Application Brief

Agilent
Trusted Answers

LUMA Multichannel Vacuum Ultraviolet Detector on an Agilent 8890 GC

Authors

Saurabh U. Patel and
Alan M. Medina-Gonzalez
Agilent Technologies, Inc.

Introduction

The LUMA multichannel vacuum ultraviolet (VUV) detector is a unique gas chromatography (GC) detector that covers a wide range of applications such as petrochemical, environmental, food, and pharmaceutical analysis. The LUMA detector is considered a universal detector with high sensitivity and a large linear range. Similar to other UV-Vis methodologies, Beer's Law is the detector's guiding principle of quantitation, making the LUMA a concentration-based detector.

The LUMA operates across the electromagnetic spectrum, from the VUV region at 118 nm to the visible light region at 1,050 nm. Light is generated by a specialized deuterium lamp that is housed within the detector box. This light is then collimated by a fixed mirror and directed through a heated flow cell, where it interacts with the analytes. A photodiode array captures the transmitted light and converts it into an electrical signal. For ease of use, this signal is divided into 12 bands, spanning wavelengths from 118 to 1,050 nm, based on discrete energy levels, as shown in Figure 1.

In this application brief, the LUMA detector was paired with an Agilent 8890 GC and Agilent J&W DB-1 column to demonstrate the analysis capabilities of the system.

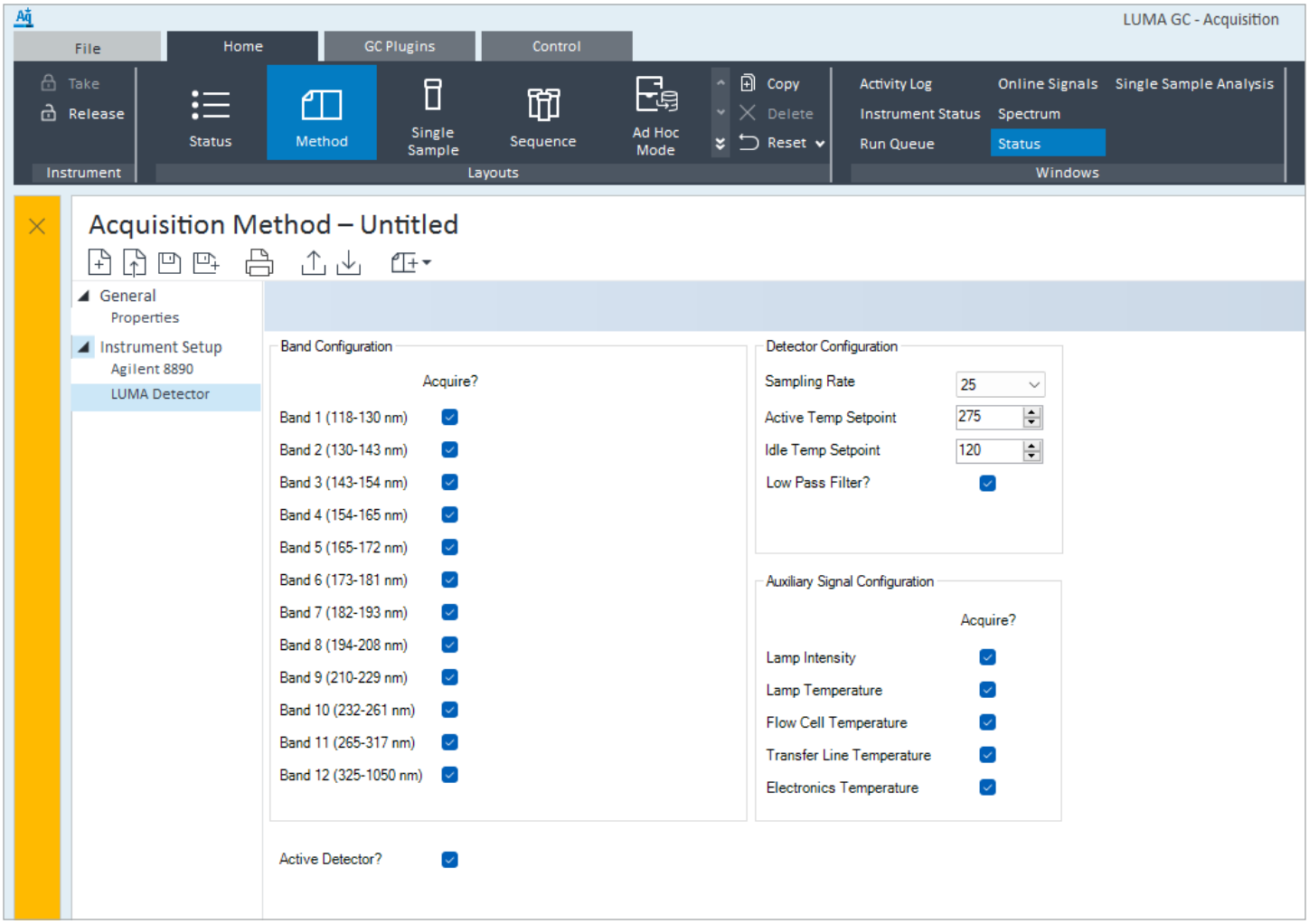

Figure 1. LUMA controls and band configuration in Agilent OpenLab CDS software. Data from all 12 bands can be simultaneously acquired and saved as individual signals for flexibility.

Experimental

To demonstrate the capabilities of the LUMA detector, Polar ISO Column Text Mix standard was used with an 8890 GC equipped with a J&W DB-1 column (30 m × 320 µm, 1 µm). The LUMA was maintained with recommended temperatures and flow rates.

Table 1. Agilent 8890 GC and LUMA detector setpoints.

Parameter	Value
Injection Volume	1 µL
Inlet (Split/Splitless)	250 °C (5:1 split)
Oven Program	40 °C (hold for 1 min), 20 °C/min to 260 °C
Column Flow	6.5 mL/min (hydrogen)
LUMA Temperature Setpoint	275 °C

Results and discussion

Six standards ranging from 7.8 to 250 ppm were prepared and evaluated to test the detector response, sensitivity, and linearity. Across the eight compounds, the average peak area RSD for five consecutive injections was < 2% for 7.8 and 250 ppm. The average R^2 value was 0.999 across eight compounds. The signal-to-noise ratio (S/N) indicates that lower limit of detection and limit of quantitation can be achieved for many of these compounds.

Table 2. Peak identification for analytes show in Figure 2. The R^2 coefficient, S/N (based on ASTM noise), and peak symmetry for each analyte are provided.

Peak	Analyte	CAS Number	R^2	S/N (7.8 ppm)	Peak Symmetry
1	Aniline	62-53-3	0.999	415	0.95 (Band 7)
2	2-Chlorophenol	95-57-8	0.999	398	0.98 (Band 7)
3	1-Octanol	111-87-5	0.999	155	0.97 (Band 2)
4	2-Nonanone	821-55-6	0.999	169	0.98 (Band 2)
5	2-Dodecanol	10203-28-8	0.999	152	0.94 (Band 2)
6	Methyl Laurate (C12:0)	111-82-0	0.999	150	1.00 (Band 2)
7	*n*-Heptadecane (C17)	629-78-7	0.999	170	0.99 (Band 2)
8	*n*-Nonadecane (C19)	629-92-5	0.999	158	0.99 (Band 2)

Figure 2 shows the mixture of eight compounds from bands 1 to 12 at 250 ppm. Peak response for each compound was proportional to the level of absorbance in each band. Peak shape was excellent in each band that the compounds were present in. The VUV spectra data can be extracted for each of these compounds.

Figure 3 shows the eight compounds at 7.8 ppm concentration on bands 2 (130 to 143 nm) and 7 (189 to 193 nm). By leveraging Beer's Law, compounds can be quantified on different bands based on the user's needs. For example, straight-chain hydrocarbons, such as *n*-heptadecane, tended to absorb strongly in bands 1 (118 to 130 nm) and 2, but showed weak to no absorption in band 6 (172 to 181 nm) or higher.

Meanwhile, aniline, a compound with a functional group , absorbed strongest in band 7 and weakest in band 2. With the ability to analyze compounds on independent bands, a user can leverage this to differentiate between coeluting compounds that might be present on one band but not the other.

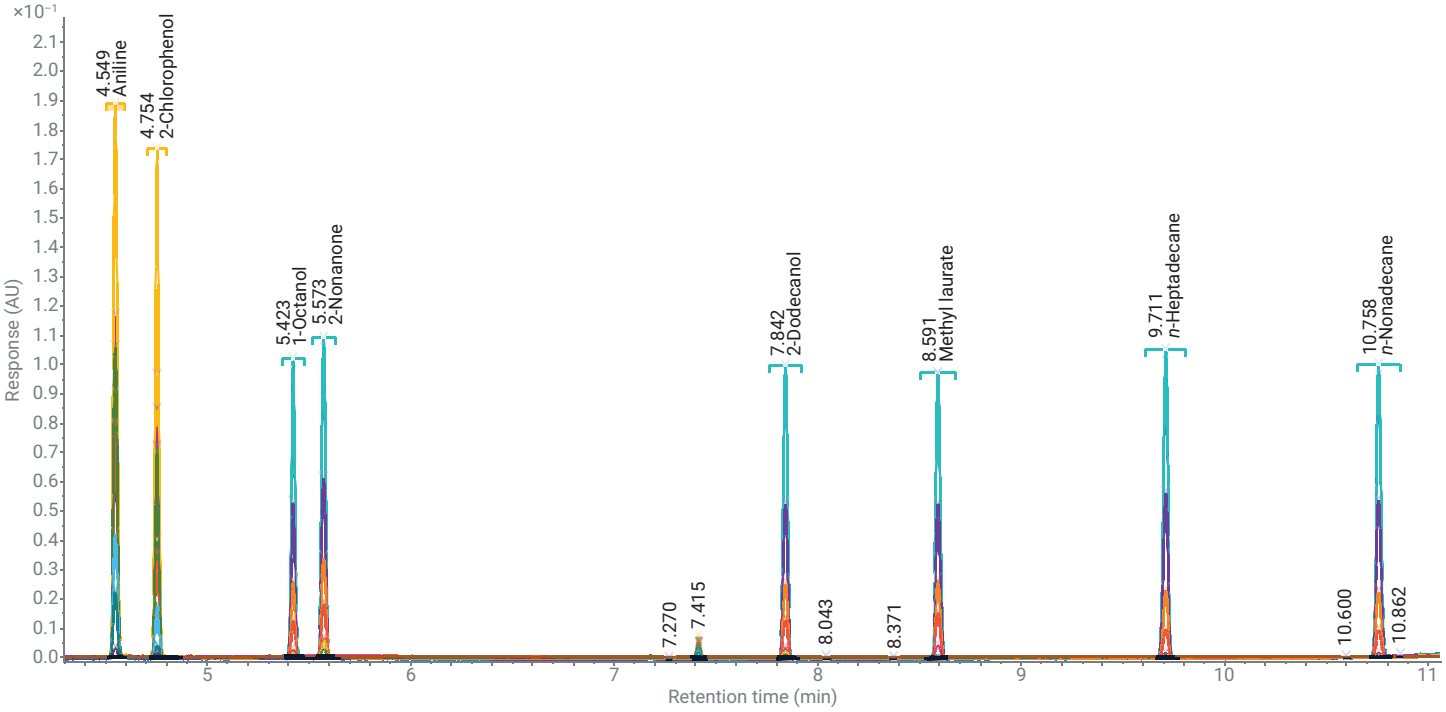

Figure 2. Overlay chromatogram at 250 ppm for eight compounds from bands 1 to 12.

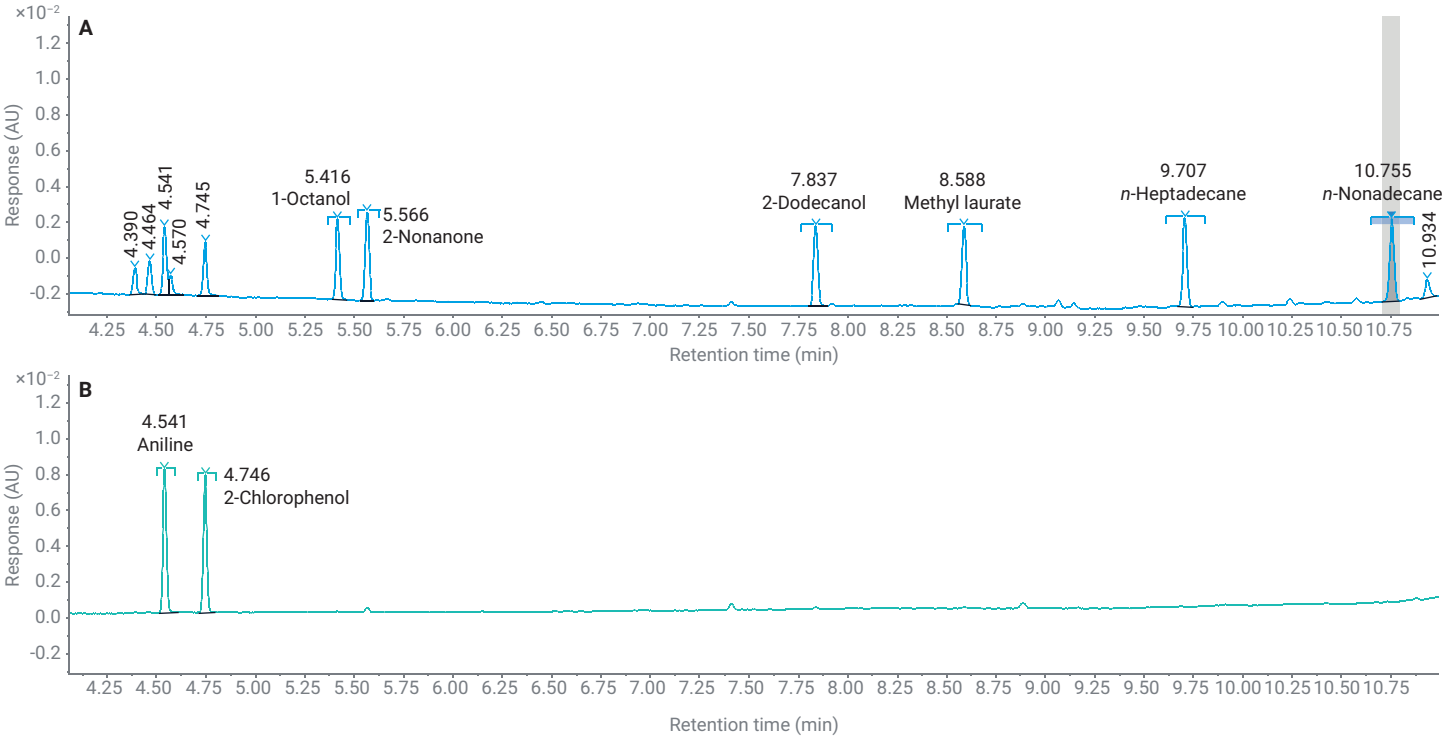

Figure 3. Chromatogram at 7.8 ppm for both nonpolar and polar compounds for band 2 (A) and band 7 (B). Note the presence of contamination between 4.25 and 4.60 minutes that is observed on band 2 but not on band 7.

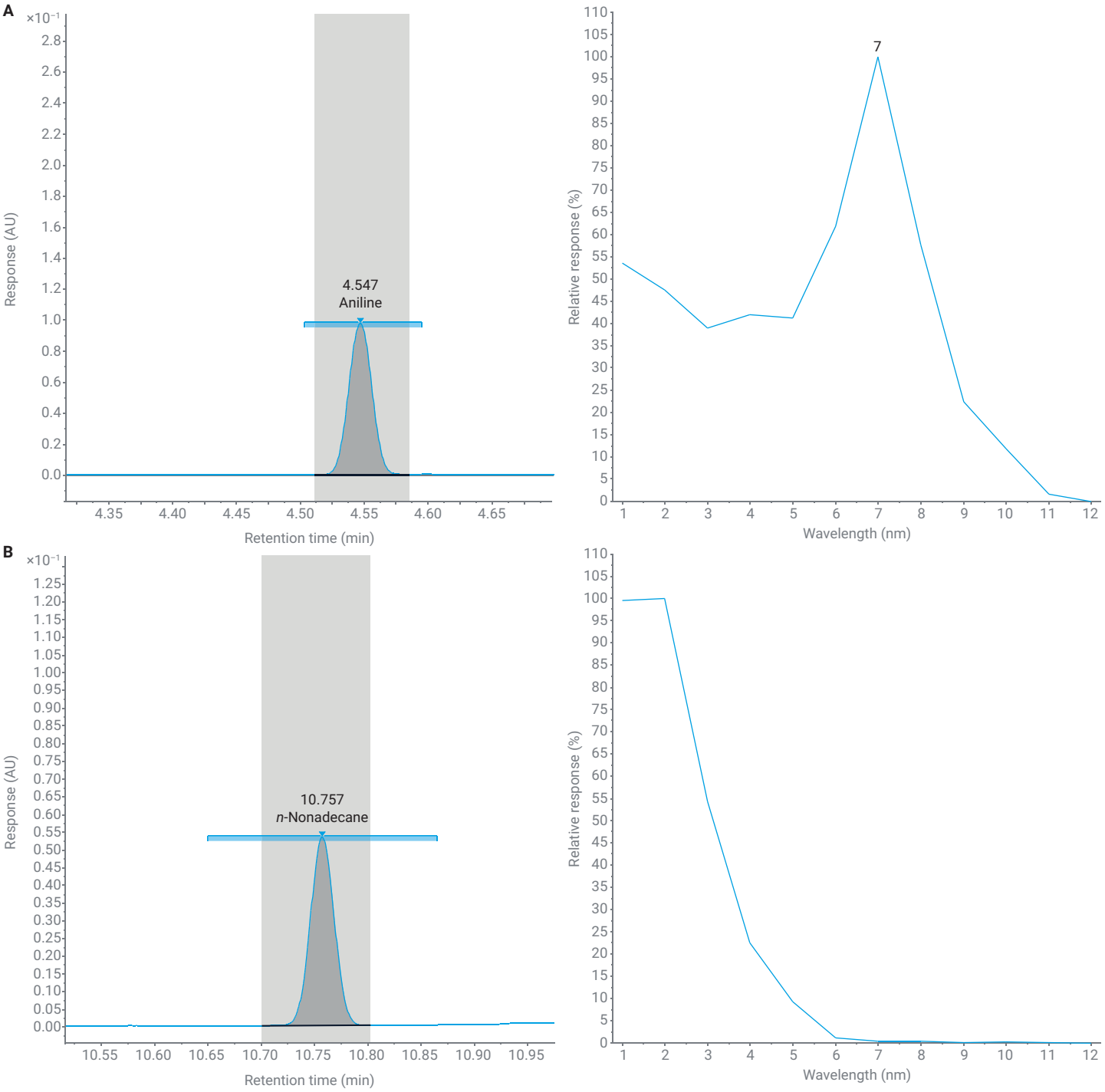

Figure 4. Chromatogram and its associated VUV spectrum of aniline (A) and *n*-nonadecane (B).

Conclusion

The LUMA multichannel VUV detector and Agilent 8890 GC equipped with an Agilent J&W DB-1 column together yield a wide range of linearity, high area repeatability, excellent peak resolution, and Gaussian peak shape. With the combination of the VUV spectral data and peak retention time, users can confidently identify the analytes in the sample.

www.agilent.com

DE-001371

Printed in the USA, October 7, 2024
5994-7848EN

Agilent
Trusted Answers