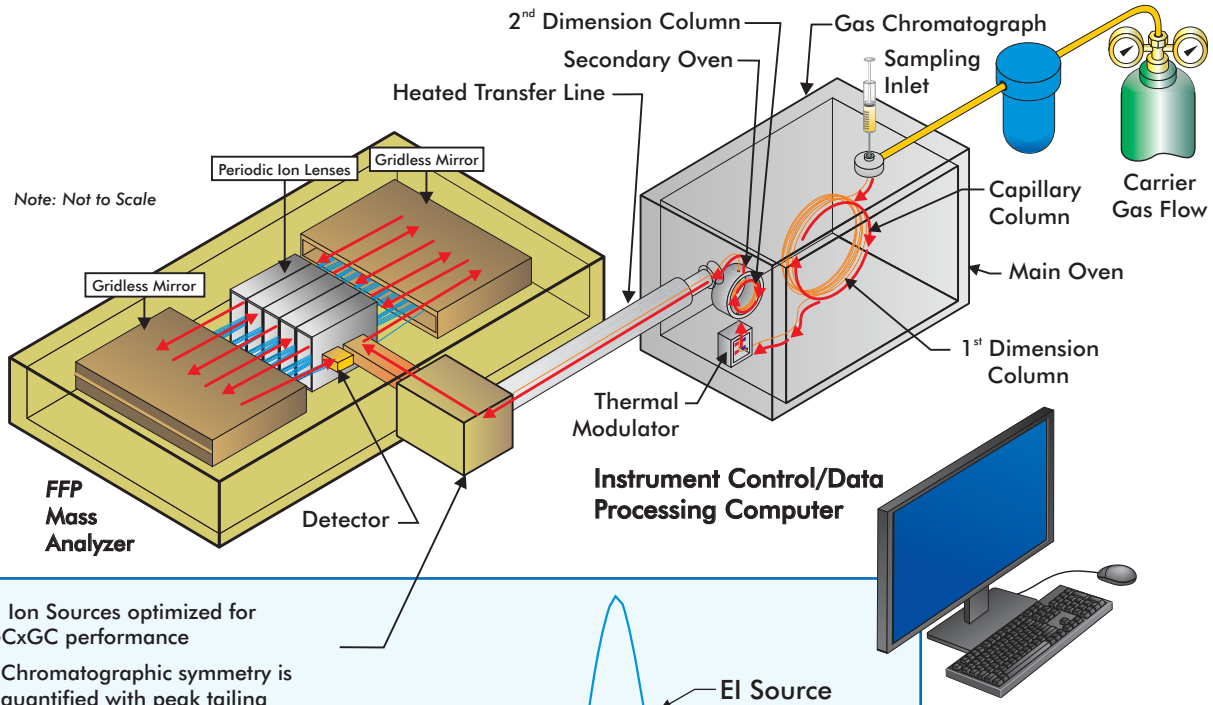
An Integration of Two High Performance Technologies



- A combination of the highest performance GCxGC and TOF on the market gives users an unprecedented ability to interrogate complex samples
- Find more analytes than ever before and identify components with the ultimate confidence
- Mass accuracies of 1 ppm and peak capacities at least two times greater than any other product in the marketplace
- The industry's most established GCxGC system; thermal modulation with liquid nitrogen or cryogen-free versions
- Novel Encoded Frequent Pushing® (EFP®) allows increased sensitivity
- Multi-Mode Source™ (MMS™) has great mass accuracy and high resolution on pseudo-molecular ions, which complements the traditional Electron Ionization Source (HR-EI), to provide the comprehensive characterization of unknowns
- Integrated software platform acquires data, controls all hardware, and analyzes and reports results with a high level of automation; tailored to get the most out of High Resolution TOF data
- Designed to maintain 1st dimension chromatographic separation and harness the power of a 2nd dimension of chromatography

Pegasus GC-HRT+ 4D Hardware

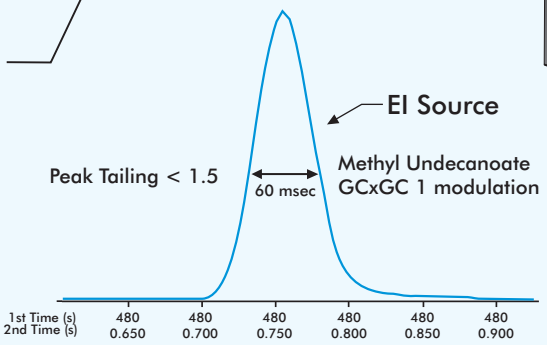
The industry's most established and reliable performance GCxGC technology.



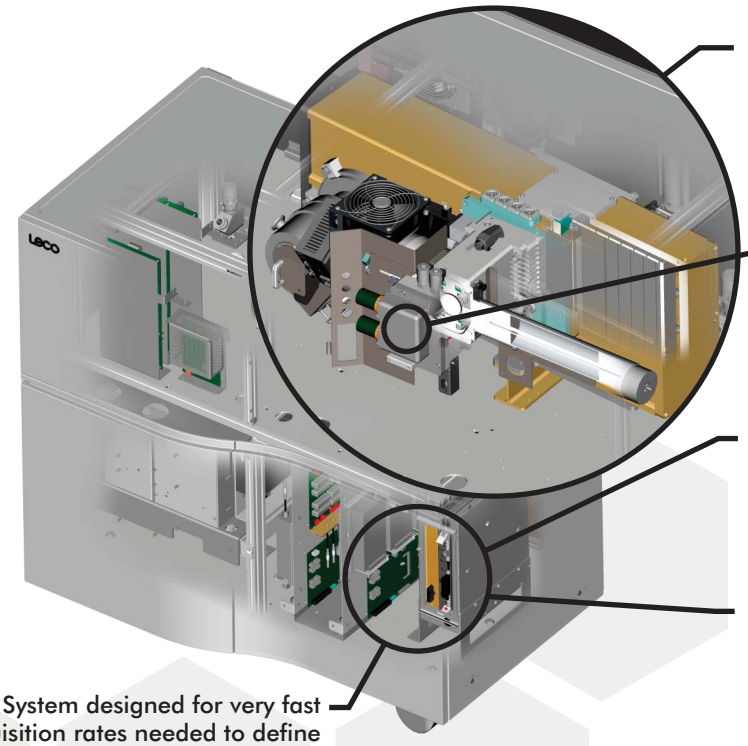
EI Ion Sources optimized for GCxGC performance

- Chromatographic symmetry is quantified with peak tailing calculation
- HR-EI compatible with both H_2 and He carrier gases

New *MMS* combining EI, PCI, and NCI all in one high-performing, easy-to-tune source; all modes compatible with GCxGC



Capable of up to 50,000 mass resolution and acquisition rates up to 200 spectra/second.



Folded Flight Path (FFP) – Provides high order TOF focusing which delivers high resolution sensitivity with two modes of operation (25k and 50k mass resolution)

HR-EI or MMS Sources

Learn more in the MMS application note, 203-821-630

KADAS – Patented acquisition system, which dramatically reduces noise, ensures mass accuracy, and reduces file size

New Encoded Frequent Pushing – Patented method of pulsing the Orthogonal Accelerator multiple times to increase duty cycle (x10)

System designed for very fast acquisition rates needed to define narrow second dimension peaks

For more information on EFP refer to white paper 209-281-006.

Pegasus GC-HRT⁺ 4D Software

Identification Grading System™ (IGS™)

Increase confidence in your identification challenges with intuitive ChromaTOF® brand software. LECO's *Identification Grading System (IGS)* feature eases data review by allowing users to quickly see, justify, have confidence in, and report on which chemicals are in a particular sample. This in turn allows a user to make confident decisions on what to do next.

Stop Guessing What is in Your Sample: KNOW

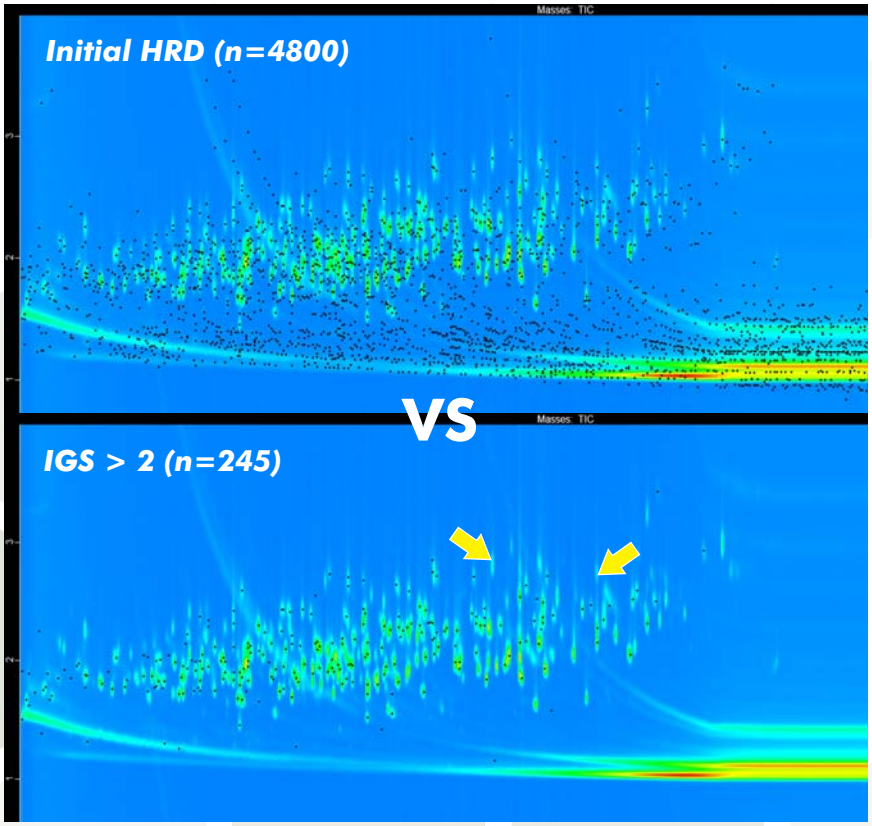
The *IGS* uses all the available chemical information generated from the *Pegasus* GC-HRT⁺ 4D to add confidence to your unknown unknown identification process.

- The *IGS* gives a grade to a particular identification based on 4 criteria:
  1. Presence and accurate mass of a molecular ion
  2. Presence and good correlation of a spectral similarity score from a curated library
  3. Accurate masses of sensible potential formulae of fragmented ions corresponding to a spectral library hit
  4. Matching retention index from the library hit

The higher the value of the grade the more confident you can be in your identification.

- The true power of identification can only be realized with the combined power of GCxGC and high resolution time-of-flight mass spectrometry (TOFMS).
  - GCxGC separates coeluting species and gives cleaner mass spectra than other techniques.
  - TOFMS enables unskewed mass spectra across a chromatographic peak even across very narrow second dimensional peak; which, when combined with deconvolution, yields the highest quality spectra that you can generate.

Born out of the EPA's Non-Targeted Analysis Collaborative Trial (ENTACT), the *IGS* is LECO's solution to the time-intensive process of data review.



Here is an example of the unfiltered deconvolution results from a GCxGC-TOFMS analysis of a sample from the EPA's ENTACT project: *https://doi.org/10.1007/s00216-018-1435-6* By applying the *IGS* filter, we can quickly view only the most confident identifications. This simplification is dramatic and enables you to immediately begin investigating the "unknown unknowns," indicated by arrows in the diagram.

Of the known compounds entered into the sample from this particular example (which was provided to LECO as a blind sample), *IGS* identified approximately 80% of the known peaks. The combination of GCxGC and high resolution TOF was proven to be necessary for this confidence. See: *https://pubs.acs.org/doi/10.1021/es5002105*

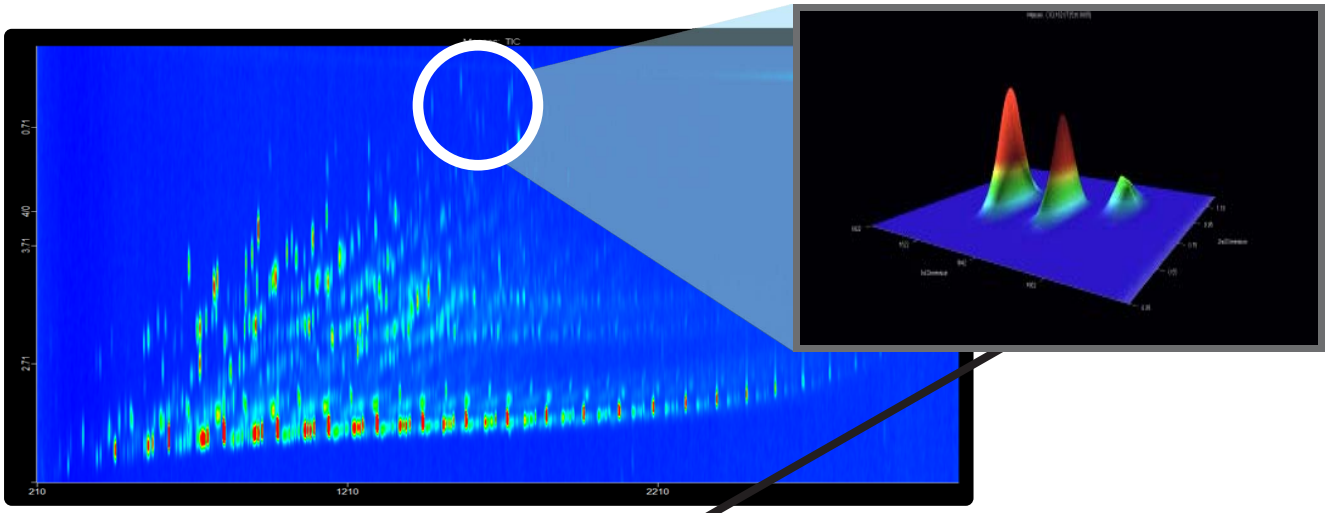
ChromaTOF Tile

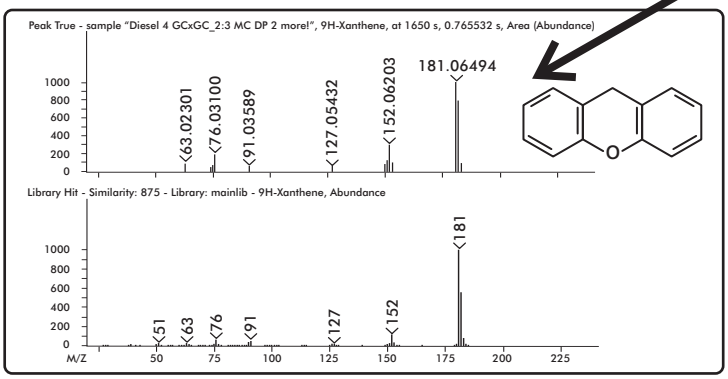
ChromaTOF Tile revolutionizes how GCxGC data is analyzed. This software compares GCxGC data files quickly and easily. Statistically significant differences rise to the top so you can spend less time finding the differences and more time finding out what they mean.

Identify Components with Confidence

High Resolution Deconvolution® (HRD®) Example: Diesel GCxGC

The combination of *HRD* and mass accuracy gives users exceptional confidence in identification.

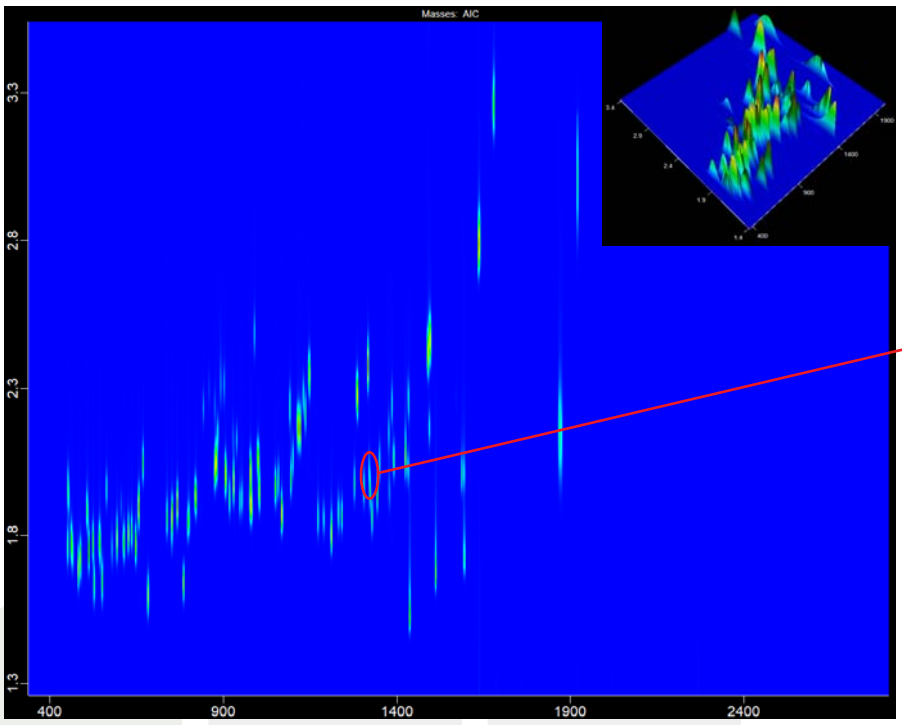


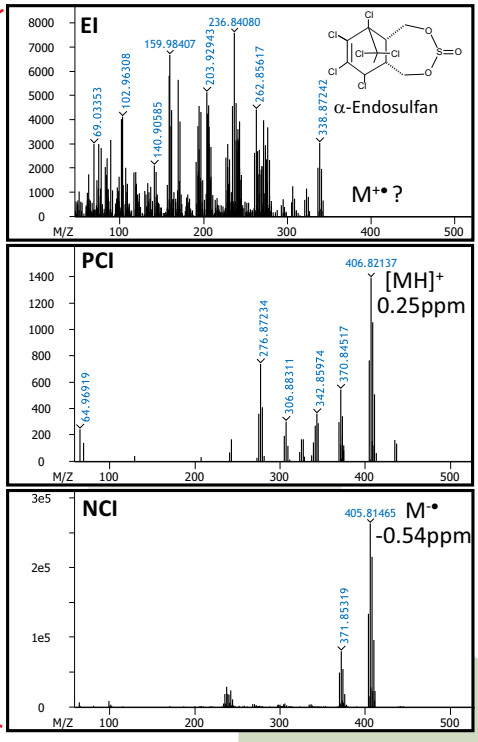


Mass	Formula	Accuracy (ppm)
182.07233	$C_{13}H_{10}O$	-0.68
181.06494	$C_{13}H_9O$	0.80
152.06207	$C_{12}H_8$	0.13

Identify More With Confidence

The highly robust Multimode Source allows for the acquisition of regular Electron Ionization as well as complementary Positive and Negative Chemical Ionization spectra in GCxGC mode, easily switching between modes for each acquisition.This uncovers extra molecular ion evidence for your identification challenges.

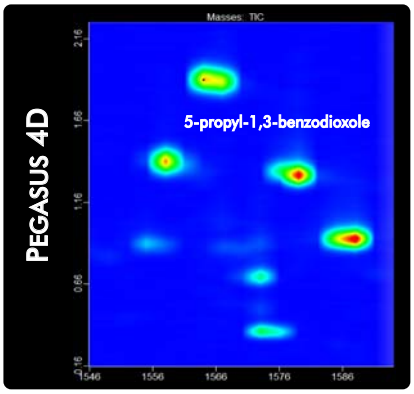


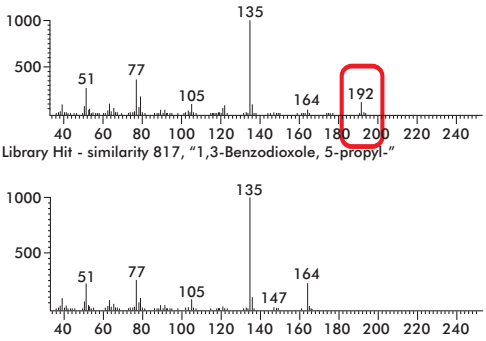


Make Your Unknowns ➡ Known

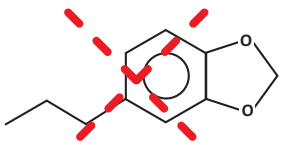
Unknown identification is made easy with the *Pegasus* GC-HRT⁺ 4D. Example: Perfume Investigation

The process of improving identifications is simplified by the GC-HRT⁺ 4D. In the following, there is a moderate identification from our *Pegasus* 4D (top) of an analyte with very different odor properties. The *Pegasus* GC-HRT⁺ 4D (bottom) has improved the identification of this component to a more odor appropriate hit, as well as being more consistent with the data.

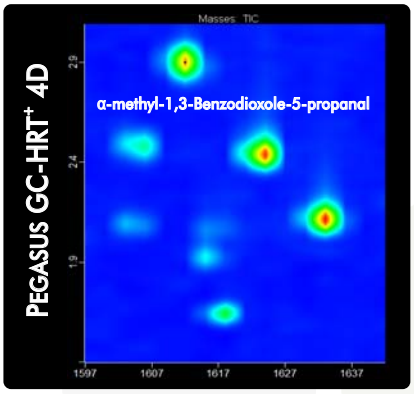


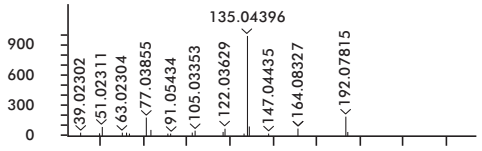


Identification close, but not precise.



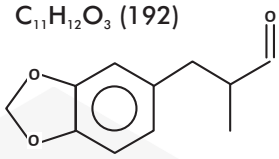
Odor Type: Spicy





Formula	Observed Mass	Calculated Mass	Mass Accuracy (ppm)
$C_{11}H_{12}O_3$	192.0782	192.0781	0.29
$C_{10}H_{12}O_2$	164.0833	164.0832	0.53
$C_8H_7O_2$	135.044	135.0441	-0.75
$C_7H_6O_2$	122.0363	122.0362	0.47
C_7H_5O	105.0335	105.0335	0.38
C_6H_5	77.03855	77.03858	-0.4

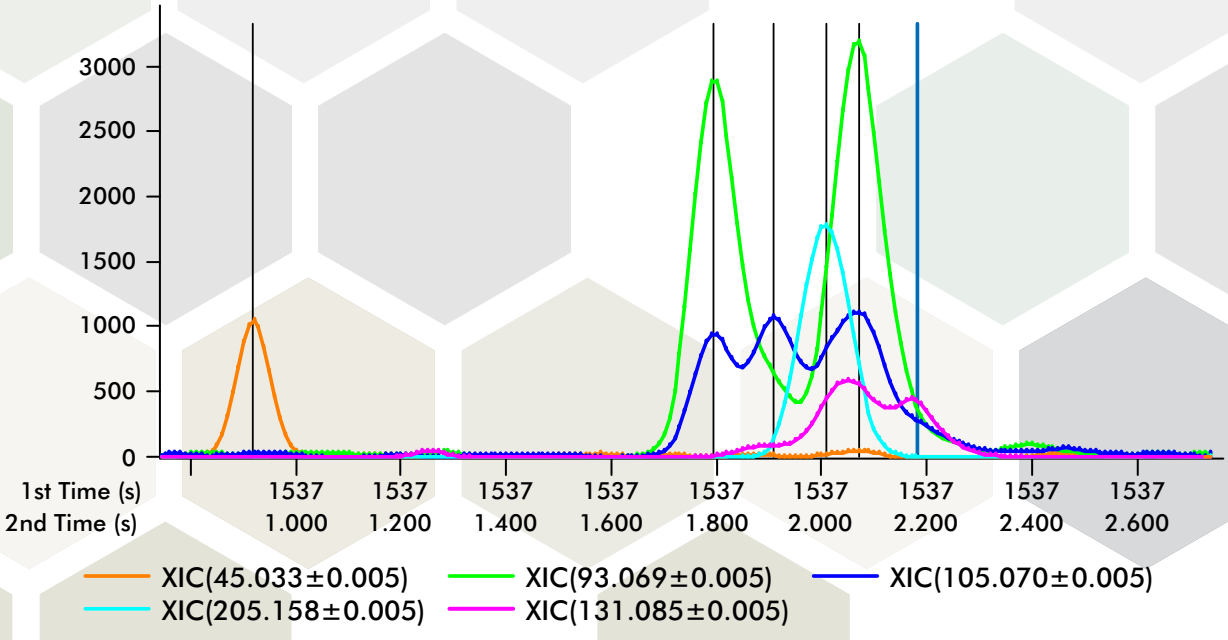
$C_{11}H_{12}O_3$ (192)



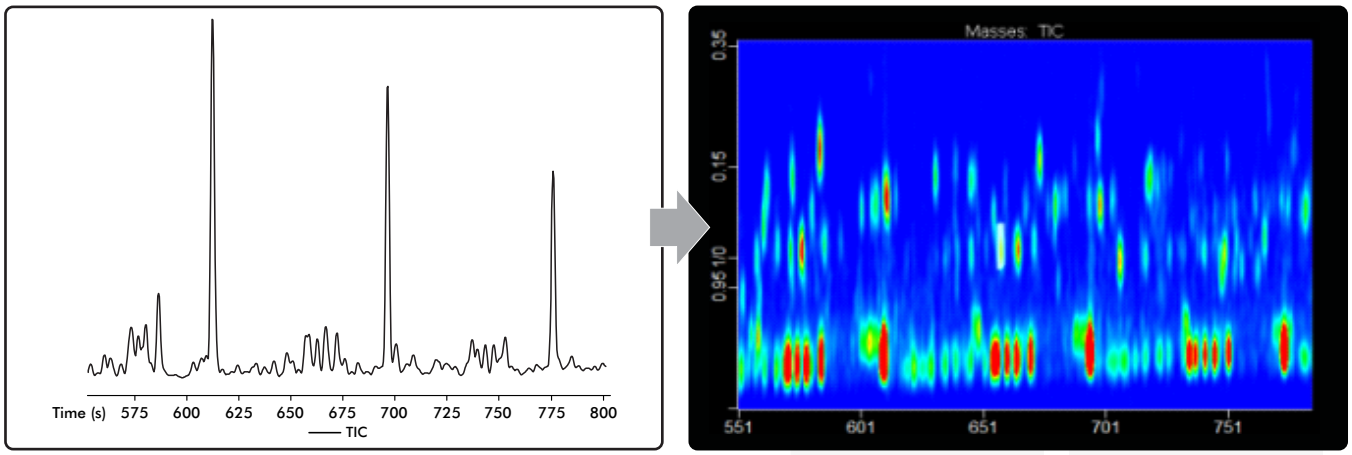
Odor Type: Floral

Find More Peaks

One modulation period is depicted below, fast spectra acquisition rates are vital to deconvolute complex regions of the chromatogram. Fast modulation is needed to maintain the first dimension of chromatography. If a peak in the second dimension chromatogram is 60 msec wide, it requires 200 Hz to sample appropriately for effective deconvolution.



Find More Peaks Using GCxGC and Discover What Else Is In Your Sample



Find more peaks than ever before using high resolution GCxGC. These insets of a diesel sample show the difference in data collected using one-dimensional (left) and two-dimensional chromatography (right).

Be More Confident In Your Assignments.

Better understand the chemistry of your sample by finding out what else is in your sample.

- ***PEGASUS* GC-HRT⁺ 4D**
- **Deconvolution | GCxGC**
- **Productivity | Reproducibility**
- **Accurate Mass | Identification**

Technical Research Center

Robert J Warren Customer Experience Center

Global Support Center

A Commitment to Quality and Service

LECO instruments are noted for superior precision, speed, and ease-of-use. We are an international company with over 25 subsidiaries worldwide. Our global network of sales/support is dedicated to customer service and satisfaction, and our commitment to quality is further underscored with ISO-9001:2015 certification. We conform to CE quality and safety specifications, fully testing our instruments at our on-site Compliance Testing Center.

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