

## Neuerungen beim bestehenden Infinity Portfolio

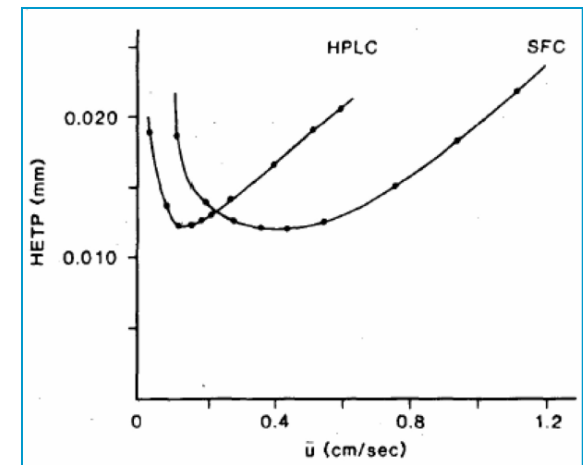
SFC-Hybrid, 1220 mit DAD,  
präparative Pumpen unter  
OpenLAB

Sebastian Krahe  
Produktspezialist LC  
Agilent Technologies,  
Deutschland/Österreich  
2. Oktober 2012 Hamburg



## Benefits of SFC vs. LC

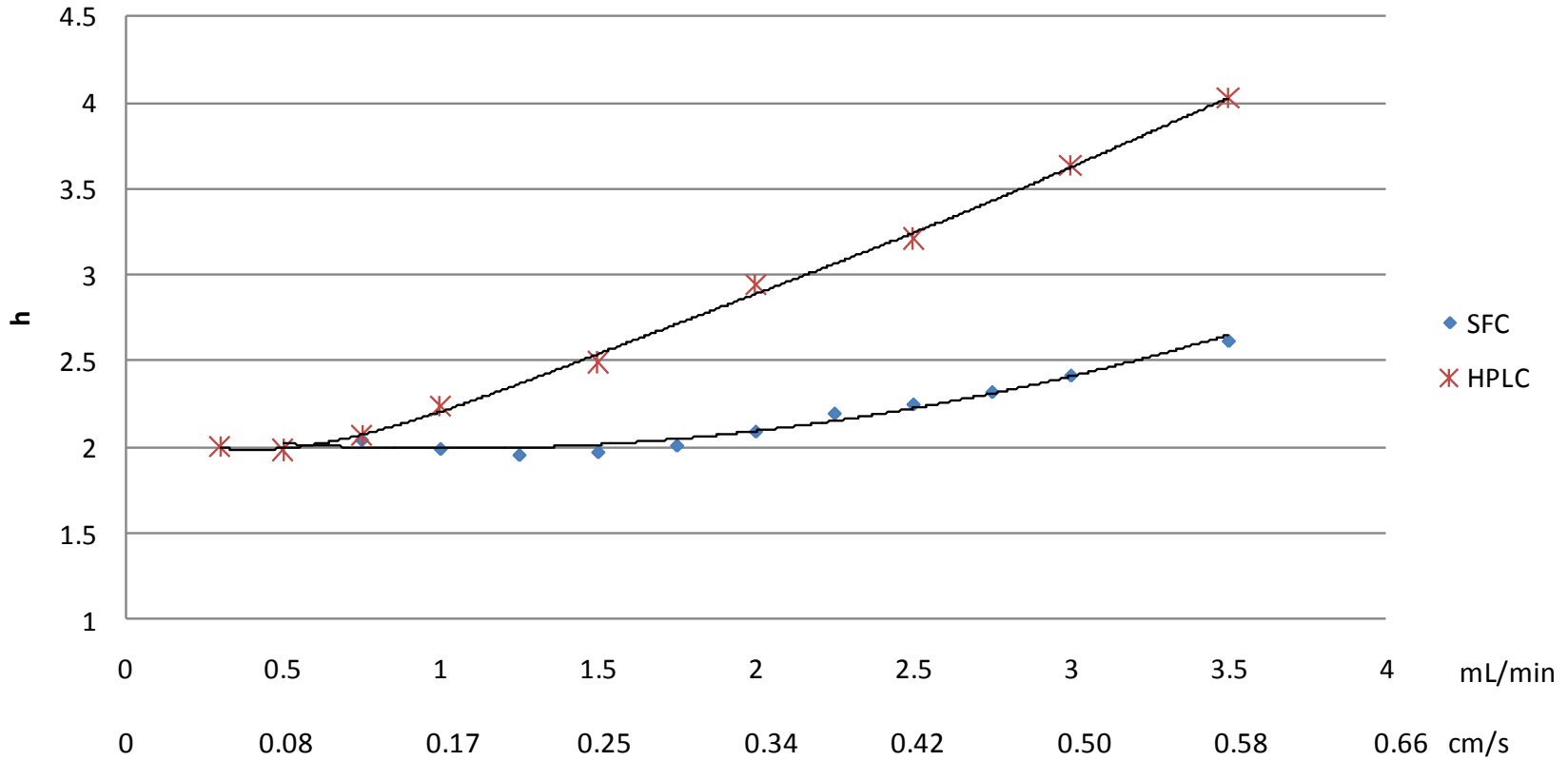
- Unique selectivity (orthogonality to HPLC)
- Premier choice for chiral compounds
- Replacement for Normal-Phase-HPLC
- Complimentary to RP-LC or HILIC
- Speed of analysis (faster than LC)
- Cheaper than LC
- Green
- Broad detector compatibility



# Fundamentals - SFC

- $N_{\text{SFC}} = N_{\text{HPLC}}$
- $U_{\text{opt SFC}} = \text{up to 5 times} > \text{than } U_{\text{opt HPLC}}$
- **This is only correct for pure  $\text{CO}_2$**
- $U_{\text{opt SFC}} = \text{up to 2-3 times} > \text{than } U_{\text{opt HPLC}}$
- **For  $\text{CO}_2$  with 5 to 40% MeOH**
- $\Delta P_{\text{SFC}} \ll \Delta P_{\text{HPLC}}$

# Fundamentals - SFC



**250 mm x 4.6 mm ID x 5 μm RX-Sil**

# Why was SFC no breakthrough in the past?

- No fundamental developments
- Instability in the SFC instrumentation market
- ... too difficult ... too many parameters
- New developments e.g. in column manufacturing, suffered from reproducibility issues, bleeding in MS, etc.
- The detector issue UV .... ELSD, CAD, MS ?
- Robustness ... IQ/PV ? ... from research to QA/QC ... validation?

# Typical Applications for analytical SFC

## Chiral Analysis: **LC robustness and LC sensitivity with SFC speed!!**

- Chiral purity analysis (qualitative) of API
- Chiral method development for Prep SFC
- Quantitation of enantiomeric purity of starting materials, intermediates, and bulk drugs( **EE**)
- metabolites, toxicology of chirals

## Achiral Analysis

- Typical Normal Phase or RP phase small molecule applications
- Drug development, library screening (lead generation)
- Pre-prep analysis and method development for Prep-SFC
- Lipids, fatty acids, vitamins
- Natural product separations,
- A-chiral separations in Petrochemical, Environmental, Food and Industrial



# Unique Features of the Agilent 1260 Infinity SFC

## Performance

- ✓ HPLC-like UV- Sensitivity
- ✓ The only SFC with 600 bar power range
- ✓ Seamless MS and ELSD connection

## Cost

- ✓ 10-15x lower operating costs with standard grade CO<sub>2</sub>
- ✓ Lowest solvent consumption and waste generation
- ✓ From entry LC upgrade to complete high-end MS/SFC
- ✓ all in one hybrid SFC/UHPLC system

## Time

- ✓ 3 x faster than LC
- ✓ no significant equilibration to change from UHPLC to SFC with the Hybrid SFC/UHPLC

## Robustness

- ✓ Based on proven 1260 Infinity quality
- ✓ Agilent warranty and service quality



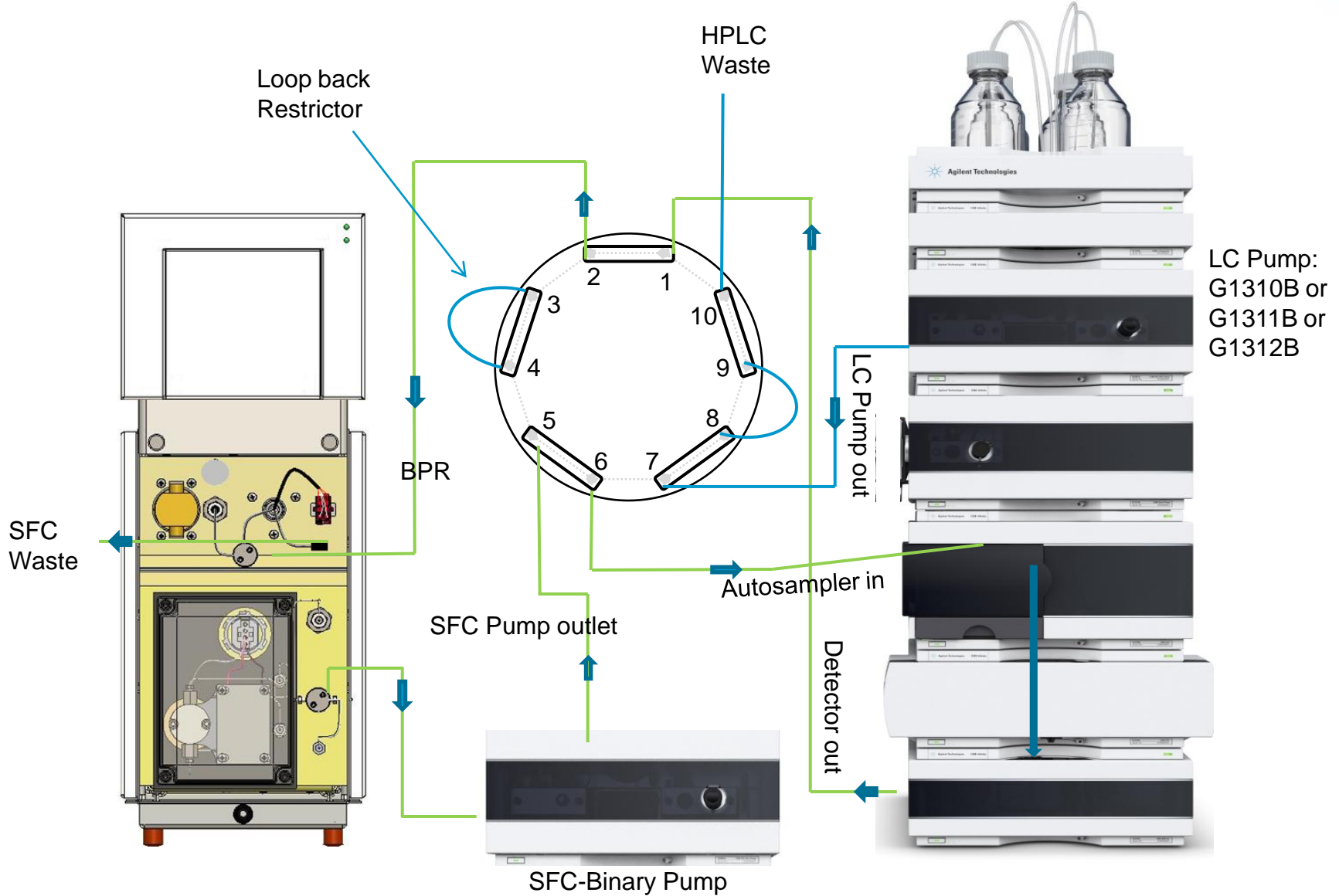
# The Agilent 1260 Infinity SFC/UHPLC Hybrid System



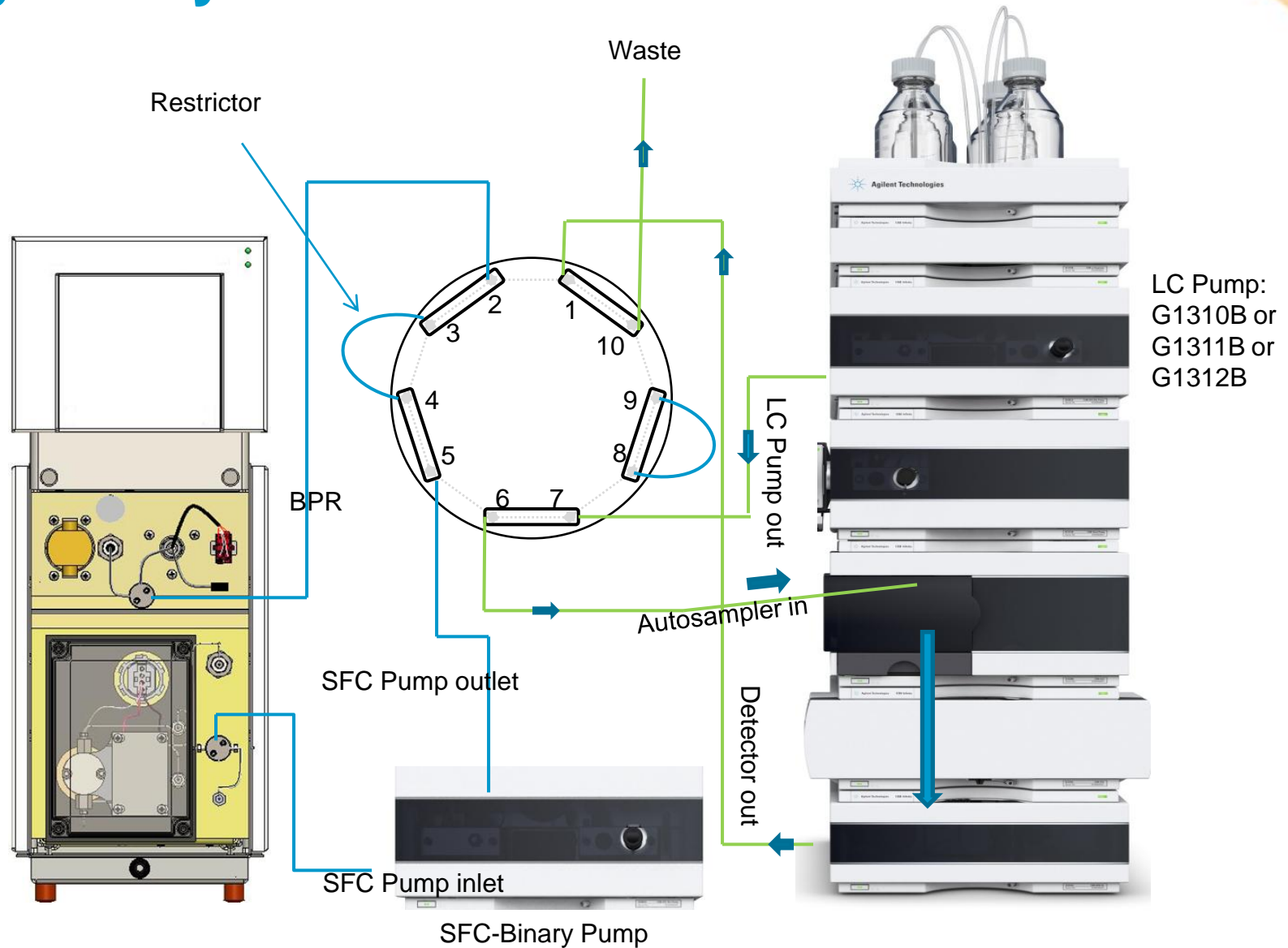
Two orthogonal techniques with a single system

*Simply switch the valve*

# Hybrid System in SFC Mode

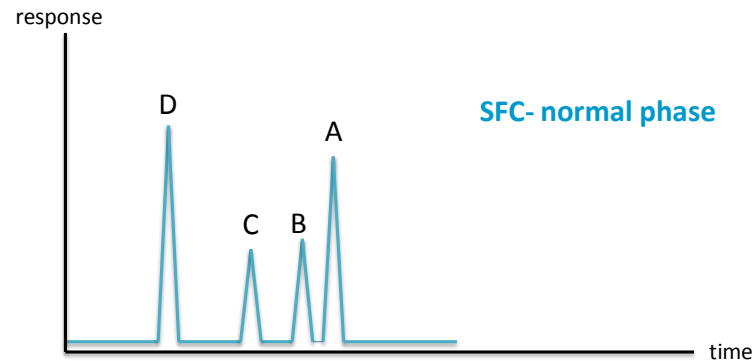
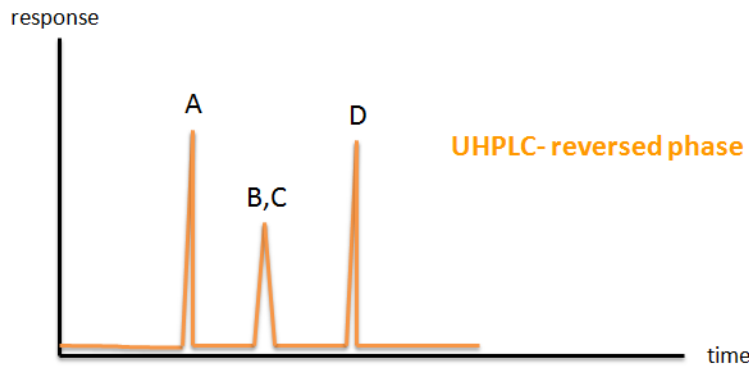


# Hybrid System in UHPLC Mode



# Why is orthogonal sample information important?

- Separate and detect impurities which co-elute when using a single technique
- Resolve peaks of complex samples
- Provide/get stronger evidence for sample identity
- Cover a broader polarity range of samples



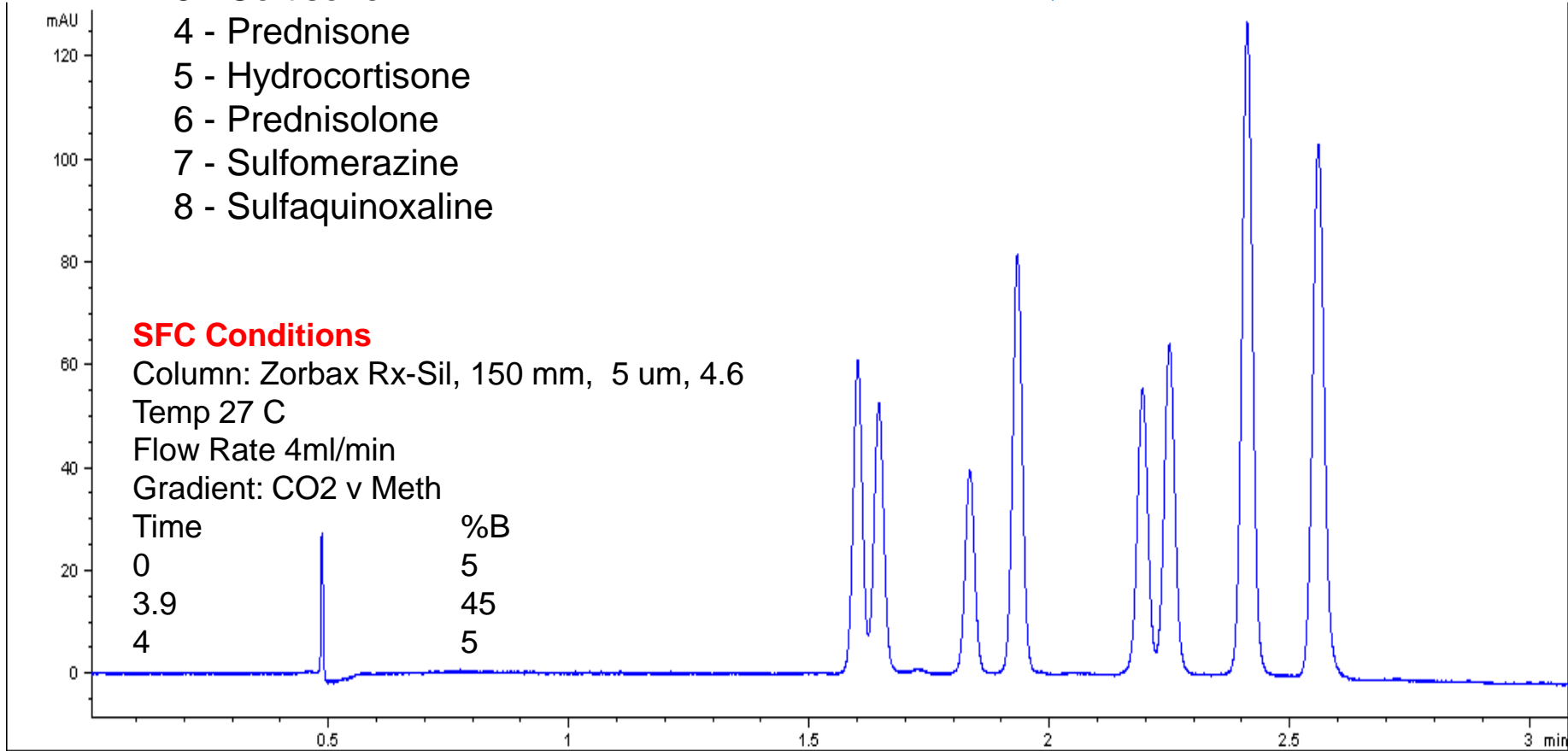
# Advantages of the Agilent Hybrid SFC/UHPLC instrument

- Orthogonal method screening in one single system
- Switch from SFC to UHPLC forth and back in a single sequence
- low equilibration time between LC and SFC (1min)
- Significant cost saving, only one system has to be purchased
- Direct results comparison between SFC and LC
- No instrument to instrument variation
- Save lab space
- The only vendor who can offer both techniques in one system

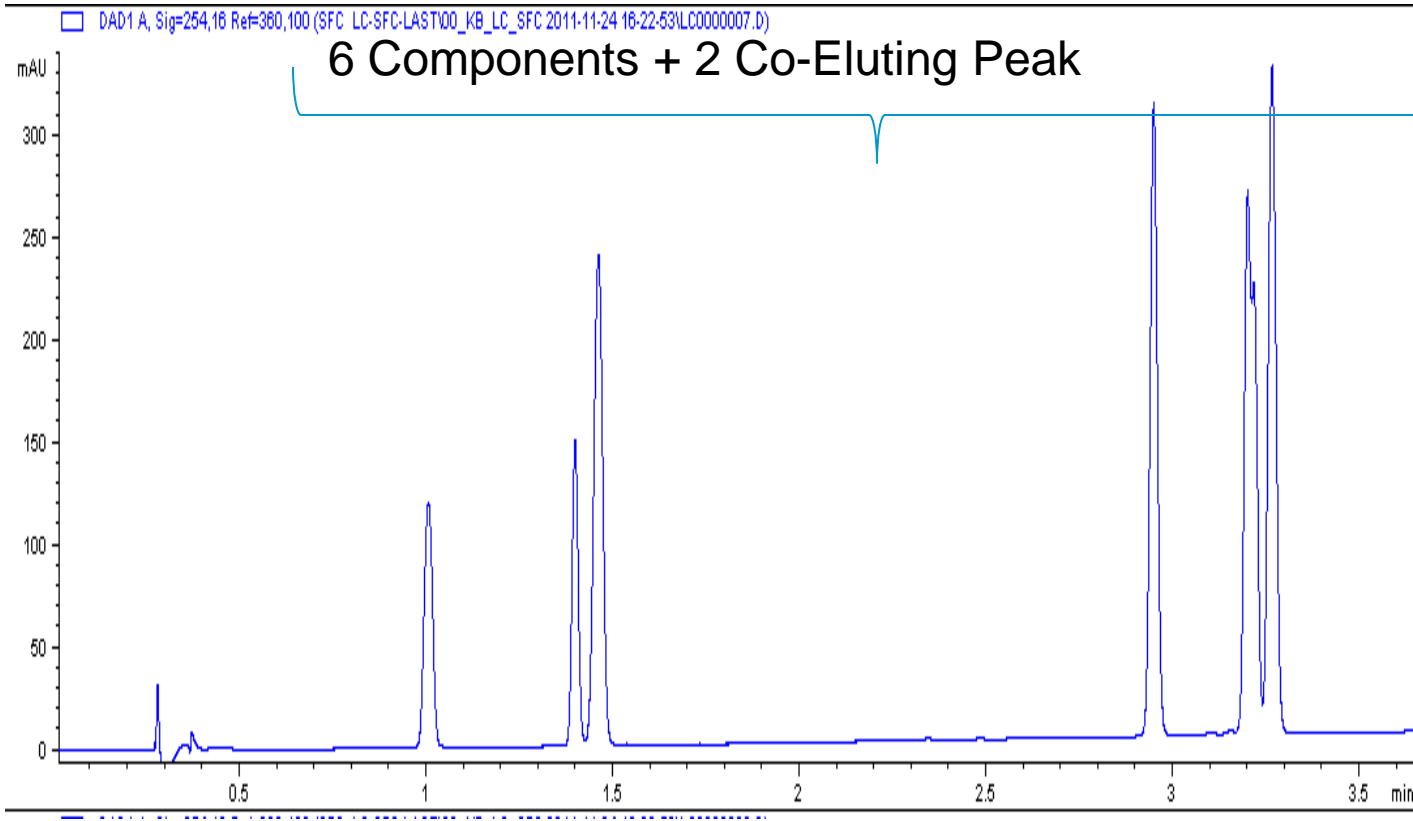
# Performance: Orthogonal Separation: SFC Mode

- 1 - Caffeine
- 2 - Theophylline
- 3 - Cortisone
- 4 - Prednisone
- 5 - Hydrocortisone
- 6 - Prednisolone
- 7 - Sulfamerazine
- 8 - Sulfaquinoxaline

8 Components



# Performance: Orthogonal Separation UHPLC Mode

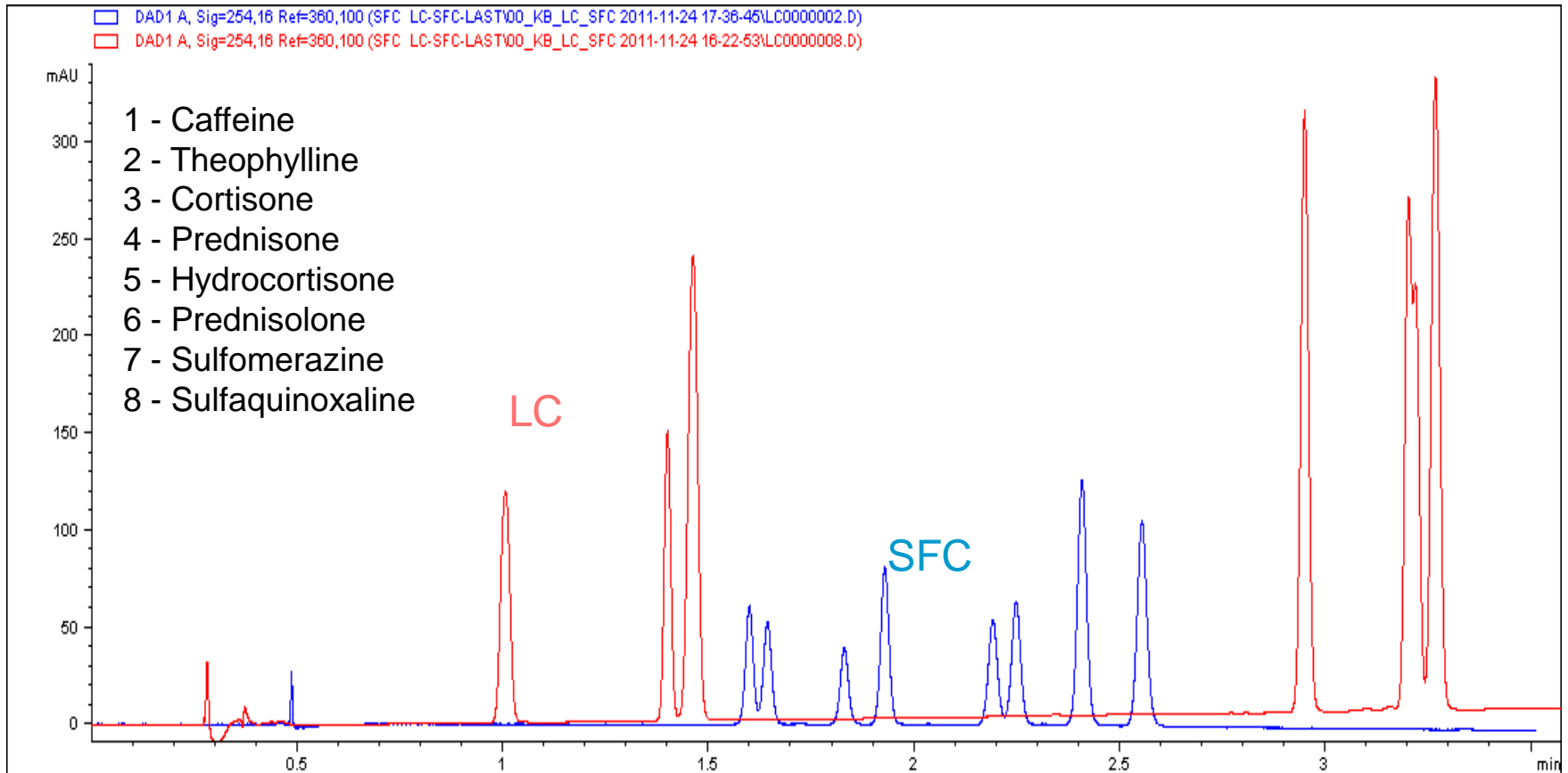


**LC Conditions**

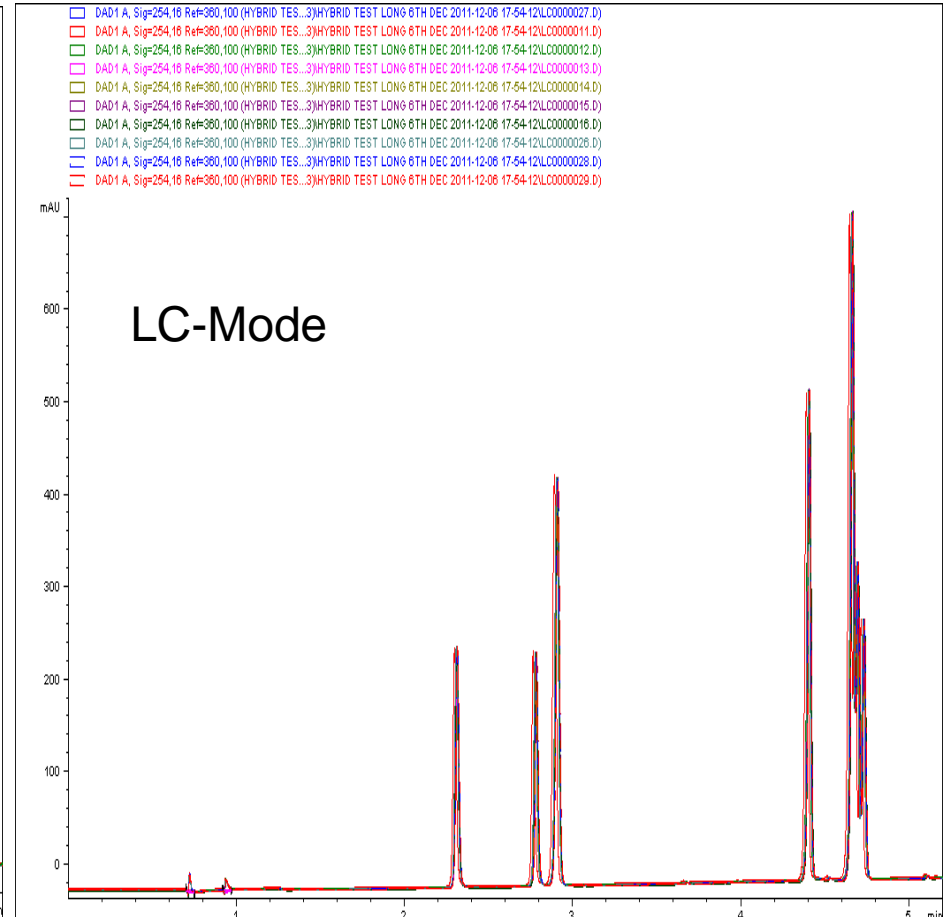
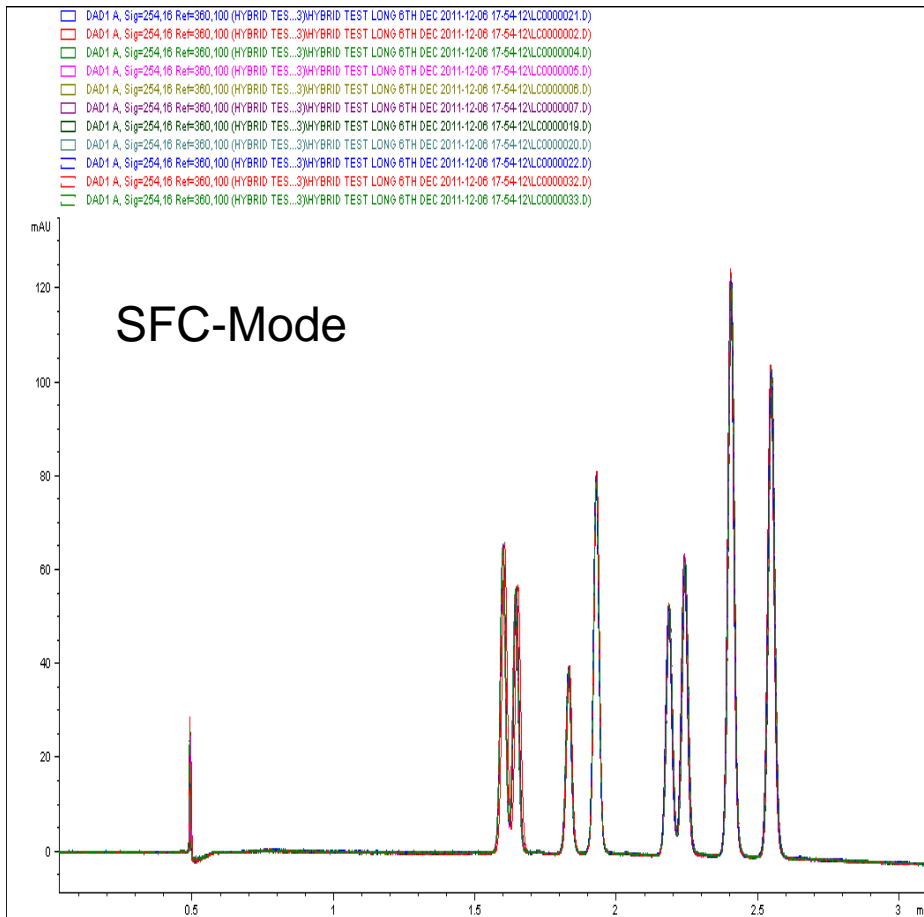
Column s—  
ACE/Poroshell 3.0 x  
150mm  
Temp 45 C  
Flow Rate 1ml/min  
H2O v Meth

Time	%B
0	5
4.1	45
4.4	45
4.6	100
5.0	100
5.1	5

# Performance: Overlay SFC versus UHPLC mode



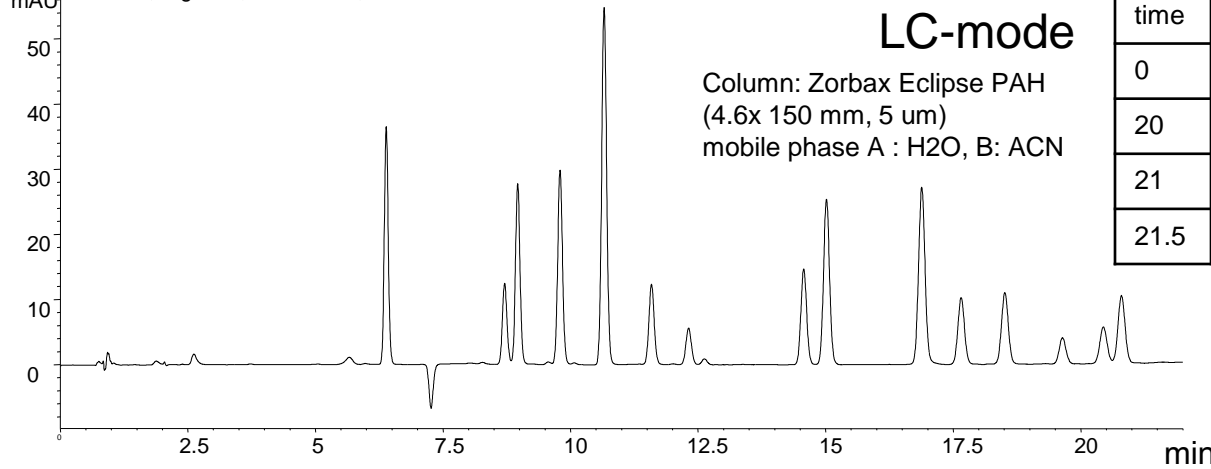
# Repeatability: SFC and UHPLC in a single sequence



Part of a sequence with alternating SFC and LC batches

# Application: PAH with the Hybrid SFC/UHPLC System

DAD1 A, Sig=254,16 Ref=360,100

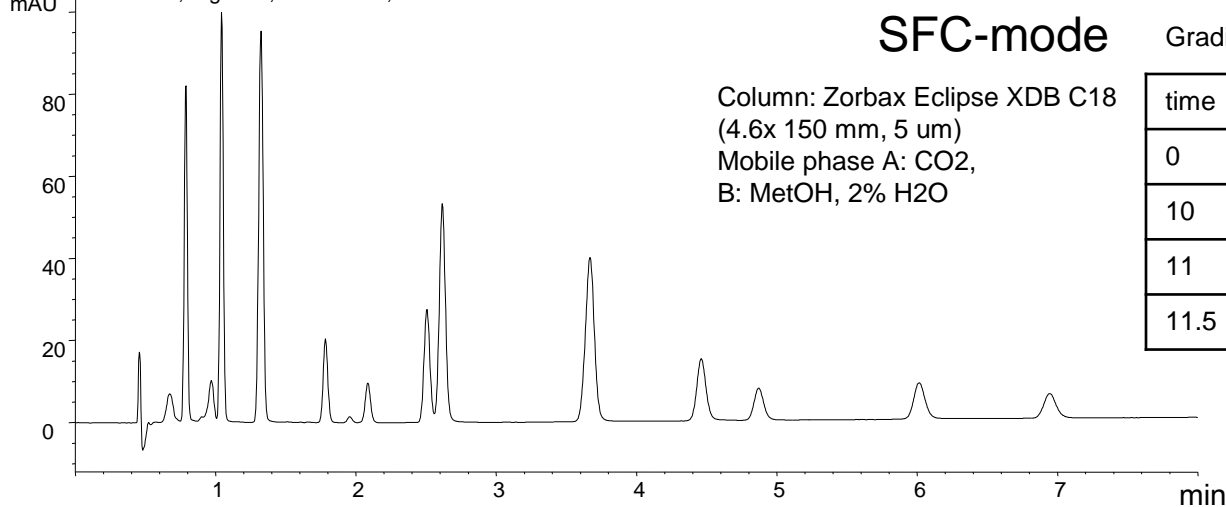


Gradient:

time	%B
0	40
20	95
21	95
21.5	40

- PAH- mix**
- Acenaphptene
  - Acenaphthylene
  - Anthracene
  - Benzoanthracene
  - Benzo(a)pyrene
  - Benzo(b)fluranthene
  - Benzoperylen
  - Benzo(b)fluranthene
  - Benzo(k)fluranthene
  - Chrysene
  - Dibenzoanthracene
  - Fluoranthene
  - Fluorene
  - Indenopyrene
  - Naphtalene
  - Phenanthrene
  - Pyrene

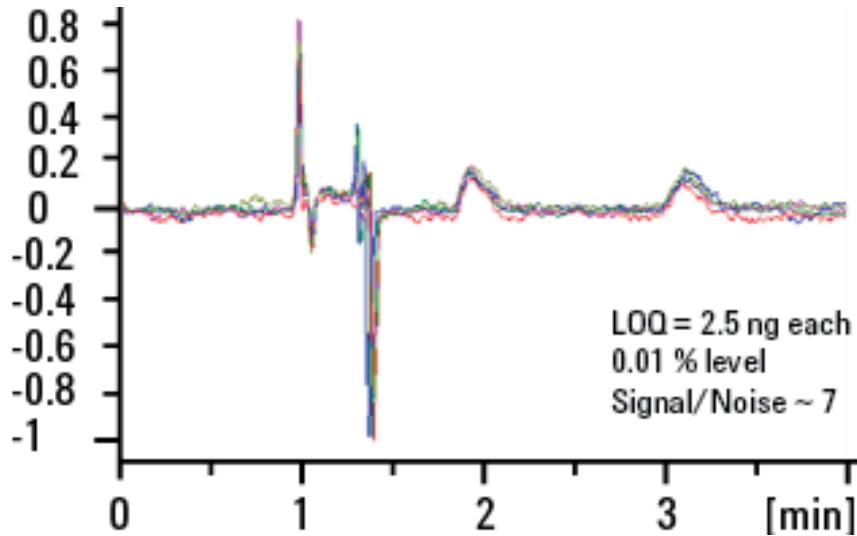
DAD1 A, Sig=254,16 Ref=360,100



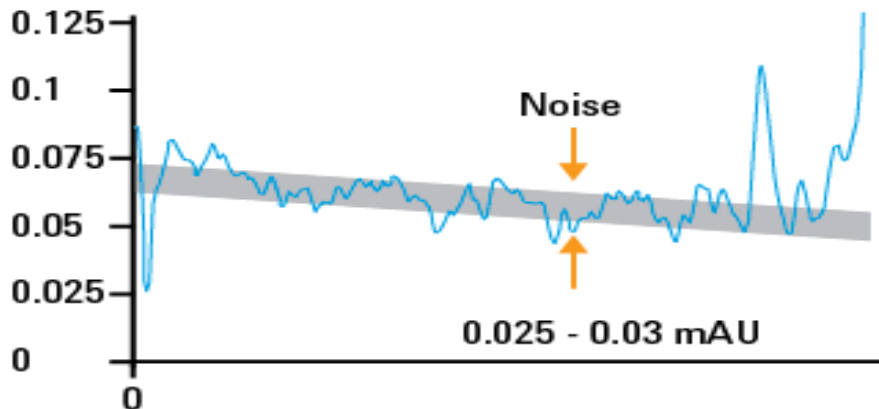
Gradient:

time	%B
0	5
10	22.5
11	60
11.5	5

# Noise performance: A New Low Noise Standard, results in highest SFC-UV sensitivity



Noise levels [mAU]

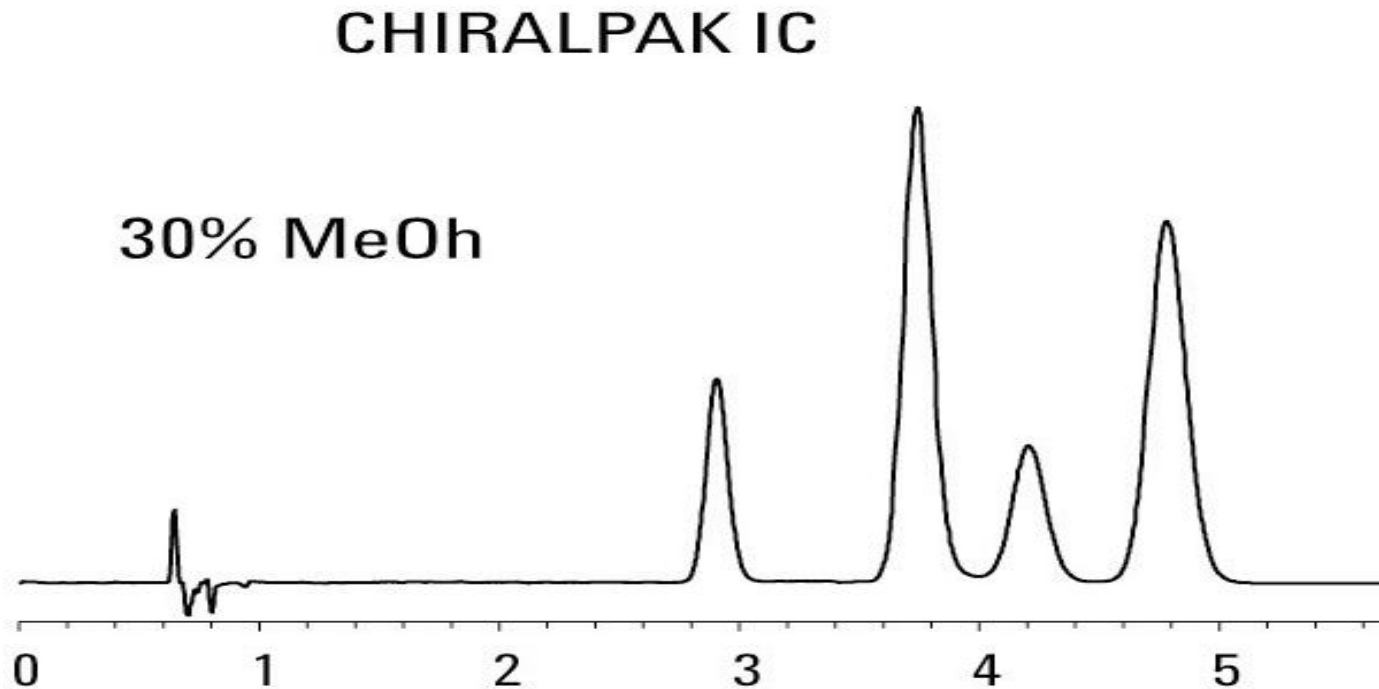


## Unprecedented sensitivity Chiral Purity Analysis

shown by five consecutive runs of 0.005  $\mu$ g of Warfarin (Racemate)

**Lowest detector noise ever achieved for SFC** measurements with noise levels between 0.025 to 0.03 mAU.

# Chiral separation performance: Superior Selectivity and Speed for Chiral Separations



## Separation of 4 Tofisopamon conformers

Conditions: 70% CO<sub>2</sub>/ 30% (MeOH/DEA 100/0.33 v/v), flow rate: 3 mL/min  
Data provided from Tong Zhang (Chiral Technologies, Strassbourg)

# Product Overview: 3 Ways to get SFC from Agilent ....

Hybrid SFC/UHPLC System	Analytical SFC	LC Upgrade to SFC
<ul style="list-style-type: none"> <li>• 1260 Infinity analytical SFC</li> <li>• LC pump (Quat, Binary)</li> <li>• 2pos/10port valve</li> <li>• Hybrid SFC/UHPLC kit</li> </ul> <p>Change from SFC to UHPLC</p> <p>Orthogonal Separation Power</p>	<ul style="list-style-type: none"> <li>• 1260 Infinity analytical SFC</li> </ul> <p>Best SFC performance</p>	<ul style="list-style-type: none"> <li>• Fusion A5</li> <li>• 1260 SFC binary pump</li> <li>• SFC accessory kit</li> </ul> <p>Convert 1100/1200 to SFC</p> <p>Most affordable</p>



# More Information on...

- Web page: <http://www.chem.agilent.com/en-US/Products/Instruments/LC/analytical/systems/sfc>
- Brochure: [http://intranet.chem.agilent.com/Library/brochures/1260-Infinity a-SFC-Brochure.pdf](http://intranet.chem.agilent.com/Library/brochures/1260-Infinity-a-SFC-Brochure.pdf) ,  
PubNo. 5990-6225EN
- Application Notes:
  - Chiral impurity analysis(5990-5969EN)
  - Achiral analysis (5990-6413EN)
  - Sub 2um analysis for ultra fast separation (5990-6412EN)
  - Highest resolution separation (5990-6934EN)
  - Strategies for column and mobile phase selection with the Agilent 1260 Infinity SFC System (5990-7147EN)
  - The Agilent SFC/MS solution (5990-7972EN)
  - Separation of enantiomers and conformers of Tofisopamon (5990-9315EN)
  - Enantiomer separation of nonsteroidal anti-inflammatory drugs (5990-9459EN)
  - Agilent 1260 Infinity Hybrid SFC/UHPLC System (5990-9514)
  - Determination of polymer additives and migration products prevalent in food packaging material (5990-9598EN)
  - Determination of phthalate migration from toys (5990-9597EN)
- SFC cost calculator: calculates operating costs of SFC vs. LC
- Hybrid SFC/UHPLC Video
- Hybrid SFC/UHPLC E-seminar
- SFC Compliance Primer



# 1220 Infinity LC

Affordable  
Flexible  
Compatible



# 1220 Infinity LC at a Glance

## Isocratic or Gradient Pump:

- flow range: 0.2- 10 mL/min (**5 mL/min at 600 bar**, **10 mL/min at 200 bar**)
- low pressure mixing
- integrated degasser
- flow precision 0.07 % RSD

## VWD or DAD:

- **80 Hz**
- wavelength range 190-600 nm
- 3.5 (7 for DAD)  $\mu$ AU noise at 230 nm



## Autosampler:

- **600 bar**
- injection range: 0.1-100  $\mu$ L
- 100 x 2 mL vials
- non-cooled
- injection cycle time 50 s
- carryover: < 0.05%

## Column Oven:

- one 25 cm column
- 80°C max

**600 bar for UHPLC Capabilities**

# Extended 1220 Infinity LC Portfolio

## A 600 bar, 80 Hz System in Four Configurations



G4286B
Isocratic Pump
Man Injector
VWD



G4288B
Gradient Pump
Man Injector
VWD



G4290B
Gradient Pump
ALS
Column Oven
VWD

G4294B
Gradient Pump
ALS
Column Oven
<b>DAD</b>

# Compatible:

## It's 1260 Infinity LC Inside!

- **Inside**, the 1220 Infinity LC consists of the established 1200 Series modules
- Same performance as 1260 Infinity Isocratic and Quaternary Pump
- Same injection precision as Standard Autosampler
- Same control software as other 1200 Infinity Series modules
- Easy maintenance, high robustness
- Familiar design

# Flexible:

Combine with Other Detectors (also 6100 Single Quad) and Any Other 1200 Infinity Series Module



6100



RID (G1362A)



ELSD (G4218A)



DAD (G4212B)



TCC (G1316A)

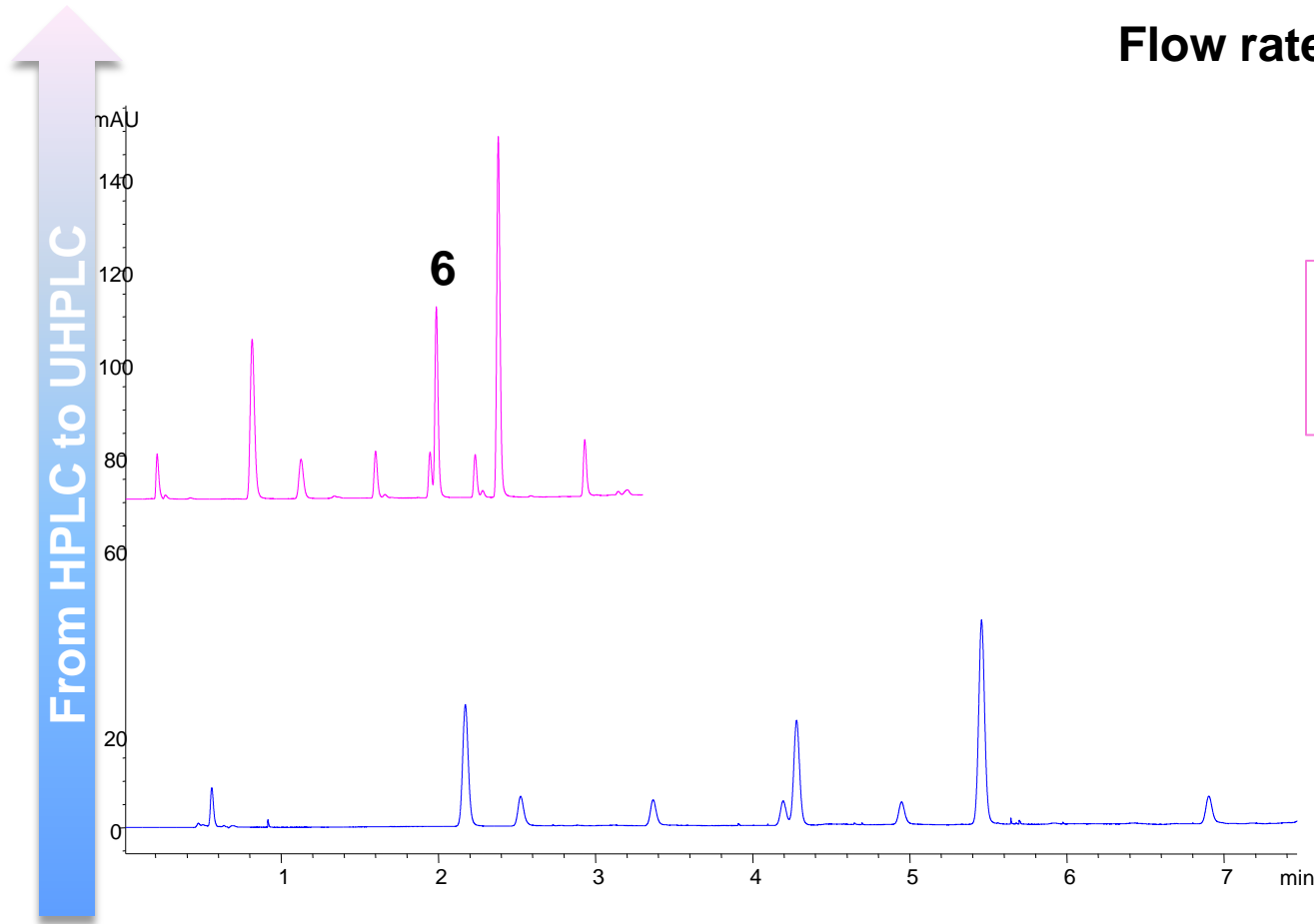


FLD (G1321B)

# From HPLC to UHPLC on the 1220 Infinity LC

## Varying Particle Size and Column Length

Flow rate: 1.2 mL/min at 40°C



**Column: 3 x 50, 1.8  $\mu\text{m}$**

T<sub>g</sub> = 3 min

Resolution peak 6 = 1.09

Run time = 3.2 min

**Column: 3 x 150, 5  $\mu\text{m}$**

T<sub>g</sub> = 9 min

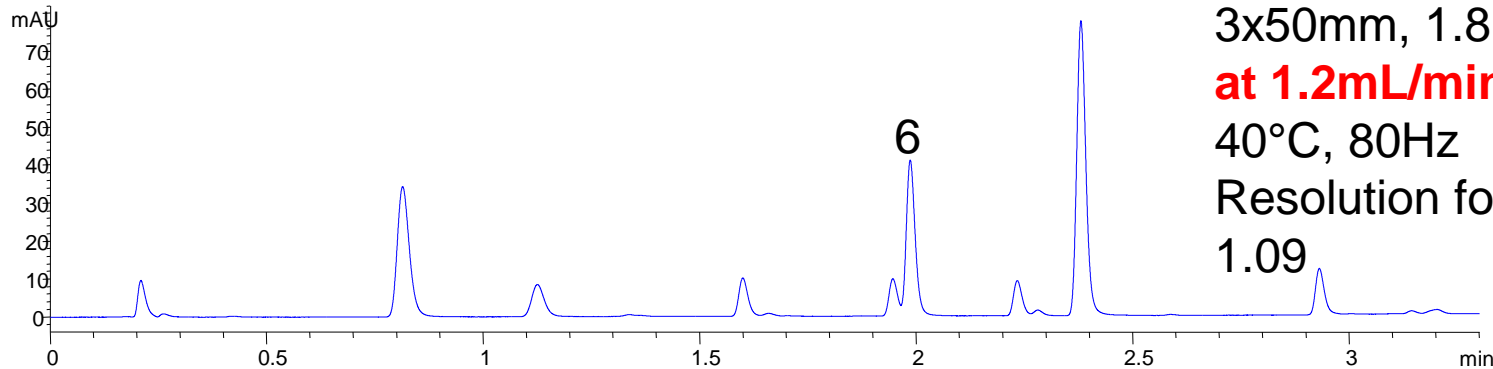
Resolution peak 6 = 1.23

Run time = 7.5 min

# Increasing Flow Rate

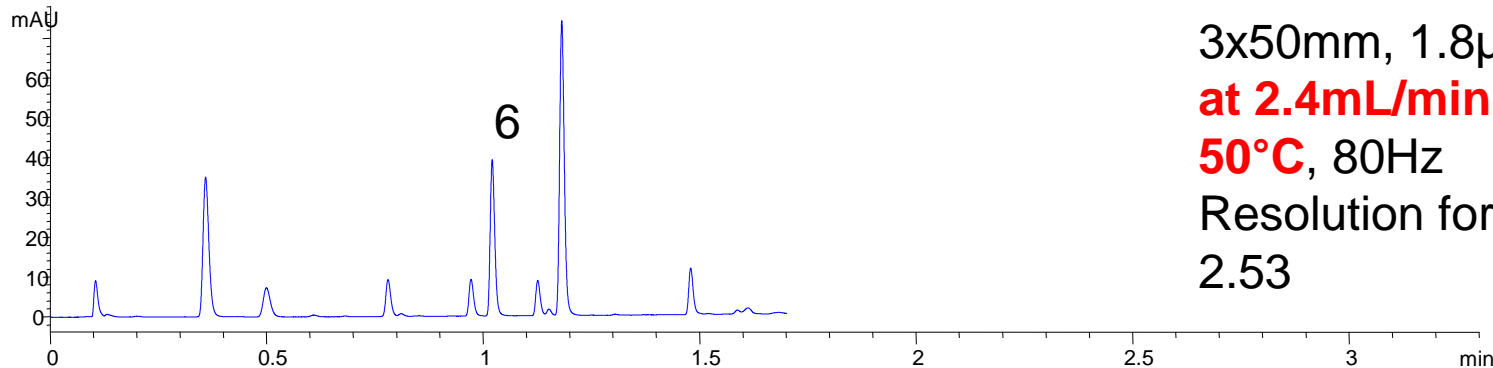
## Shorter Analysis Time with Improved Resolution

VWD1 A, Wavelength=254 nm (TEST1220\PART14000001.D)



3x50mm, 1.8 $\mu$ m column  
**at 1.2mL/min at 315bar,**  
40°C, 80Hz  
Resolution for peak 6=  
1.09

VWD1 A, Wavelength=254 nm (TEST1220\PART21000001.D)



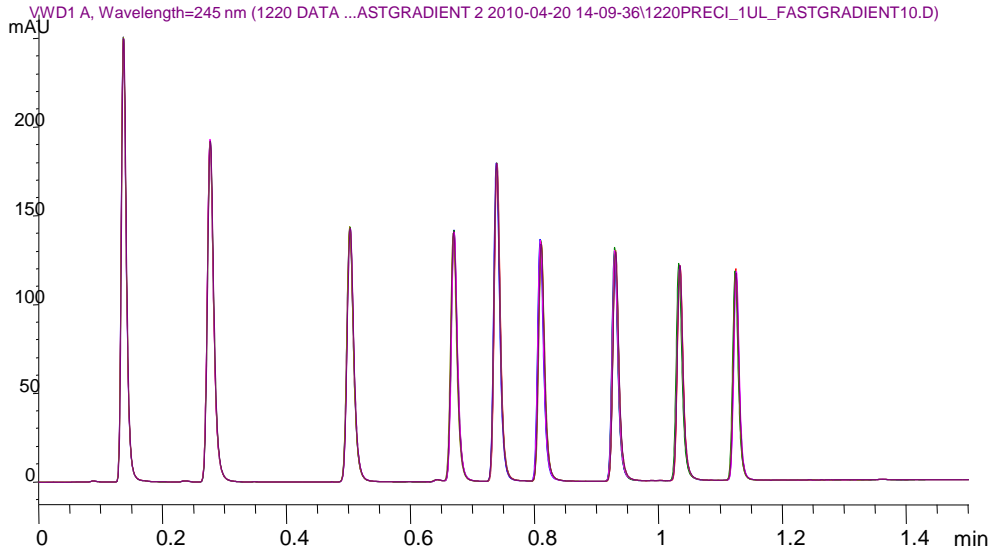
3x50mm, 1.8 $\mu$ m column  
**at 2.4mL/min at 510bar,**  
**50°C,** 80Hz  
Resolution for peak 6 =  
2.53

**Increase flow rate and adapt gradient time and temperature**

# Precision on Agilent 1220 Infinity LC for **fast gradient (UHPLC)** runs, 563 bar

6 consecutive runs

**Poroshell 120 EC-C18, 3.0 x 50 mm, 2.7  $\mu$ m**



Peak	RSD RT (%)	RSD area (%) 1 $\mu$ L
1	0.149	0.3003
2	0.096	0.3128
3	0.070	0.4475
4	0.090	0.6441
5	0.060	0.5561
6	0.106	0.3719
7	0.097	0.3338
8	0.073	0.8496
9	0.059	0.6734

Specs: Composition precision= <0.2% RSD at 0.2 and 1mL/min  
 Specs: Area precision = <0.25% RSD from 5 to 100 $\mu$ L, <1%RSD from 1 to 5 $\mu$ L

# 1220 Infinity Mobile LC Solution

- 1220 Infinity LC can be mounted into a mobile lab
- main component is the 'attenuation unit' which acts as a shock absorber to protect the instrument during transit
- solvent bottle unit keeps the bottles fixed to the instrument.
- column wire mesh keeps the column safe in the column heater



**Mobile LC Upgrade Kit**  
Applicable for G4294B and G4290B

# 1220 Infinity Mobile LC Solution

## Features



- **Dual gradient pump** with integrated degasser, 600 bar, up to 10 mL/ min, for reliable and robust analysis
- **Vial sampler** with injector programming, expandable to walk-up
- **80°C oven** for one 25 cm column
- **Variable wavelength or diode array detector** with 80 Hz sampling rate for highest sensitivity
- **Mobile Upgrade Kit** with Attenuation Unit for vibration resistance
- **Walk-Up Upgrade Kit** with external tray for easy sharing of one instrument for LC/MS analysis

# Walk-Up 1220: G4291A

...an automated 1220 Infinity LC with external tray and Easy Access SW (G2725AA)



# Usage of Walk-Up 1220

- In **drug discovery**, it is common for one LC/MS system to be shared by many medicinal chemists.
- system should be capable of **rapidly running large numbers of different samples** without need to pause the system.
- should also be **rugged enough** so that it is difficult for an **untrained chemist** to put the system in a state that will either shut down the LC/MS or cause bad data to be produced for subsequent samples.



Agilent Easy-Access - STATUS

5 runs in queue (est. 22 mins 30 secs to completion)

Sample Queue

Vial	Batch	Notebook #	+/-	Method	Data file
>> 1	lot_15	zeg_234	✖	Default Method	ZEG_2341-120407.D
1 2	lot_15	zeg_235	✖	Default Method	ZEG_2351-120407.D
2 3	lot_15	zeg_236	✖	Default Method	ZEG_2361-120407.D
3 4	orga_43	orga_423_1	✖	Standard Gradient	ORGA_423_11-120407.D

JobID	User	Group	LoginDate
1	galley_3	MS Chemist	02/01/07 17:07:39
2	lot_23	Chemist	02/01/07 17:04:14
3	23_jan_07	Chemist	02/01/07 16:22:04
4	top_cut	MS Chemist	02/01/07 15:47:16

18159 20 40 60 80 100

18101 1 21 41 61 81

100 2ml vials, —

Submit New Sample

# List Price 1220-DAD vs 1260 Quat VL (with DAD) and SW

**Save up to 10,000 USD!!  
= 25 iPads\***

1260 Description	LP US (\$)	1220 Description	LP US (\$)
1260 Quat VL with DAD and OpenLAB CDS ChemStation and spectra SW	56,214	1220 DAD with OpenLAB CDS ChemStation VL and spectra SW	46,114
1260 Quat VL with DAD and OpenLAB CDS ChemStation PC Bundle	59,725	1220-DAD and OpenLAB CDS ChemStation PC Bundle	54,514

*Note: Red arrows in the original image point from the 1260 descriptions to the 1220 descriptions, with callouts: 'Save 10,000 USD' and 'Save 5,000 USD'.*

\* ....for 400 USD

# Purely Better Agilent 218 Purification System

## Flexible and Affordable



# Agilent 218 Purification System

*Flexible and affordable*

Dual Path  
325-UV Dual Wave  
Length Detector

218 Solvent  
Delivery Modules  
1 - 200 ml/min  
Exchangeable  
Pump Heads



10 ml Manual or  
Automated  
Injection

440-FC Open Bed  
Fraction Collector

Easy OpenLAB  
CDS Software

# Agilent OpenLAB CDS User Interface

*A single software for purification & analysis*



The screenshot displays the 'Method and Run Control' window for a 'Varian Prep LC' system. The interface is organized into several functional areas:

- Method and Run Control:** Shows the current method 'DEF\_I.C.M.' and sequence 'DEF\_I.C.S.' with a status of 'nRdy Wait' and '7.6'.
- Instrument Control:**
  - Autosampler:** Controls for Oven (- °C), Tray (26 °C), and Vial 1 (0 uL). State is 'Idle' with 'No error'.
  - Pumps:** Controls for two pumps (A and B) with flow rates of 100.000 % and 0.000 % at 0 kPa. Flow rate is set to 1.000 mL/min.
  - Detector:** Controls for two channels (WL 1 254 nm and WL 2 300 nm). State is 'Method ready' with a 'Run time' of 0.0 min.
  - Fraction collector:** Controls for Rack (1), Vial (1), and Divert valve (Waste). State is 'No error'.
- Sampling Diagram:** A circular diagram showing the layout of the autosampler tray.
- Online Plot:** A graph showing 'mAU' vs 'min' for 'DET, Channel 1' and 'DET, Channel 2'. The x-axis ranges from 7 to 9.5 minutes.
- Taskbar:** Shows the Windows taskbar with various application icons and the system tray displaying 'SYSTEM (localhost)', 'Varian Prep LC', and the date/time '10:21 AM 12/2/2011'.

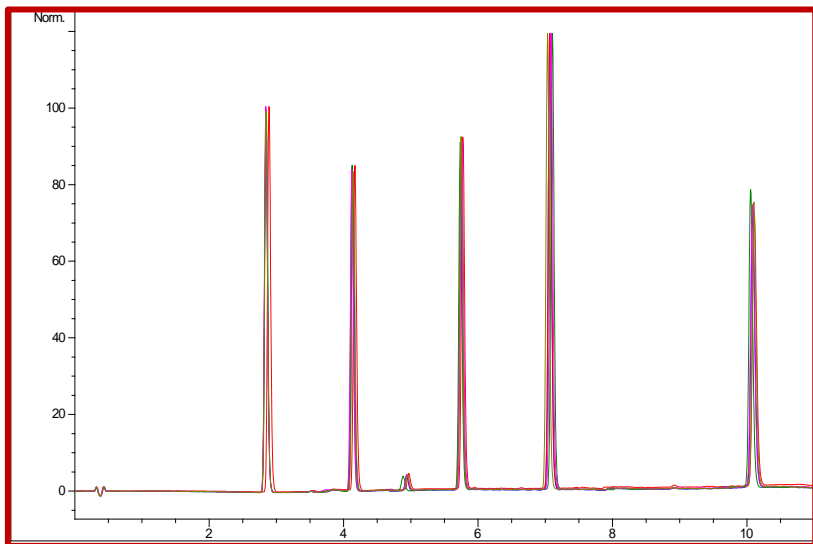
**OpenLAB**  
CAPTURE • ANALYZE • SHARE

# Agilent 218 Solvent Delivery Module

*Excellent performance – day in and out*



- **Suitable for high-resolution HPLC at low flow rates and high-flow preparative applications** – integrated interchangeable pulse damper
- **High pressure mixing design for binary gradient work** – no degasser required
- **Exchangeable pump heads** for flow rates up to **10, 25, 100 and 200 ml/min** - Available also in PEEK or Titanium for Bio-Purification



Standard sample, overlay of 5 injections

Excellent gradient reproducibility  
at 10 ml/min and 100 ml pump  
head



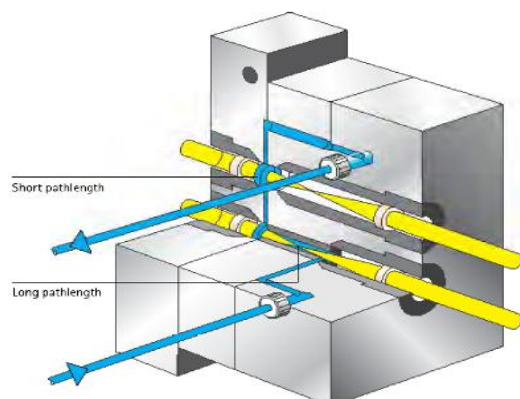
Easy to change  
pump head assembly

# Agilent 325 UV-Vis Detector

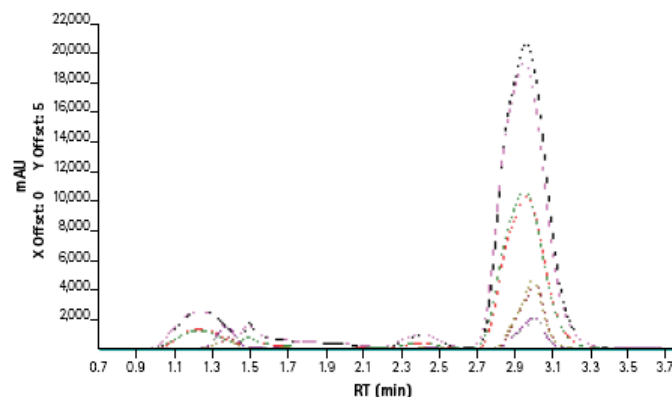
## *Unique dynamic range*



- **Ideal to cover extremely high and low concentrations without flow cell change** – dual path length flow cells
  - 9x1mm flow cell has useable absorbance up to 13AU
  - 4x0.15mm flow cell has useable absorbance up to 80AU
- **Maximum sensitivity** over the wavelength range from 190 to 900nm



The dual path length cell maximizes sensitivity for analytical applications whilst preventing “flat top peaks” for preparative runs. The dual path cell is as described – its two cells merged into one!



Achieve up to 80 AU when moving from analytical to preparative operation, without changing the dual pathlength flow cell. Above shows dynamic range from 2 to 21 AU of 5-hydroxytryptophan sample.

Column: Varian Pursuit XRs C18; Mobile phase: 85% water, 15% methanol; Detection: UV at 230 and 280 nm; Flow: 21 mL/min

# Agilent 440 Fraction Collector

## *Open-bed flexibility*

- **Ideal for semi-prep and preparative scale work** - compatible with flow rates from 1 ml/min to 800 ml/min
- **Secure Fraction Triggering** - Choice of collection by any combination of time-slicing, threshold or peak detection
- **Easy retrieval of collected fractions and source injections** - software graphical display
- **Flexibility from a range of supported collection vessels**
  - Large collection capacity of up to 270 x 13 mm OD tubes
  - From microvials to up to 50ml tube capacity
  - Funnel rack for unlimited volume collection



# Agilent Load & Lock Columns & Self-Packer

*Leading innovative DAC columns & self-packer technology*



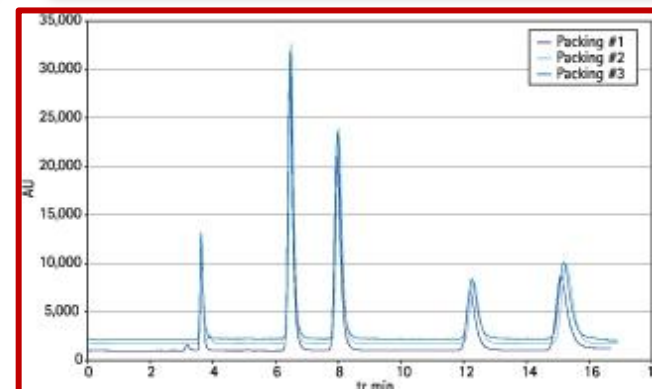
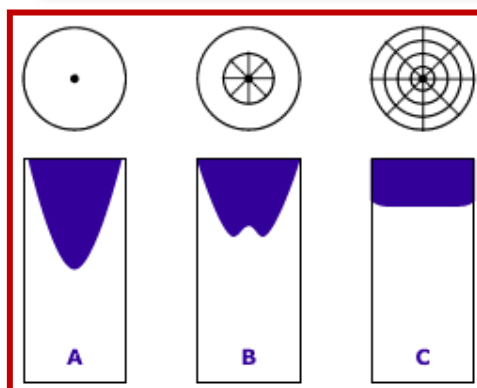
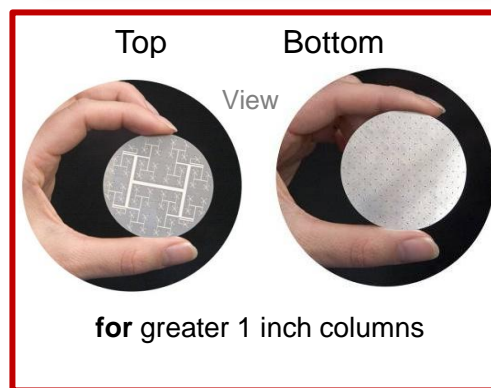
- **Highest Performance** – achieve superior results with the unique flow distribution system.
- **Maximum Flexibility** – perform both Dynamic or Static “locked” axial compression (DAC/SAC) at 1 inch up to 8 inch ID.
- **Greater Convenience** – pack your own column in a few minutes.
- **Maximum Mobility** – column and packing station are combined in one easy-to-move skid, wherever it’s needed.



Agilent column  
distribution plate

Impact on profile  
C: with Agilent plate

Unmatched reproducibility of  
self-packed columns



# Agilent SD-1 Purification System

## Flexible and Efficient

Dual Path  
325-UV Dual Wave  
Length Detector

SD-1 Solvent  
Delivery Modules  
1 -800 ml/min  
Exchangeable  
Pump Heads



Manual injection  
or  
Injection Pump

440-FC Open Bed  
Fraction Collector

Easy OpenLAB  
CDS Software

# Agilent OpenLAB CDS User Interface

## *A single software for purification & analysis*



The screenshot displays the 'Method and Run Control' window for a 'Varian Prep LC (online)'. The interface is organized into several functional areas:

- Method and Run Control:** Shows the current method 'DEF\_I.C.M.' and sequence 'DEF\_I.C.S.'. The status is 'Run in Progress/Data Acquisition' with a remaining time of 'nRdy Wait 7.6'.
- Instrument Control:** Features a 'Single Sample' button and a 'Sequence Queue'.
- Autosampler:** Displays 'Oven - °C', 'Tray 26 °C', and 'Vial 1 0 uL'. The state is 'Idle' with 'No error'.
- Pumps:** Shows two pumps with '100.000 %' and '0.000 %' flow rates at '0 kPa' and '800 kPa'. The flow rate is '1.000 mL/min'.
- Detector:** Shows two channels: 'WL 1 254 nm' and 'WL 2 300 nm'. The state is 'Method ready' and 'Run time 0.0 min'.
- Fraction collector:** Shows 'Rack 1', 'Vial 1', and 'Divert valve Waste'. The state is 'No error'.
- Data Analysis:** A vertical sidebar with icons for data analysis and a 'Data Analysis' window showing a chromatogram.
- Sampling Diagram:** A circular diagram representing the sample tray layout.
- Online Plot:** A chromatogram showing 'mAU' vs 'min' for 'DET, Channel 1' and 'DET, Channel 2'. The x-axis ranges from 7 to 9.5 minutes.
- Fraction collector racks:** A floating window showing a grid of 48 positions for fraction collection.
- Sequence templates:** A sidebar on the left listing various methods like 'AFCDelay.S', 'BATCH.S', etc.
- Bottom Panel:** Includes 'Vial Symbol Legend', 'Seq...', and system status information.

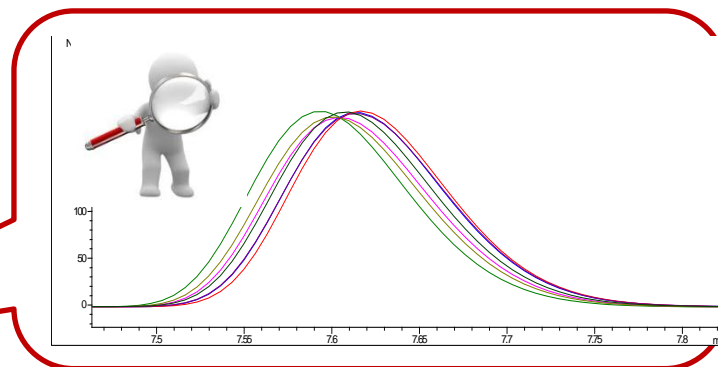
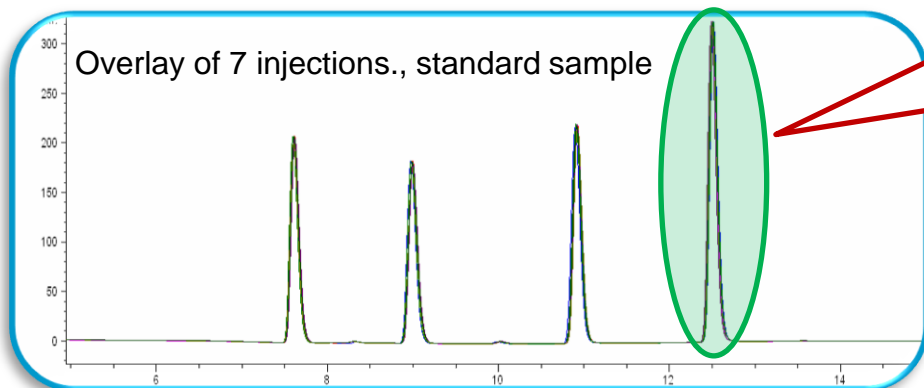
**OpenLAB**  
CAPTURE • ANALYZE • SHARE

# Agilent SD-1 Solvent Delivery Modules

Maximized flexibility and performance



- **Optimum performance for high-resolution HPLC at low flow rates and high-flow preparative applications** – dual piston design with independent control
- **High pressure mixing design for binary gradient work** – no degasser required
- **Exchangeable pump heads** for flow rates up to **200, 500 and 800 ml/min** for 4.6 mm up to 6 inch ID column



Outstanding gradient reproducibility at 1 ml/min and 200 ml pump head

# Agilent SD-2 Purification System

*Capable and Efficient*



Agilent 325 UV/VIS  
Dual WL Detector

Agilent SD-2 Solvent  
Delivery Modules  
1 – 1200 ml/min  
Exchangeable  
Pump Heads



Agilent 530 OPTO  
Control Module

Easy LC ReSponder  
Software

Agilent 530 Fluidics  
Module

# Agilent LC ReSponder User Interface

*Easy process control software*



DEMO VERSION - LCReSponder Operator: rs [CYCLE: 002] \*\*\*[DEMO PLAYBACK: Sales-Demo]\*\*\*

File Control Edit Setup Security Help

WL: 254 nm    Det 1: 0.27 AUFS    Run Time: 7:18    Pressure: 0.00 PSI    Collect Valve: Waste    %B: 0.00 %

Varian Scientific Instrument SD2-1200

	1	2	3	4
Seg	Equil	Inject	Grad	Grad
%B	0	0	30	80
Duration	0:01	0:01	2:00	5:00
Shape	Linear	Linear	Step 1	Linear
Flow (ml/min)	200	200	200	200
Inlet A	A1	A1	A2	A3
Inlet B	B1	B1	B3	B3

GRADIENT SEGMENT

Duration 12:02 Elapsed 7:18

Dec Run Inc Run Active Run View Run 1-1 Stored

Start F5 Stop F6 Cont F7 Abort F8 Hold F9 End F11

Ready

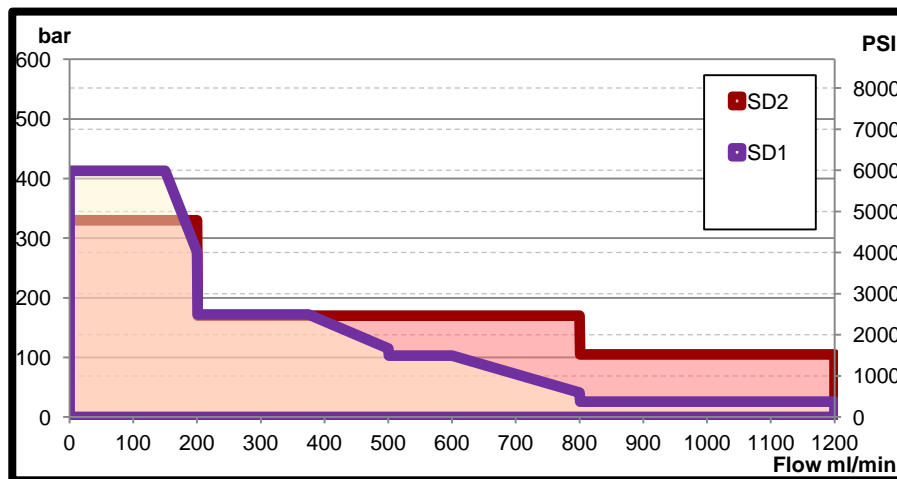
start Eudora - [In] LC Responder Presen... ppt\_P2P Seminar LCR... ppt\_P2P Seminar Inst... pptPREP\_Training V-I... DEMO VERSIO... 14:54

# Agilent SD-2 Solvent Delivery Modules

*Maximum capacity for large scale throughput*



- **High flow consistency, reliability and low pulsation for high-flow applications** – interactive key-board control or fully automated PC control
- **Low or High pressure mixing setup for binary gradient work**
- **Exchangeable pump heads** for flow rates of **200, 800 and 1,200 mL/min** for 1 to 8 inch ID columns



Extended Power Range  
above 500 ml/min

**VIELEN DANK FÜR IHRE  
AUFMERKSAMKEIT!!**

