



Overview

of



456 Complete Gas Analyzer (CGA)

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Outline of Today's Presentation

- Overview of Gas composition
- Overview of Scion 456 GC hardware
- Chromatography
- Summary

Gas Samples

Potential Gas Compositions

- Permanent gases (He, H₂, O₂, Ar, N₂, CH₄, CO, CO₂)
- Saturated & Unsaturated hydrocarbons (C₂-C₁₂)
- Sulfur components (H₂S, COS, mercaptans)

Important!

1. Keep it hot (dew point)
2. Reduce dead volume
3. Mind your eddies
4. Particulate/Coalescing filters



456 Complete Gas Analyzer– What does it do?

- Any Sample pressure – from Tedlar bags to 3000psi gas cylinders
- 100ppm to 100% of He, H₂, O₂, N₂, CH₄, CO, CO₂, C₂H₄, C₂H₆, C₂H₂, H₂S by Dual TCD
- 1ppm to 100% of C₃ to C₁₆ by FID
- No problems with Moisture/Oxygenates
- FAST analysis! Sample to Sample < 4 minutes up to C₆. <10 minutes up to C₁₂



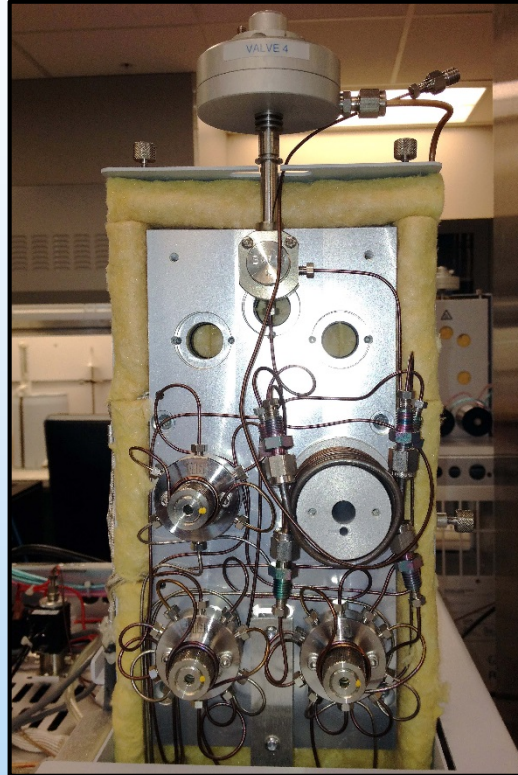
456 Complete Gas Analyzer – How does it do it?

- Three channels with independent heated zones, flow controllers & backflushes
- Fixed loop injection, accuracy independent of sample gas composition
- System maintenance in the field, easy access to valves and columns
- Automated normalization & BTU calculations with Compass CDS software
- Easy to implement stream selection valves for automation
- Certified for use with H₂ carrier gas

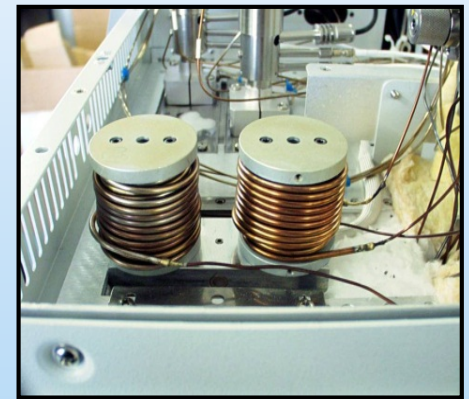
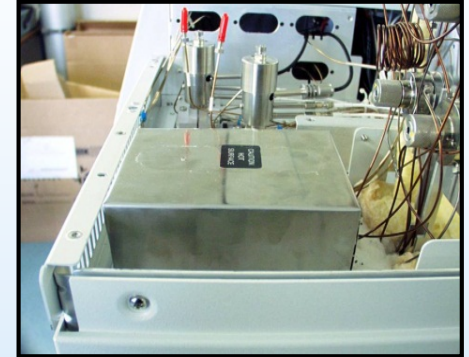
Scion 456 GC – Three Independent Ovens



- Large GC Oven
- Quick Heating/Cooling
- Cap/Packed columns



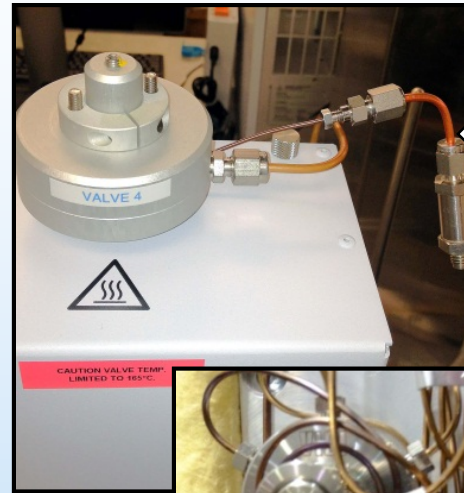
- Large isothermal valve oven
- Top or Side Mounted
- GSVs, LSVs, NVs, Columns



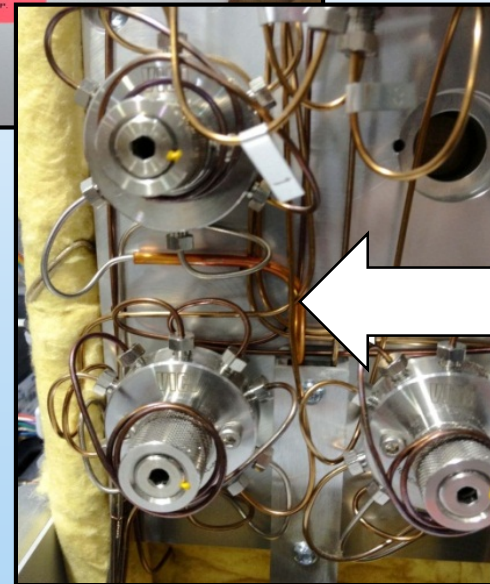
- Horizontal small oven(s)
- Single, Dual or Triple configuration
- GSVs, LSVs, Columns

Connection of the Gas Sample Line

- Standard 1/8" or 1/16" connections
- Stainless steel or inert coated
- HT/HP on/off solenoid mounted directly in heated zone
- Copper Transfer lines prevent any cold spots



Sample line connection

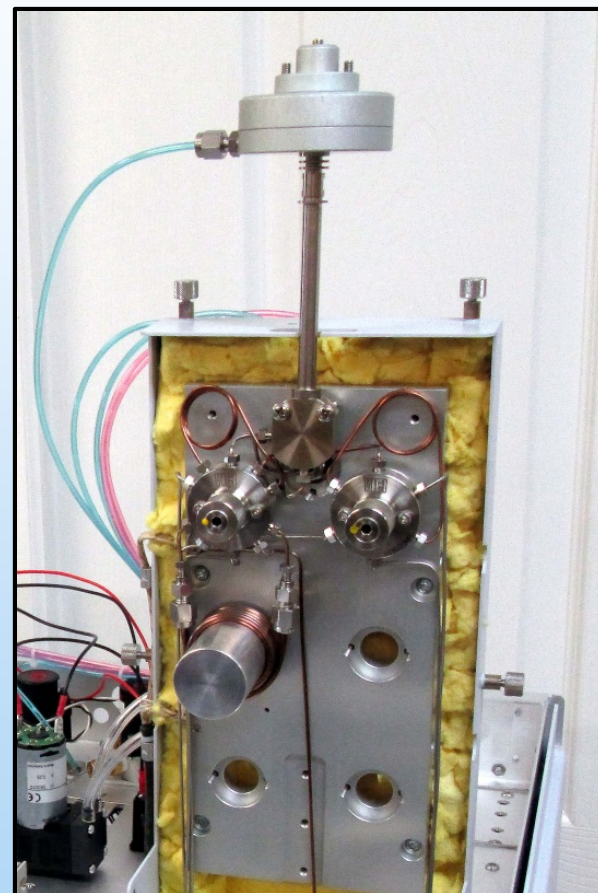


Copper Transfer line

Scion 456 GC – High Pressure Automation

VICI HT/HP on/off Solenoid

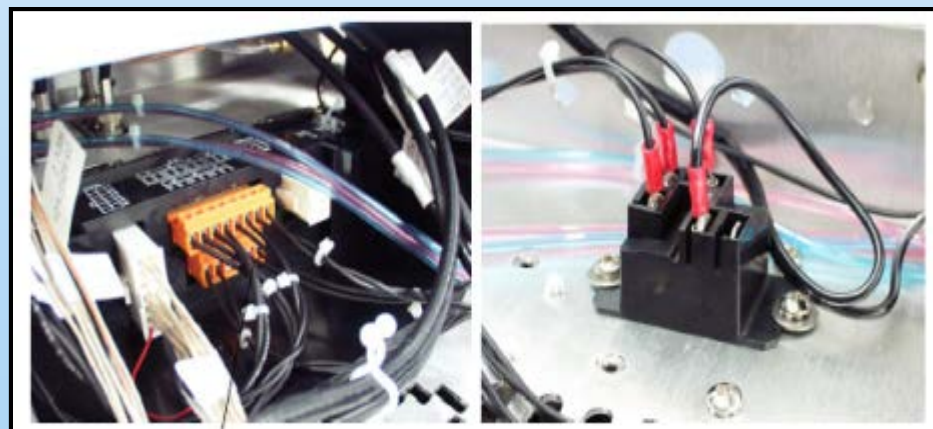
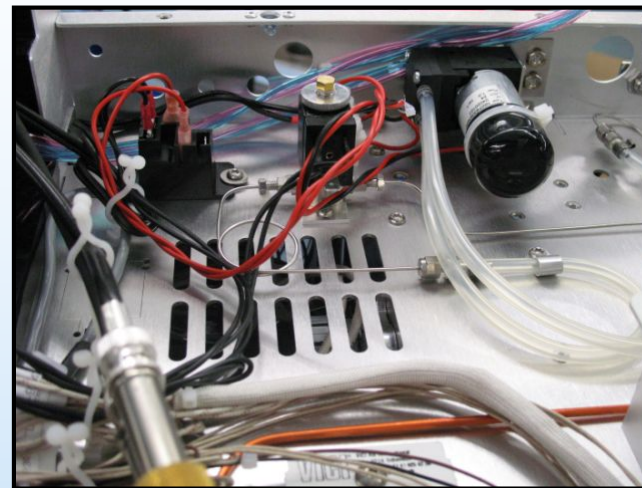
- 10-3000psi, up to 300°C
- Controlled & Automated by GC
- Mounted directly into Large Valve oven
- Easy switch between high & low pressure samples



Scion 456 GC – Low Pressure Automation

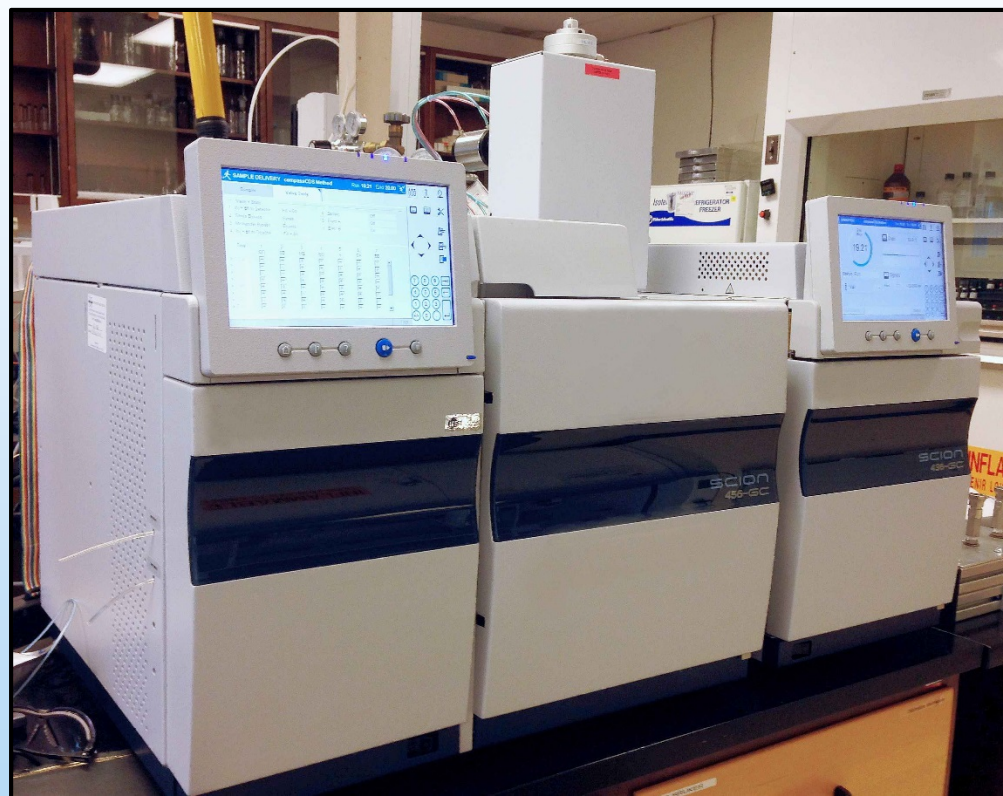
3/2 solenoid & sample pump

- 0-10psi – Tedlar Bags
- Controlled & Automated by GC
- Mounted under top GC cover
- Automated switching between high & low pressure samples



Daisy Chain Multiple Gas GCs

- Multiple Instruments connected in series
- Allows for Simultaneous Compositional & Trace analysis
- Example: Compositional Nat Gas and Speciated Trace Sulfur with one sample cylinder and one injection.
- Compass Software will export/print normalized, multichannel report from all detectors

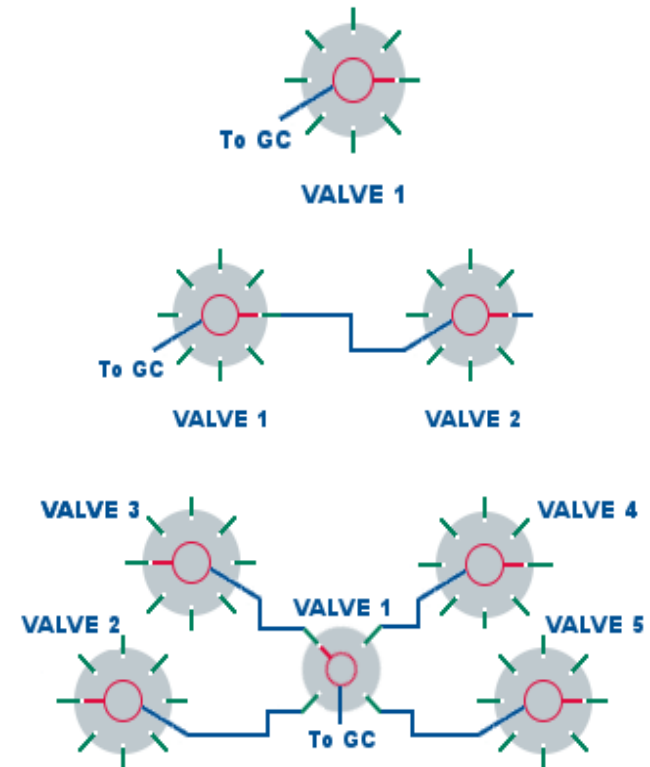


Scion GC SSV Automation

Valco Stream Selection Valves

- SSVs in Single, Chained or Networked configurations
- Valve Position is entered directly into the Compass sequence table
- Configurations support up to 64 streams

SSV Control is the key to automation of gases or compressed liquids!



SSV Gas Autosamplers – High & Low Pressure



Thermal Conductivity Detector (TCD)

Universal detector

- Detects both organic and inorganic components

Gas requirements

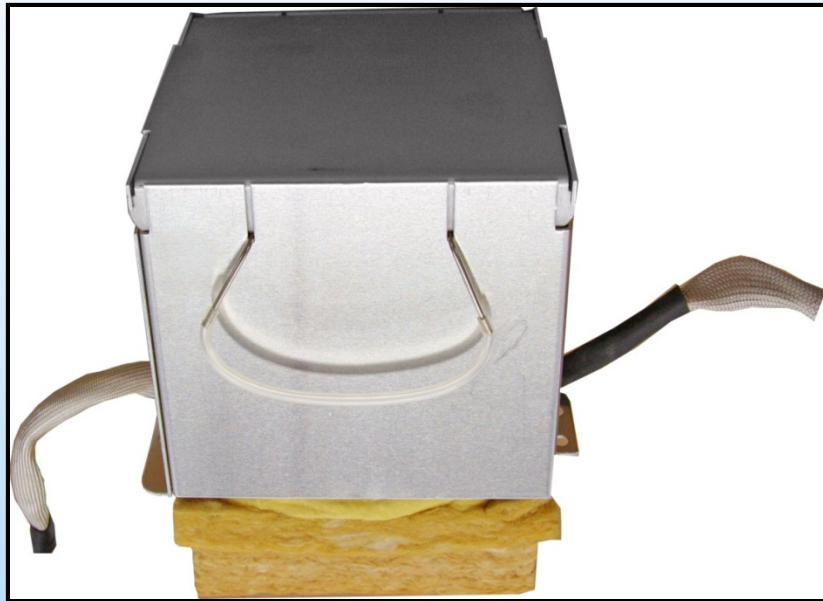
- Single gas (H_2 , He, N_2 , or Ar)

Automatic filament protection

- Prevents keep filament from burning out

Non-destructive

- Sample output can be sent to another detector (i.e. FID)

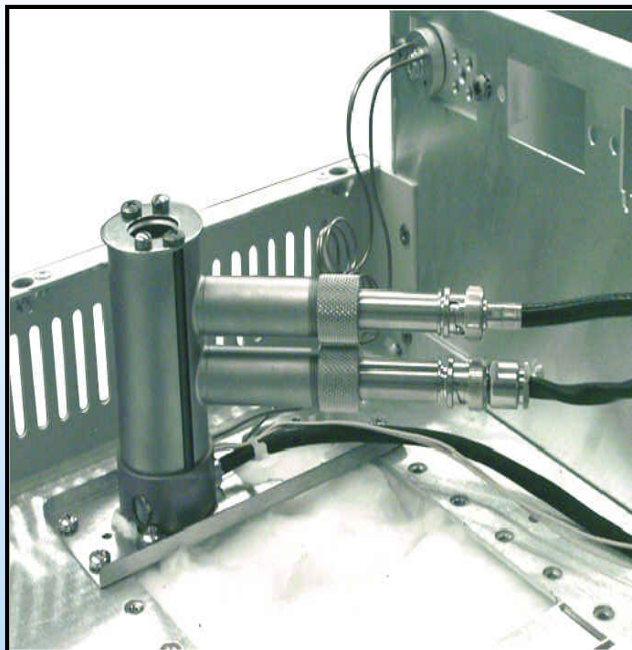


Thermal Conductivity Detector (TCD)

GAS	THERMAL CONDUCTIVITY
ACETYLENE	4.400
AMMONIA	5.135
ARGON	3.880
CARBON DIOXIDE	3.393
CARBON MONOXIDE	5.425
CHLORINE	1.829
ETHANE	4.303
ETHYLENE	4.020
HELIUM	33.60
HYDROGEN	39.60
HYDROGEN SULPHIDE	3.045
METHANE	7.200
NEON	10.87
NITRIC OXIDE	5.550
NITROGEN	5.680
NITROUS OXIDE	3.515
OXYGEN	5.700
SULPHUR DIOXIDE	1.950

Choose your carrier gas to optimize sensitivity & linearity

Flame Ionization Detector (FID)



Universal Detector

- Ionize most Carbon containing material in a H₂ rich flame. (except CO, CO₂)

Predictable Hydrocarbon RFs

- FID response of hydrocarbons is proportional to Molecular weight

Wide linear range

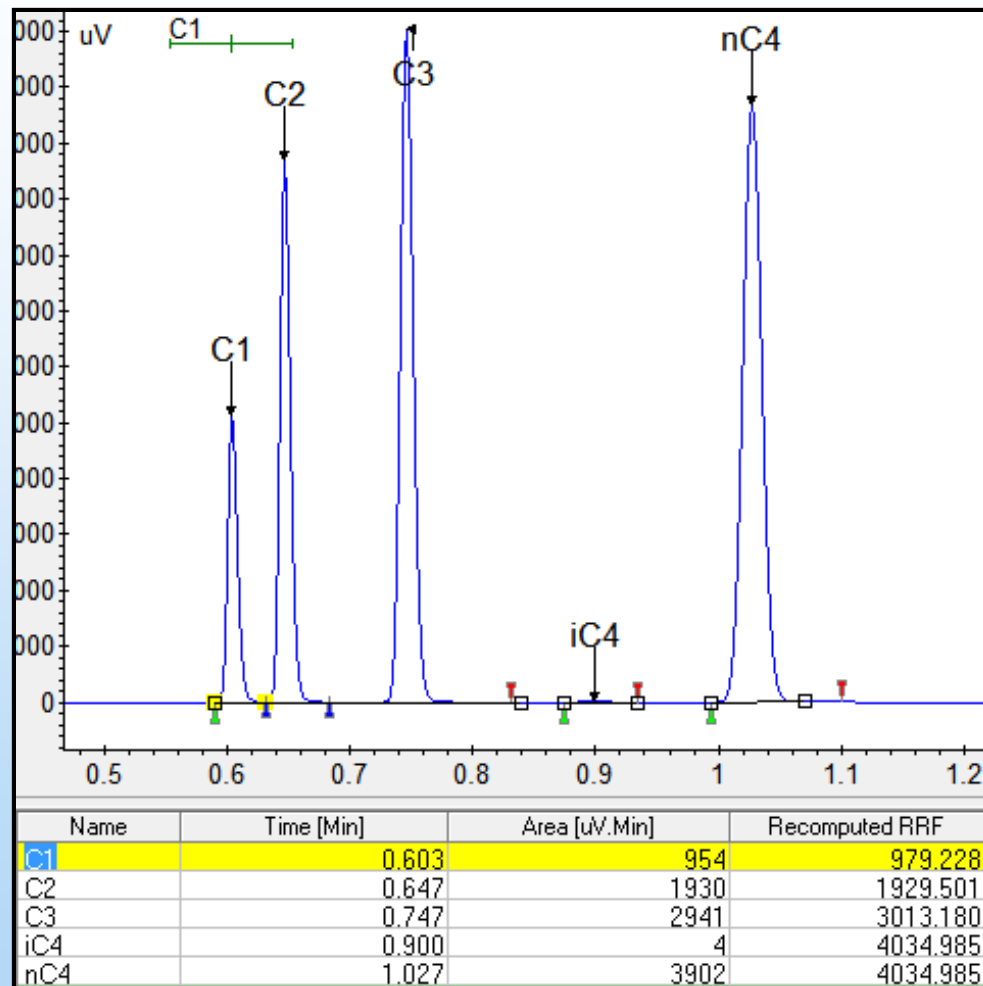
- >10⁷
- 100% down to sub PPM

Ceramic flame tip

- Eliminates compound-dependent discrimination
- Reliable and Rugged
- Available as 0.02" & 0.01" ID

Relative Molar Response Factors on FID

Compound	MW (g/mol)	Area Counts
C3H8	44.06	2941
C4H10	58.08	3902
Ratio	0.759	0.754



Ratio within 1% of expected result!

Pulsed Flame Photometric Detector

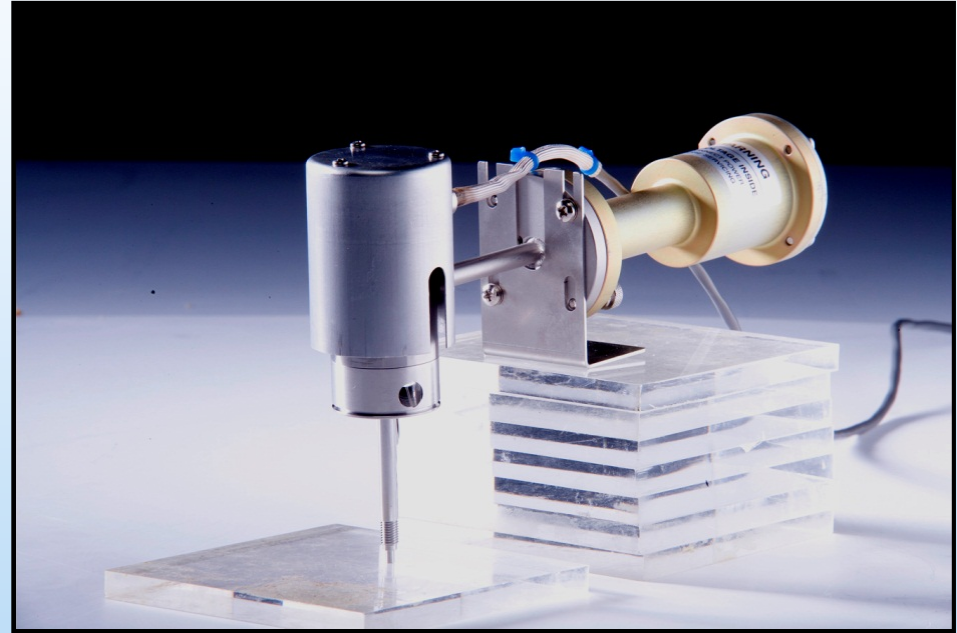
An element selective detector!

- 28 elemental species
- S, P, N, Sn, etc

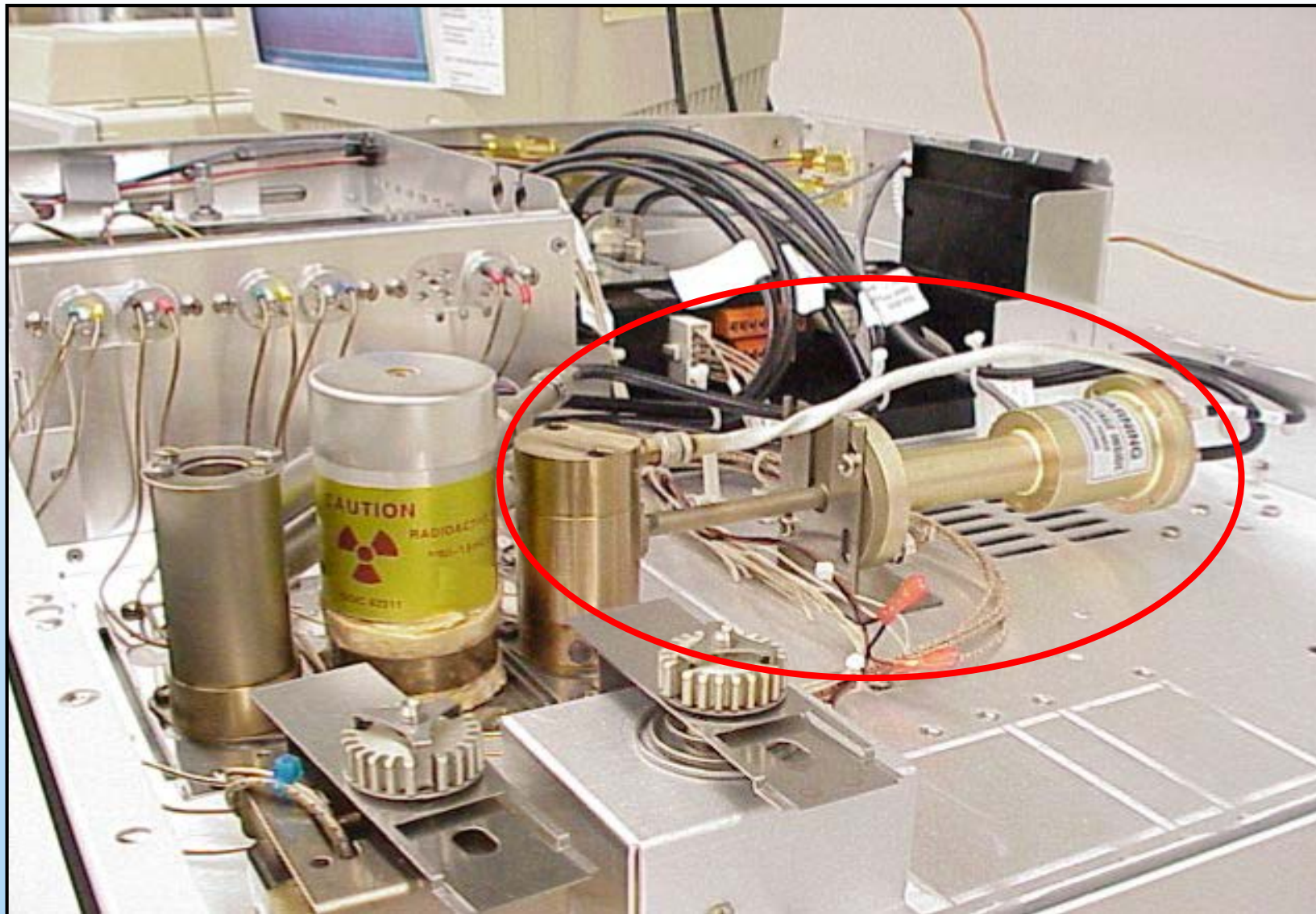
What does this offer you?

The ability to selectively detect components containing a specific element

- Highly sensitive
- Pick out specific components in a highly complex matrix
- Equimolar RFs



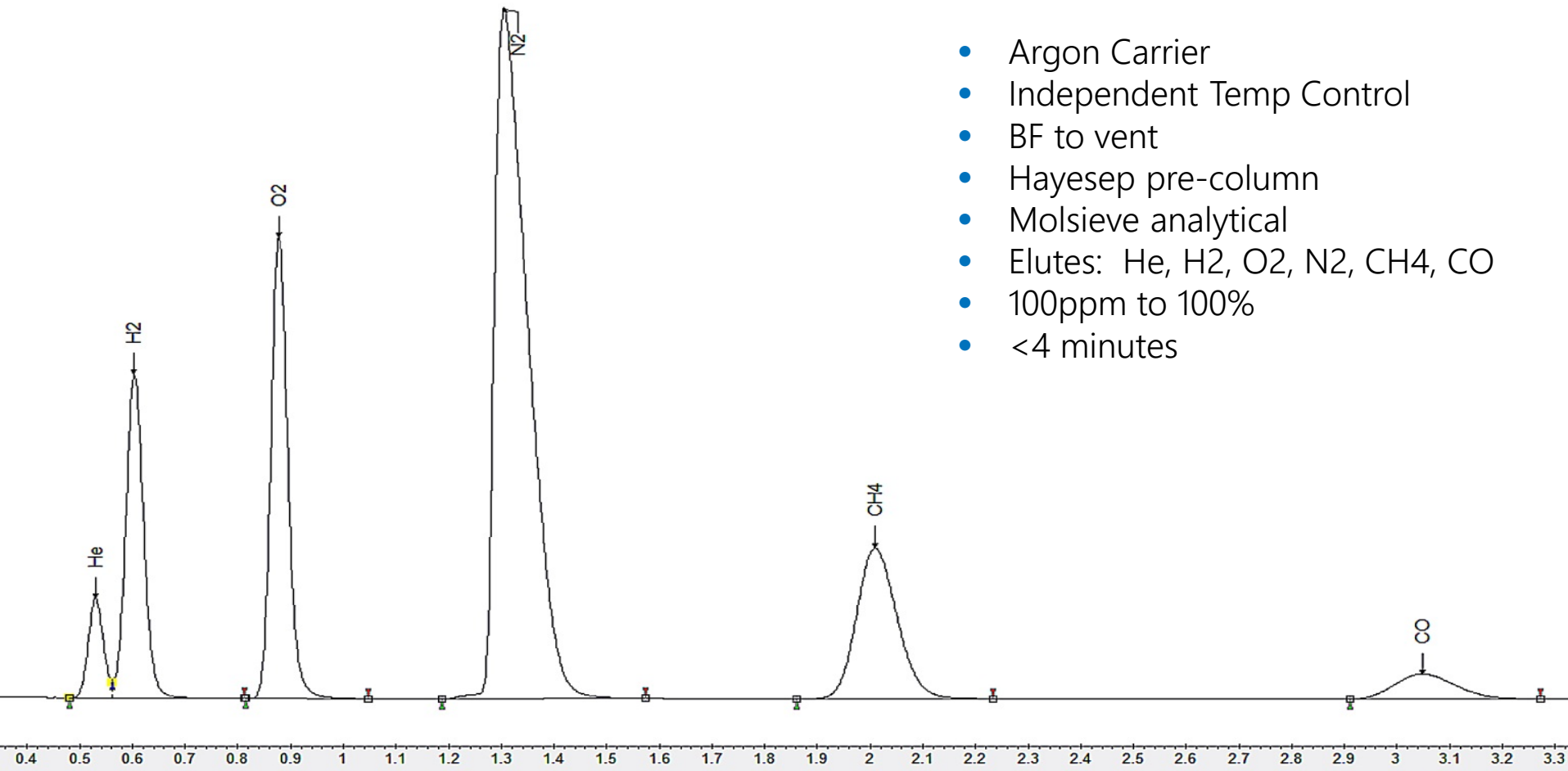
Pulsed Flame Photometric Detector





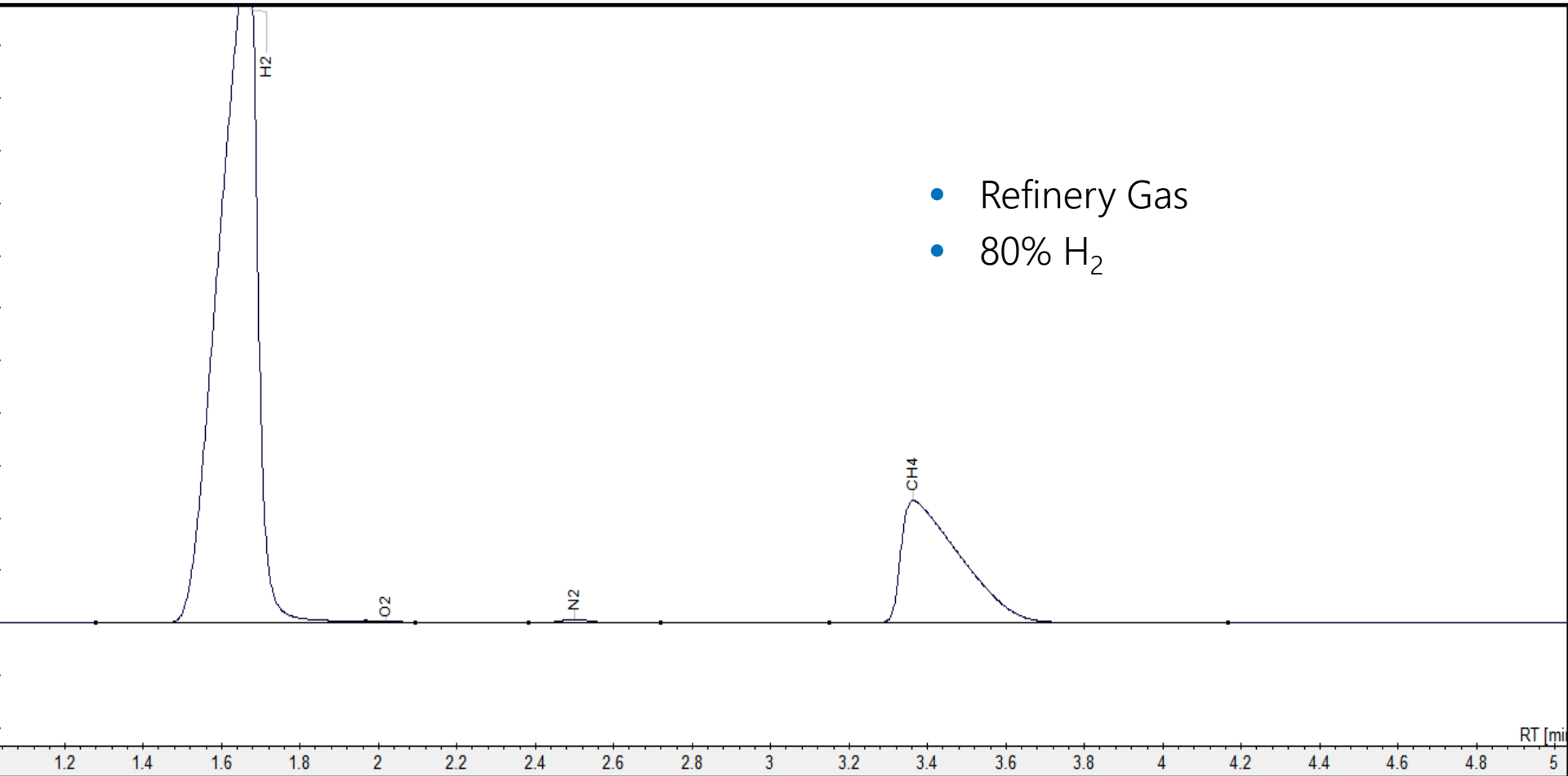
Chromatography

1st channel: Molsieve channel - TCD



- Argon Carrier
- Independent Temp Control
- BF to vent
- Hayesep pre-column
- Molsieve analytical
- Elutes: He, H₂, O₂, N₂, CH₄, CO
- 100ppm to 100%
- <4 minutes

1st channel: Molsieve channel - TCD



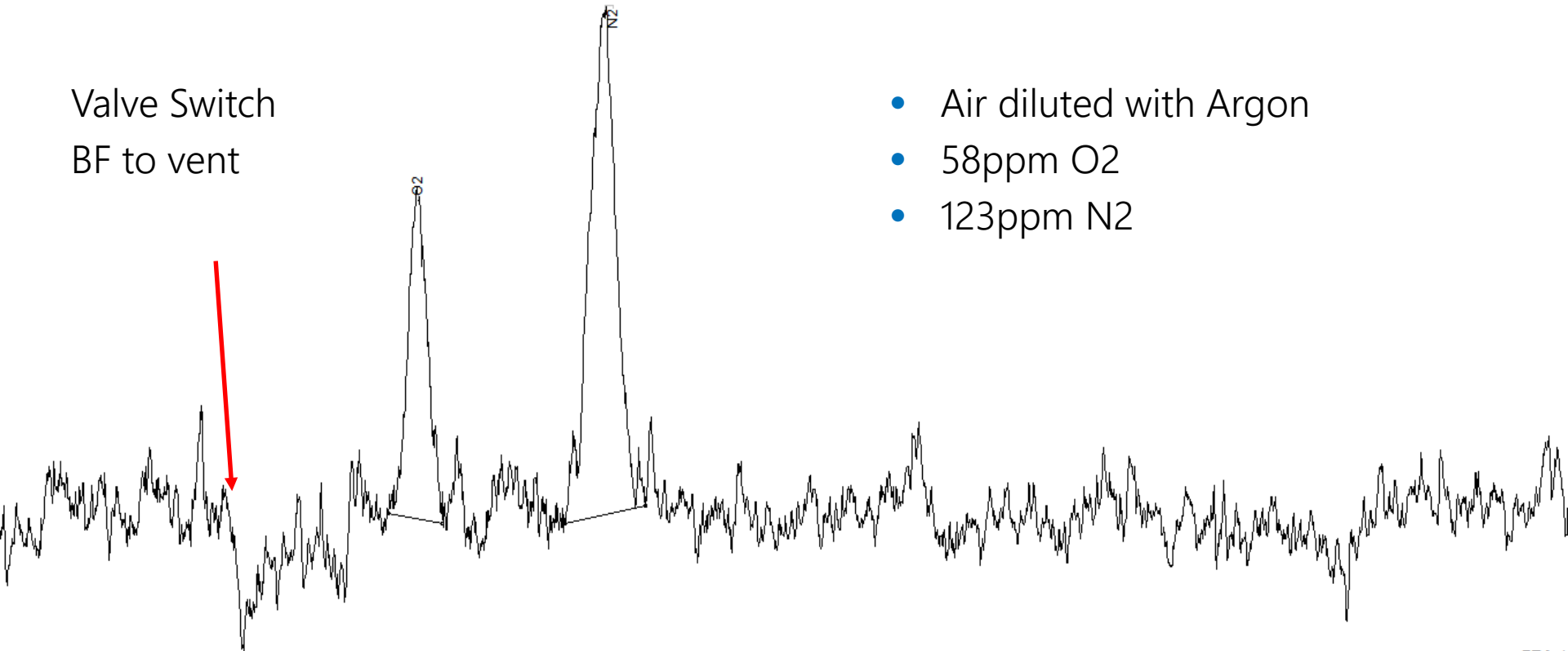
- Refinery Gas
- 80% H₂

1st channel: Molsieve channel - TCD

µV

Valve Switch
BF to vent

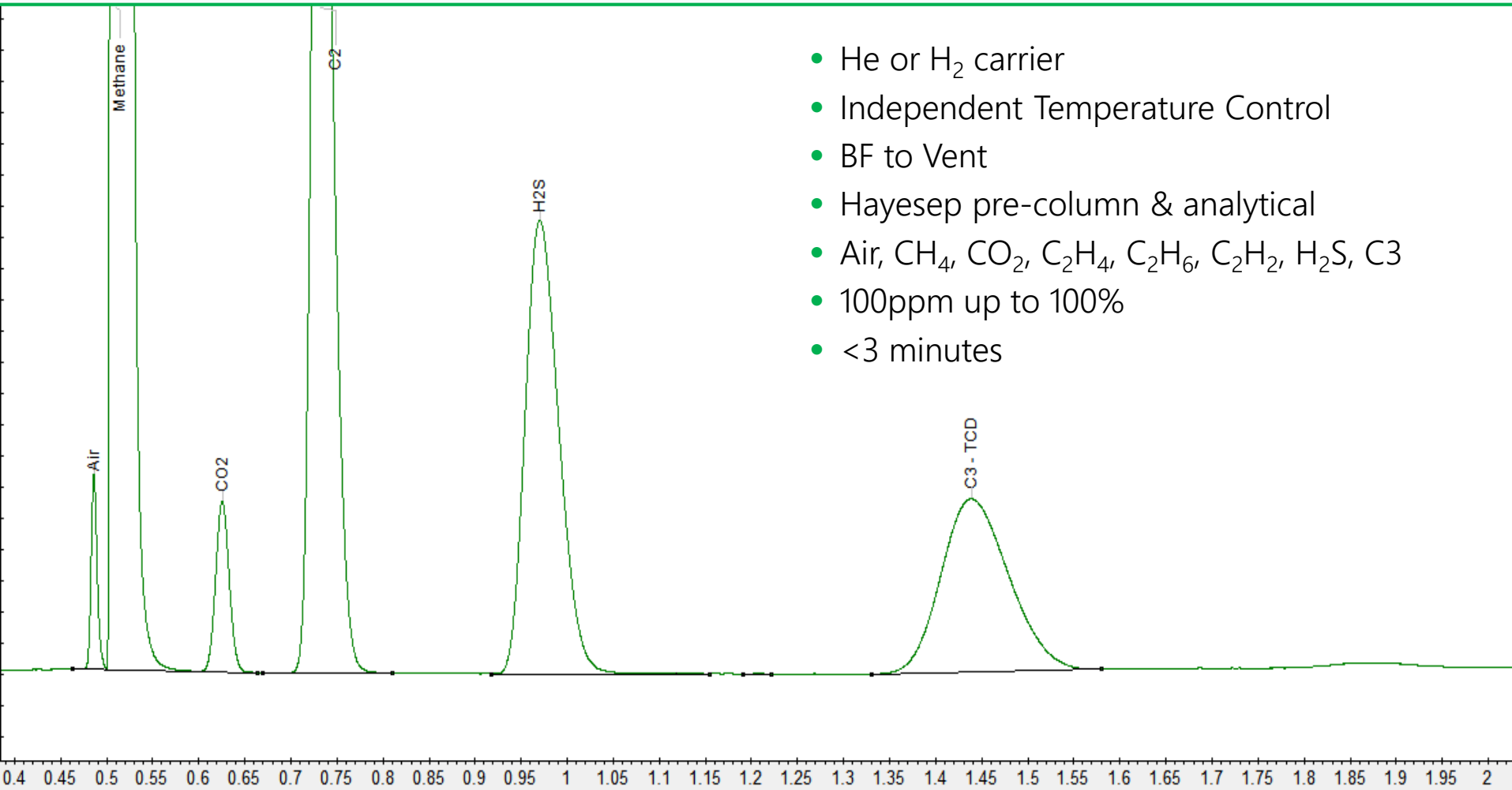
- Air diluted with Argon
- 58ppm O₂
- 123ppm N₂



RT [min]

#	Name	Time [Min]	Area [µV.Min]	Quantity [mol%]
1	O ₂	2.02	8.4	0.0058
2	N ₂	2.51	17.9	0.0123

2nd channel: Hayesep channel - TCD

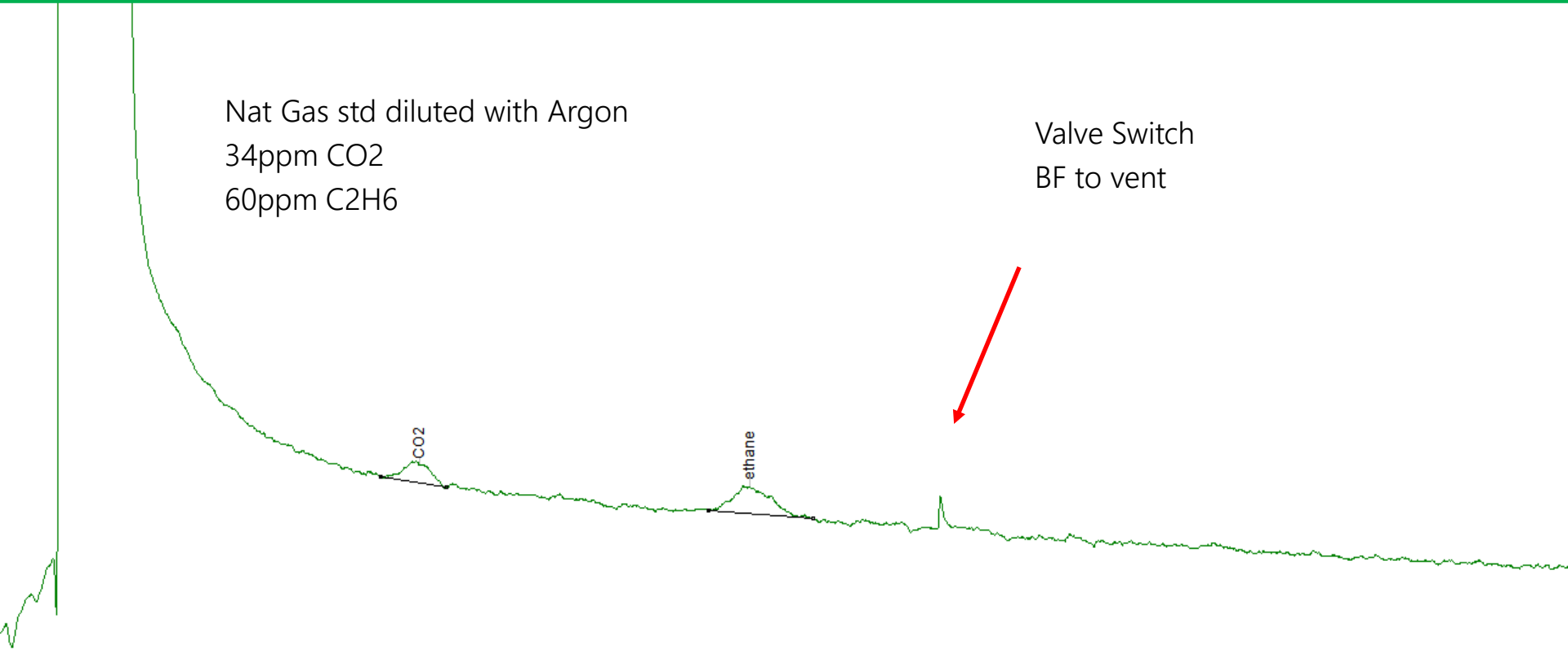


- He or H₂ carrier
- Independent Temperature Control
- BF to Vent
- Hayesep pre-column & analytical
- Air, CH₄, CO₂, C₂H₄, C₂H₆, C₂H₂, H₂S, C₃
- 100ppm up to 100%
- <3 minutes

2nd channel: Hayesep channel - TCD

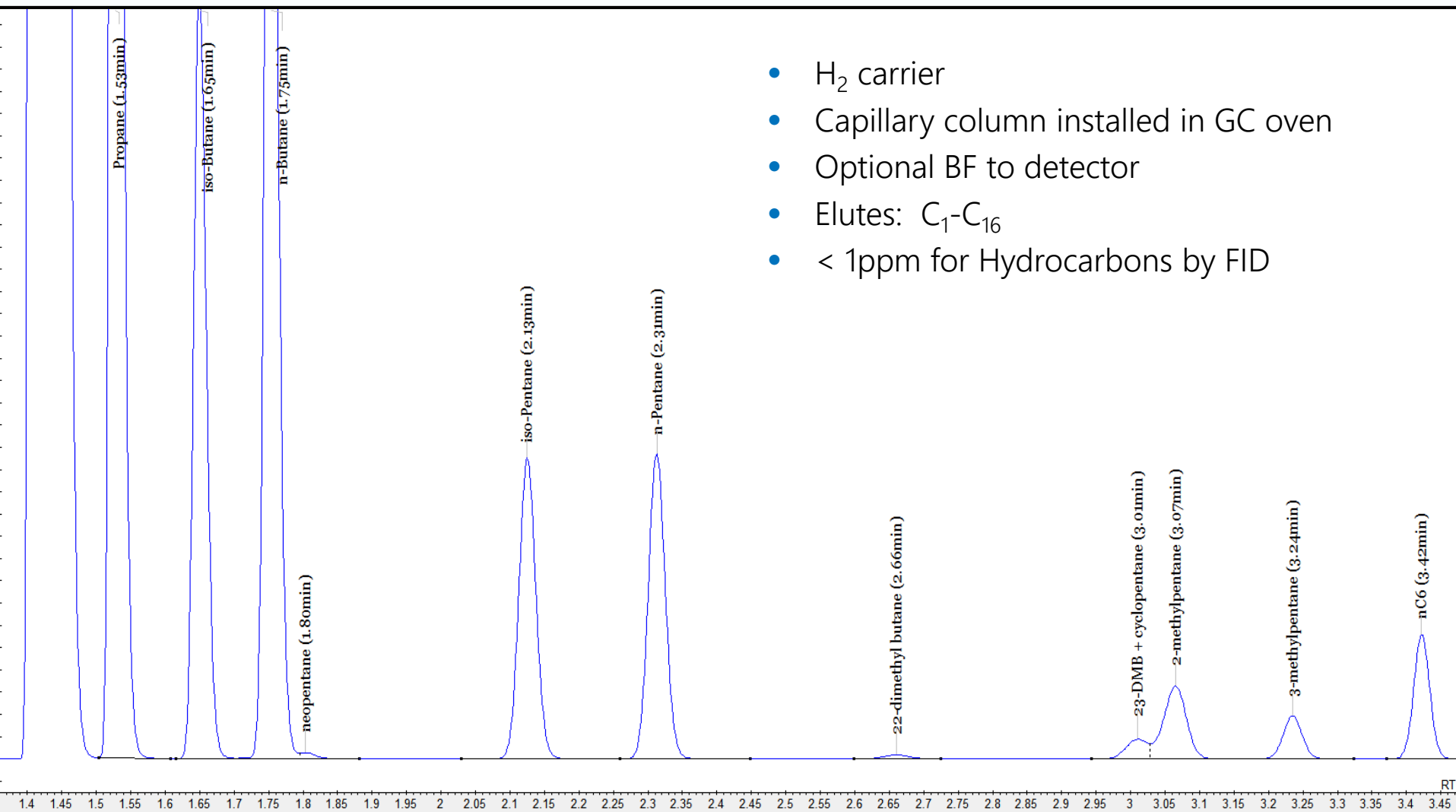
Nat Gas std diluted with Argon
34ppm CO₂
60ppm C₂H₆

Valve Switch
BF to vent



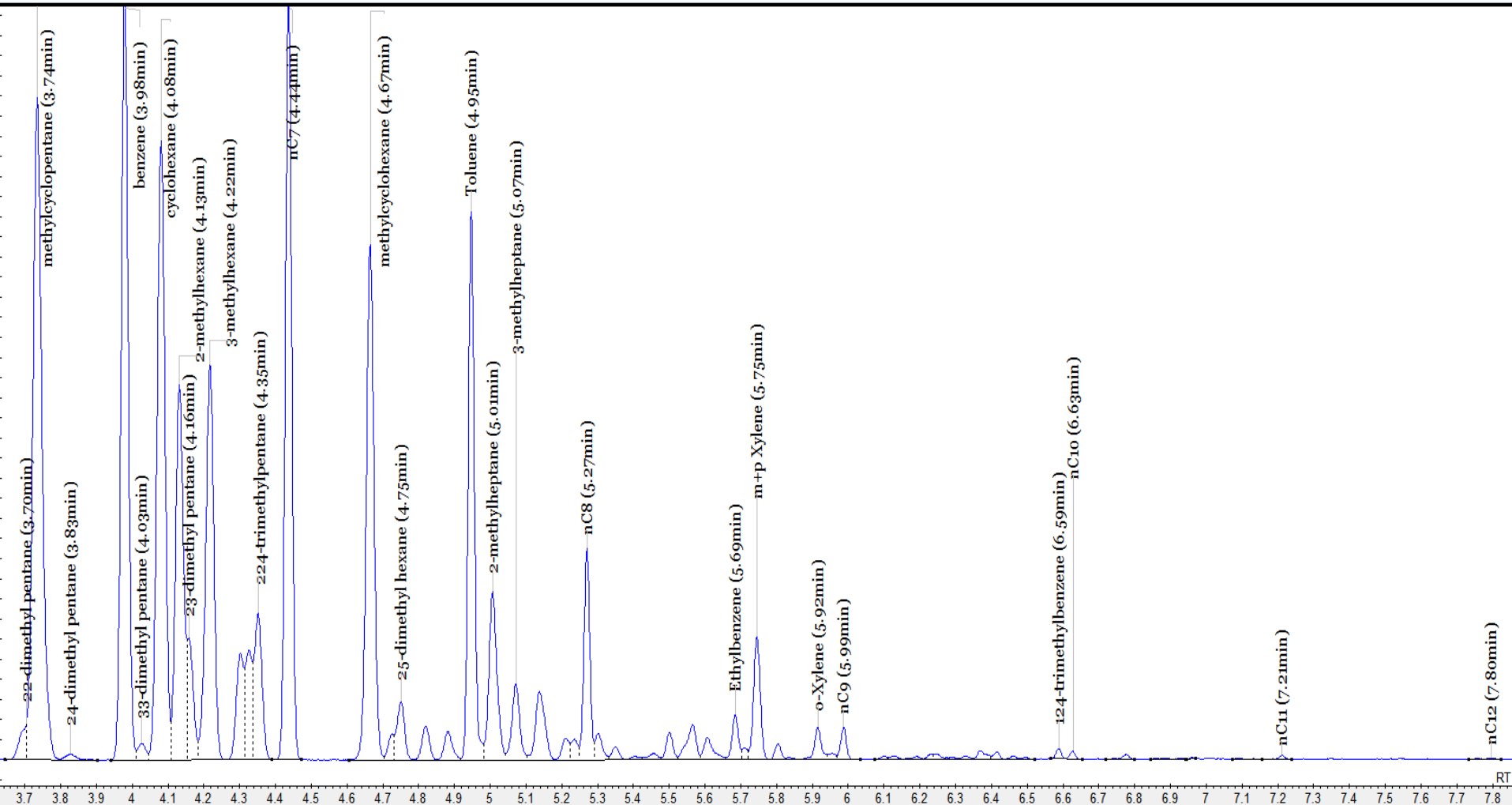
Name	Time [Min]	Area [µV.Min]	Quantity [mol%]
CO2	1.69	10.5	0.0034
ethane	2.53	19.2	0.0060

3rd channel: Capillary column – FID C₁-C₆ zoom in

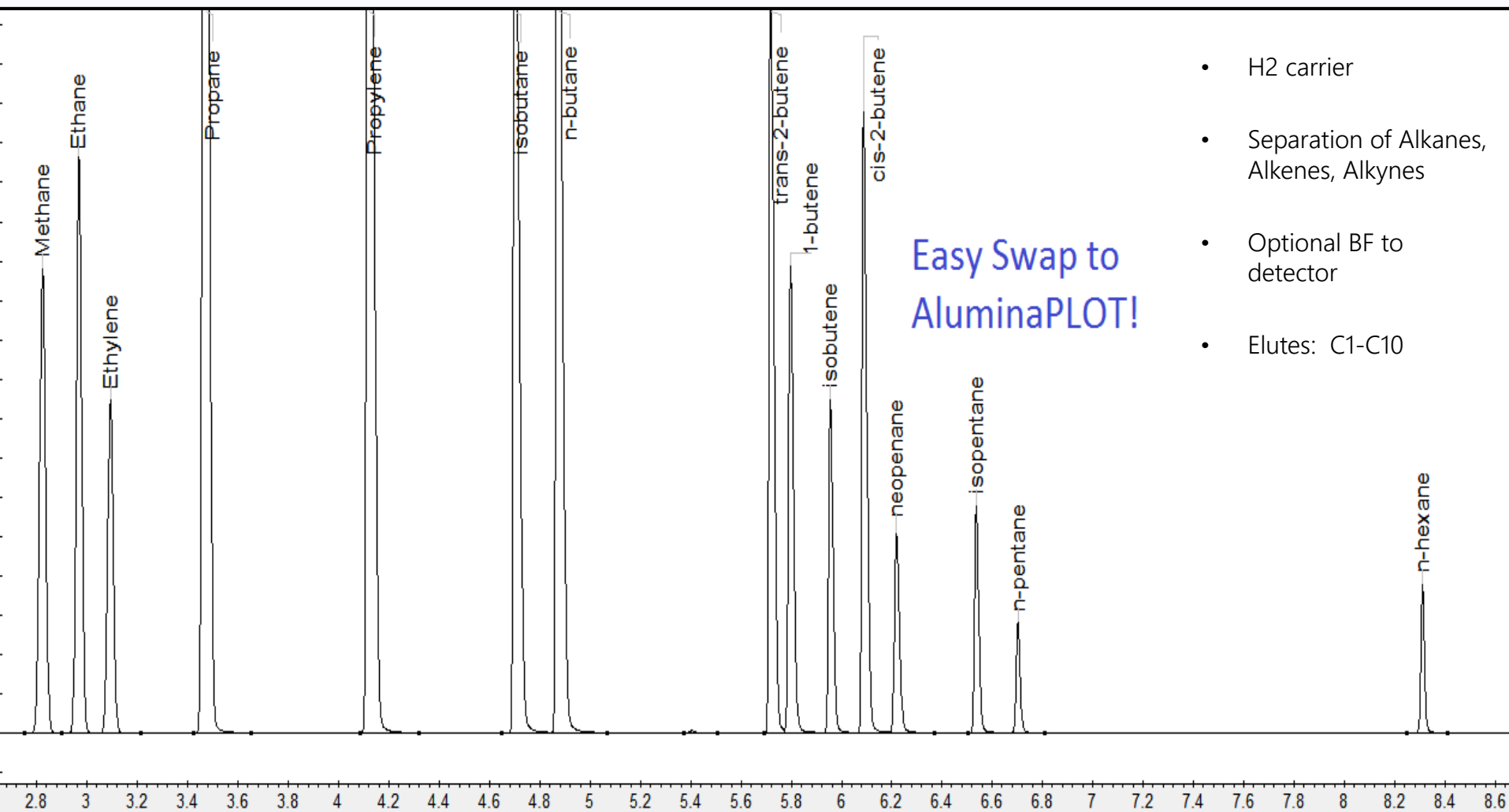


- H₂ carrier
- Capillary column installed in GC oven
- Optional BF to detector
- Elutes: C₁-C₁₆
- < 1ppm for Hydrocarbons by FID

3rd channel: Capillary column – FID (C₆-C₁₂ zoom in)



3rd channel: Optional AL₂O₃ Capillary column – FID



- H₂ carrier
- Separation of Alkanes, Alkenes, Alkynes
- Optional BF to detector
- Elutes: C₁-C₁₀

3 Channel Report

Report Options

- Normalized or not
- Printed or not
- Peaks & Groups
- Export to Excel or LIMS
- BTU
- PDF
- HTML

#	Peak Name	Channel	RT	Result	Area
1	Helium	Front (TCD)	1.6700	0.0000	23294
2	Hydrogen	Front (TCD)	1.7733	0.0000	861
3	Oxygen	Front (TCD)	0.0000	0.0000	0
4	Nitrogen	Front (TCD)	2.5350	4.1887	71089
5	Methane	Front (TCD)	3.3233	74.8674	11413815
6	Carbon-Dioxide	Middle (TCD)	2.1983	2.6228	831451
7	Ethane	Middle (TCD)	2.9167	9.4413	3002580
8	H2S	Middle (TCD)	0.0000	0.0000	0
9	Propane	Rear (FID)	1.5267	4.2034	1298406
10	iso-Butane	Rear (FID)	1.6500	1.0916	446811
11	n-Butane	Rear (FID)	1.7533	1.9185	788335
12	neopentane	Rear (FID)	1.8033	0.0097	3998
13	iso-Pentane	Rear (FID)	2.1250	0.4588	234214
14	n-Pentane	Rear (FID)	2.3133	0.4653	238151
15	22-dimethyl butane	Rear (FID)	2.6600	0.0068	4283
16	23-DMB + cyclopentane	Rear (FID)	3.0100	0.0395	18824
17	2-methylpentane	Rear (FID)	3.0650	0.1487	76095
18	3-methylpentane	Rear (FID)	3.2350	0.0727	37216
19	nC6	Rear (FID)	3.4217	0.1467	92169
20	22-dimethyl pentane	Rear (FID)	3.7038	0.0016	1087
21	methylcyclopentane	Rear (FID)	3.7350	0.0437	29925
22	24-dimethyl pentane	Rear (FID)	3.8267	0.0004	292
23	benzene	Rear (FID)	3.9783	0.0402	25895
24	33-dimethyl pentane	Rear (FID)	4.0250	0.0009	624
25	cyclohexane	Rear (FID)	4.0800	0.0356	23869
26	2-methylhexane	Rear (FID)	4.1317	0.0236	14802
27	23-dimethyl pentane	Rear (FID)	4.1583	0.0052	3256
28	3-methylhexane	Rear (FID)	4.2167	0.0247	15518
29	224-trimethylpentane	Rear (FID)	4.3517	0.0062	5583
30	nC7	Rear (FID)	4.4367	0.0321	23494
31	methylcyclohexane	Rear (FID)	4.6650	0.0246	19017
32	25-dimethyl hexane	Rear (FID)	4.7500	0.0029	2246
33	Toluene	Rear (FID)	4.9467	0.0205	16184
34	2-methylheptane	Rear (FID)	5.0067	0.0089	6548
35	3-methylheptane	Rear (FID)	5.0717	0.0039	2859
36	nC8	Rear (FID)	5.2700	0.0067	6010
37	Ethylbenzene	Rear (FID)	5.6850	0.0015	1345
38	m+p Xylene	Rear (FID)	5.7450	0.0046	4015
39	o-Xylene	Rear (FID)	5.9150	0.0012	1071
40	nC9	Rear (FID)	5.9867	0.0009	915
41	124-trimethylbenzene	Rear (FID)	6.5883	0.0003	311
42	nC10	Rear (FID)	6.6283	0.0002	230
43	nC11	Rear (FID)	7.2117	0.0001	137
44	nC12	Rear (FID)	7.7950	0.0001	72
45	Hexanes	Rear (FID)	Group	0.0001	37
46	Heptanes	Rear (FID)	Group	0.0101	7374
47	Octanes	Rear (FID)	Group	0.0084	7518
48	Nonanes	Rear (FID)	Group	0.0063	6431
49	Decanes	Rear (FID)	Group	0.0016	1807
50	Undecanes	Rear (FID)	Group	0.0005	633
51	Dodecanes	Rear (FID)	Group	0.0002	246
Totals				100.0000	18810938

3 Channel Report

3 channel Report:

Can be reported as Groups

Name	Channel	RT [Min]	Area [μ V.Min]	Quantity [mol %]
He	Front TCD	0.81	23644.0000	0.3543
H2	Front TCD	0.91	10234.0000	0.1756
O2	Front TCD	1.15	56.1	0.1006
N2	Front TCD	1.31	1545.9	2.7731
CH4	Front TCD	1.66	41217.0	83.5378
CO2	Middle TCD	0.63	531.1	0.9832
C2	Middle TCD	0.72	2544.9	3.8210
H2S	Middle TCD	0.99	3064.0	4.6004
C3	Rear FID	1.43	554032.5	1.5663
iC4	Rear FID	1.52	98566.9	0.2033
nC4	Rear FID	1.59	96103.5	0.1978
iC5	Rear FID	1.79	52410.3	0.1019
nC5	Rear FID	1.85	60162.8	0.1024
C6 Group	Rear FID	2.12	17907.0	1.1410
C7 Group	Rear FID	2.52	4046.0000	0.2578
C8 Group	Rear FID	2.97	1287	0.0820
C9 Group	Rear FID	3.43	35	0.0022
C10 Group	Rear FID	3.99		

Summary

- Scion Instruments – Continuing a tradition of excellence from Varian / Bruker
- 50+ year legacy of successfully providing solutions not just boxes
- A global team of highly accessible GC specialists in place to help you
- Extremely flexible GC hardware and software platform
- A full line of high performance application tuned columns

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