Charged aerosol detector (CAD)

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Chromatography detectors:

Destructive detectors

- Charged aerosol detector (CAD)
- Flame ionization detector (FID)
- Evaporative light scattering detector (ELSD)
- Mass spectrometer (MS)
- Electrolytic Conductivity detector (ELCD)

Non-destructive detectors

- UV detectors
- Thermal conductivity detector (TCD)
- Fluorescence detector
- Electron capture detector (ECD)
- Refractive index detector (RI or RID)

Introduction:

- The Charged Aerosol Detector (CAD) is a universal detector used in conjunction with high-performance liquid chromatography (HPLC) and ultra high-performance liquid chromatography (UHPLC) to measure the amount of chemicals in a sample by creating charged aerosol particles which are detected using an electrometer.

- It is commonly used for the analysis of compounds that cannot be detected using traditional UV Vis approaches due to their lack of a chromophore.

- The CAD can measure all non-volatile and many semi-volatile analytes including, but not limited to, antibiotics, ions, lipids, natural products, biofuels, sugars and surfactants.

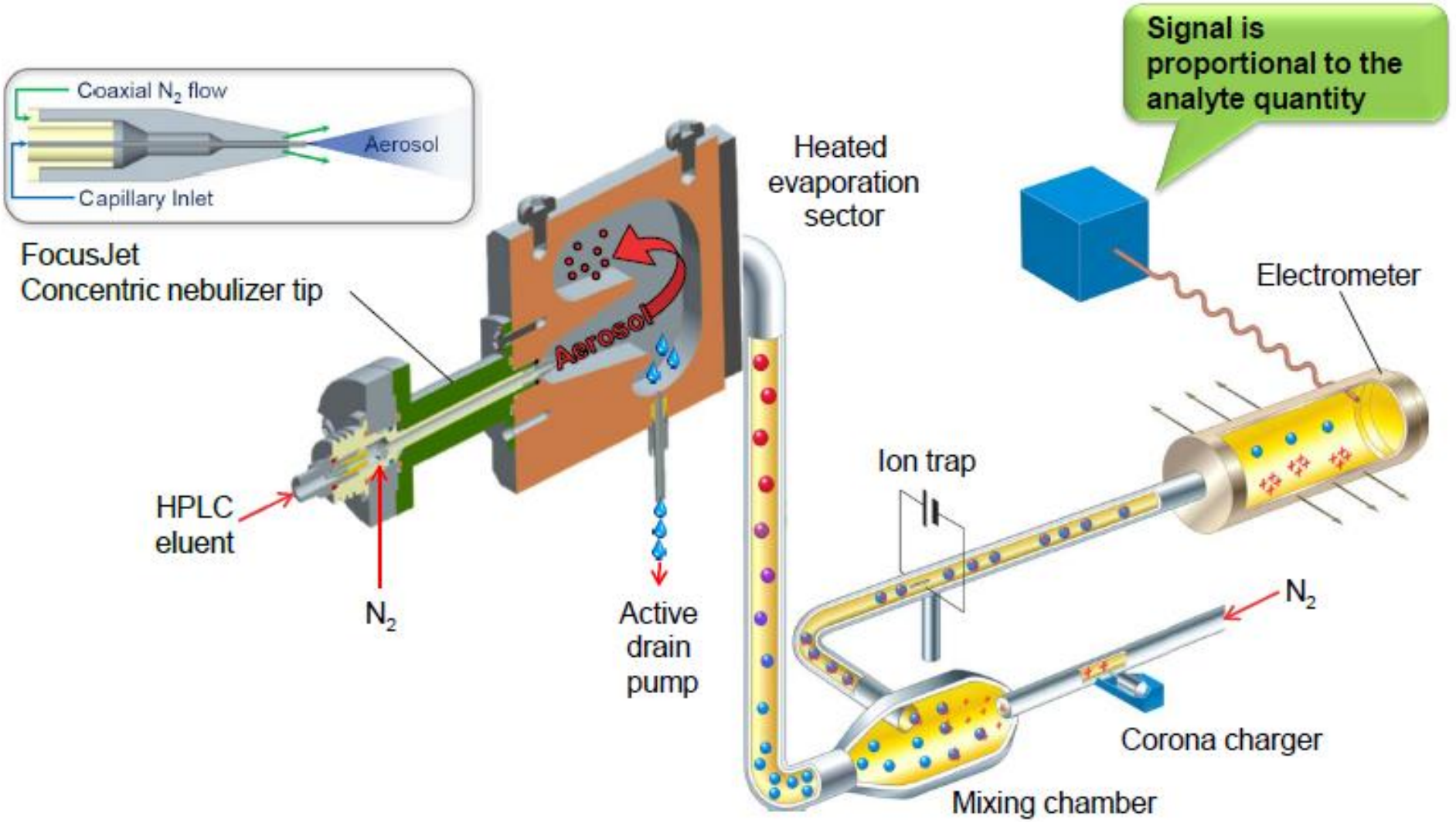
History:

2005	2006	2009	2011	2013	2015
ESA Biosciences, Inc.Corona™ CAD	ESA Biosciences, Inc.Corona™ PLUS	ESA Biosciences, Inc.Corona™ ultra	Dionex™ Corona™ ultra RS	Thermo Scientific™ Dionex™ Corona™ Veo	Thermo Scientific™ Vanquish™ Charged Aerosol Detector
•First commercial CAD •Designed for near-universal detection on any HPLC •Isocratic or gradient separations	•Expanded solvent compatibility •Heated nebulization •External gas conditioning module for improved precision	•UHPLC compatible •Stackable design •Enhanced sensitivity •Incorporated precision internal gas regulation system	•Unified with Dionex™ UltiMate™ 3000 UHPLC+ system •Added on-board diagnostics/monitoring •Automated flow diversion capability •Selection of linearization parameters	•Extended micro flowrate range •Total redesign with concentric nebulization and optimized spray chamber •Heated evaporation and electronic gas regulation	•Full integration with ThermoScientific™ Vanquish™ UHPLC platform •Slide-in module design •Reduced flow path for optimum operation

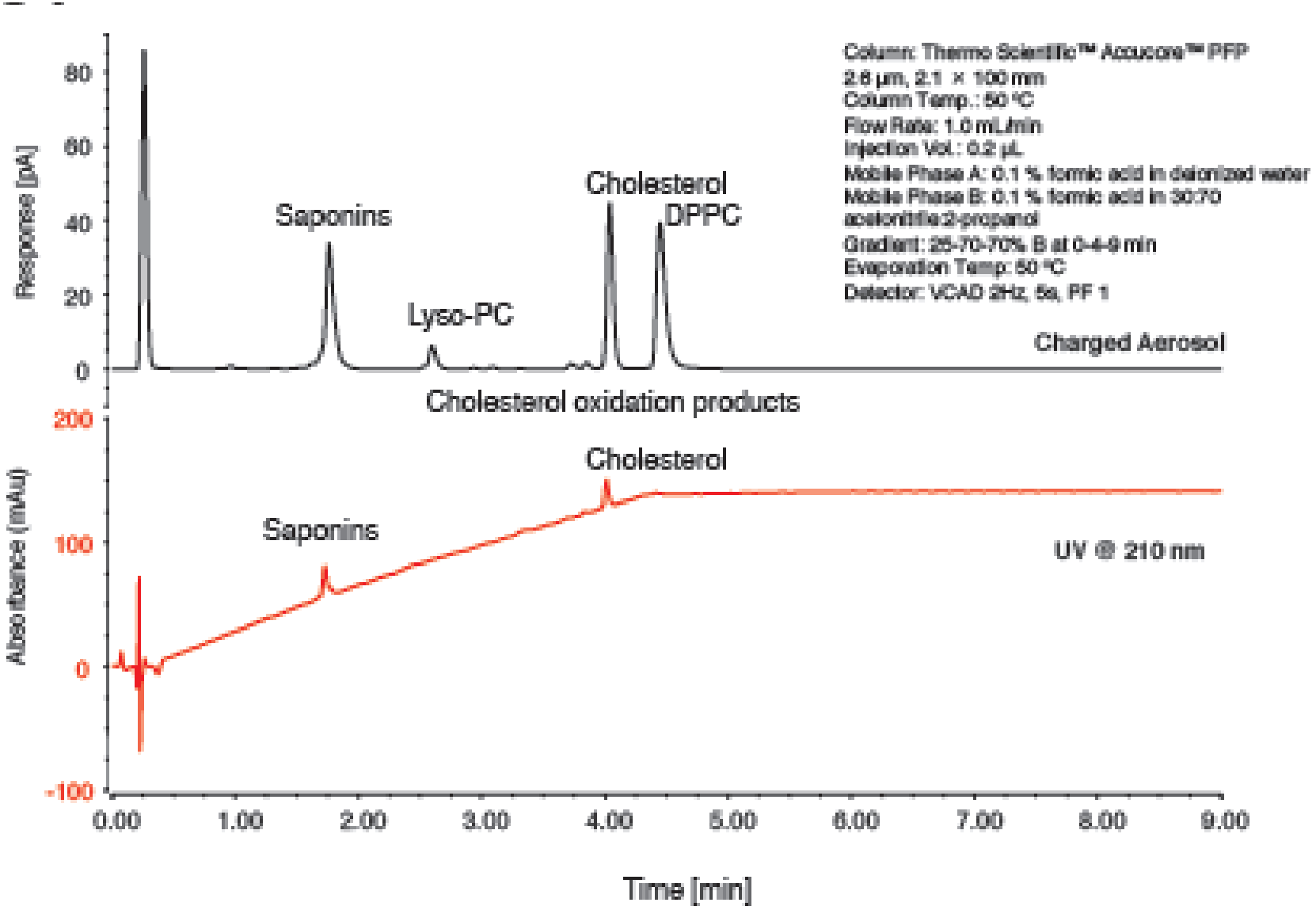
Principle:

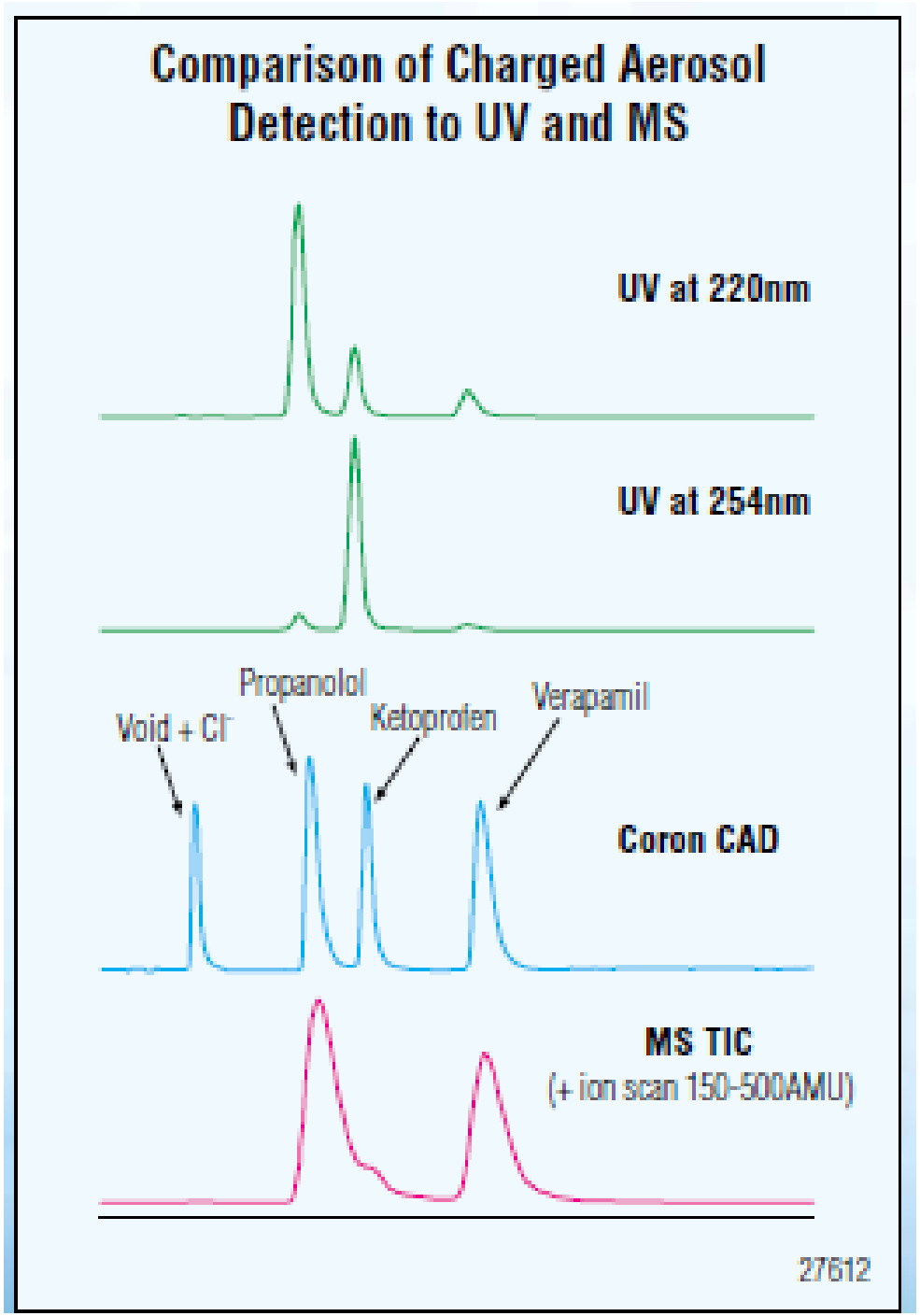
- Pneumatic nebulization of mobile phase from the analytical column forming an aerosol.
- Aerosol conditioning to remove large droplets.
- Evaporation of solvent from the droplets to form dried particles.
- Particle charging using an ion jet formed via corona discharge.
- Particle selection by an ion trap is used to remove high mobility charged particles.
- Measurement of the aggregate charge of aerosol particles using a filter/electrometer.

Schematic diagram

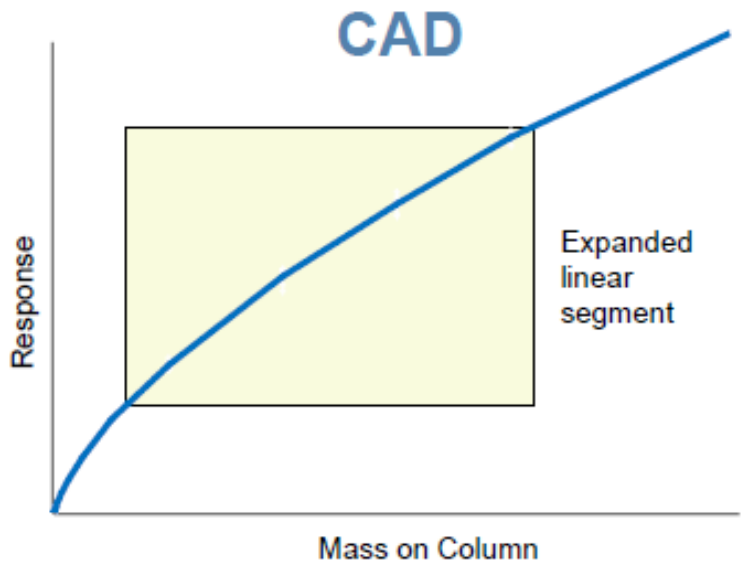


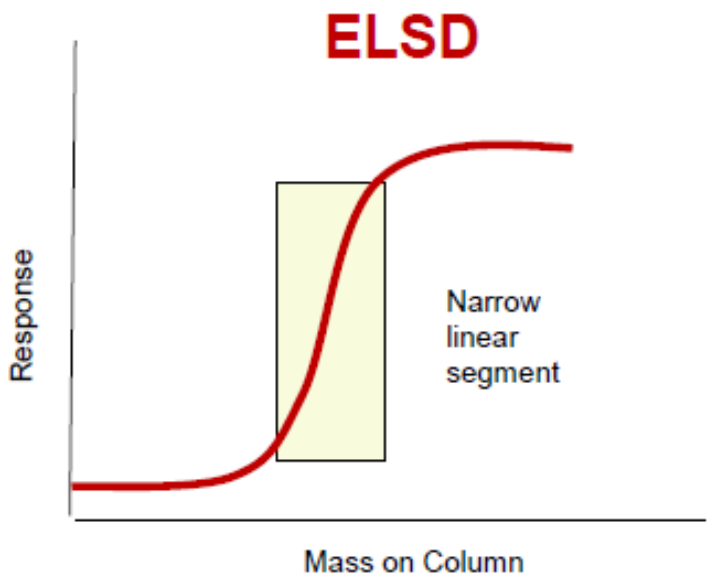
Detection of vaccine adjuvants using CAD and UV vis detectors




Comparison of Charged Aerosol Detection to UV and MS
UV at 220nm
UV at 254nm
Propanolol
Void + Cl⁻
Ketoprofen
Verapamil
Coron CAD
MS TIC
(+ ion scan 150-500AMU)
27612

Charged Aerosol Detector (CAD)	Evaporative light scattering detector (ELSD)
• Detection limits extend to lower mass levels • Wider quasi-linear and dynamic range (~ 10^4 to 10^5) • Gradual changes in slope = better precision	• Exponential signal drop at low mass range • Narrow quasi-linear and smaller dynamic range10^2 to 10^3) • Large changes in slope = poorer precision





References:

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https://en.wikipedia.org/wiki/Charged_aerosol_detector


Thank you!