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Comprehensive two-dimensional gas chromatography (GC x GC)

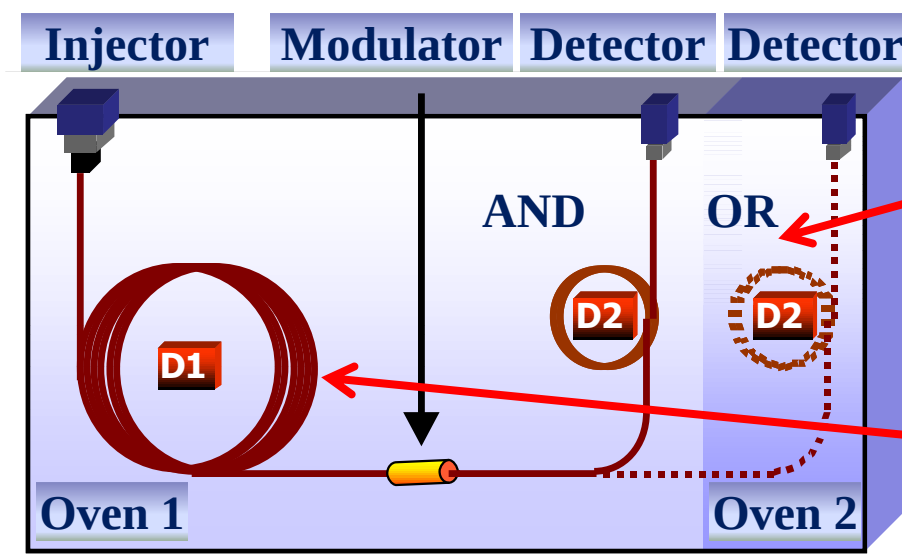
Separation of analytes using two capillary columns with different separation mechanisms connected by a modulator

1. Dimension (D1) - column 1 $\approx$ conventional separation

- a long nonpolar column - separation by vapor pressure

2. Dimension (D2) - column 2 $\approx$ „flash“ separation

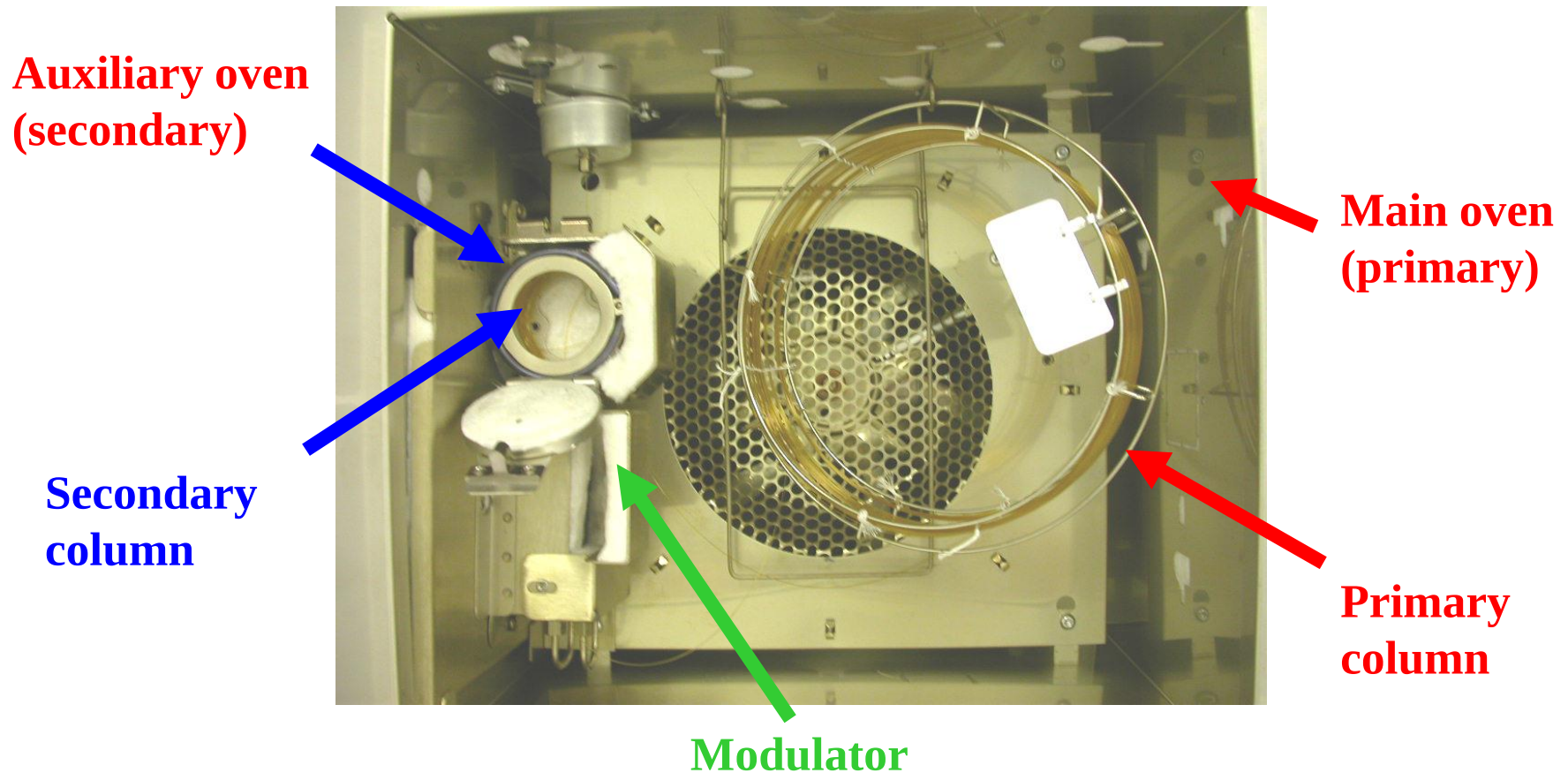
- a short narrow polar column - separation by polarity



D2 - either the same
temperature program as D1
or
different from D1
(but dependent with
limited difference)

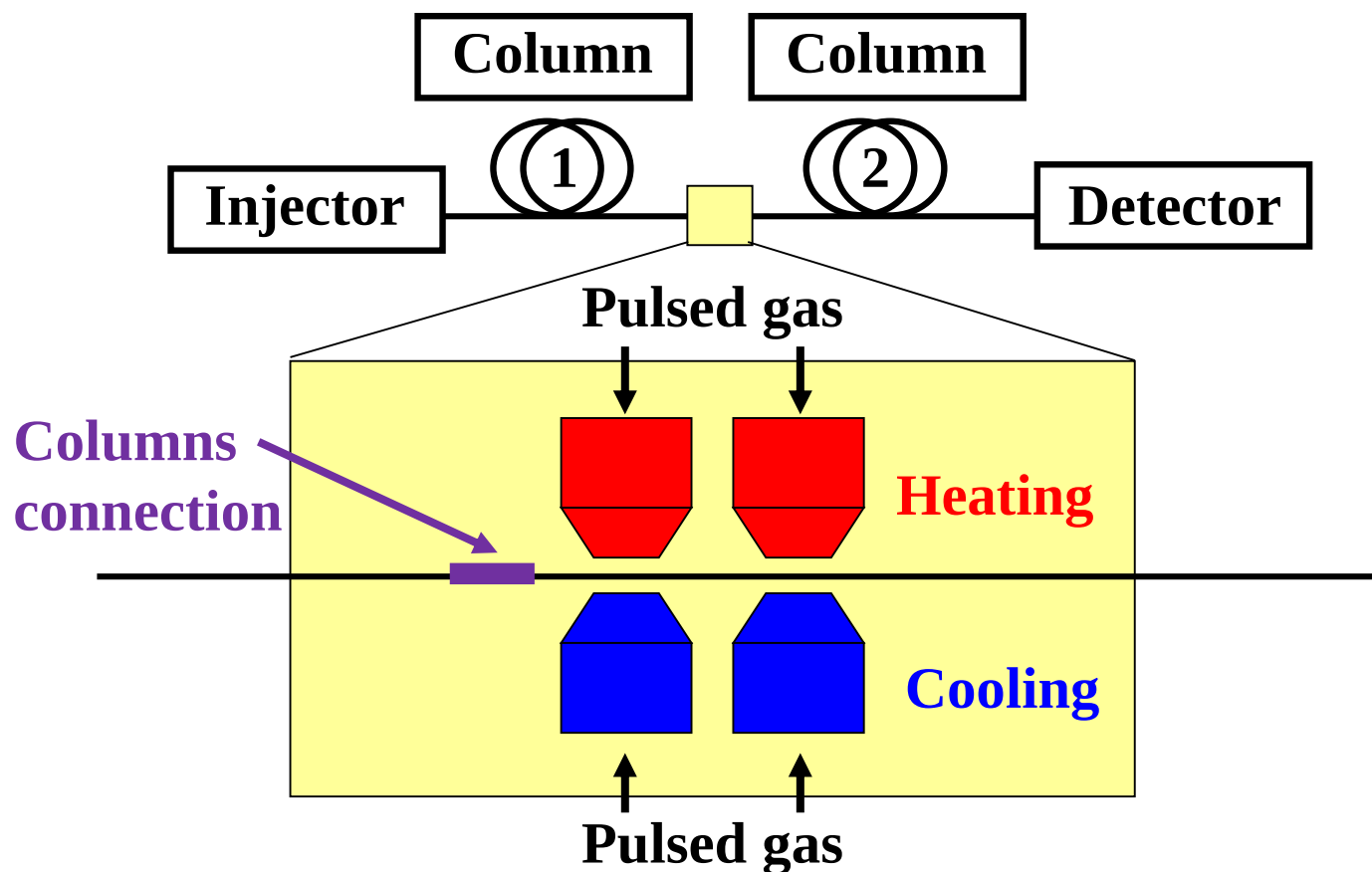
Comprehensive two-dimensional gas chromatography (GC x GC)

Technical realization - two differently heated columns with modulator between them



Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

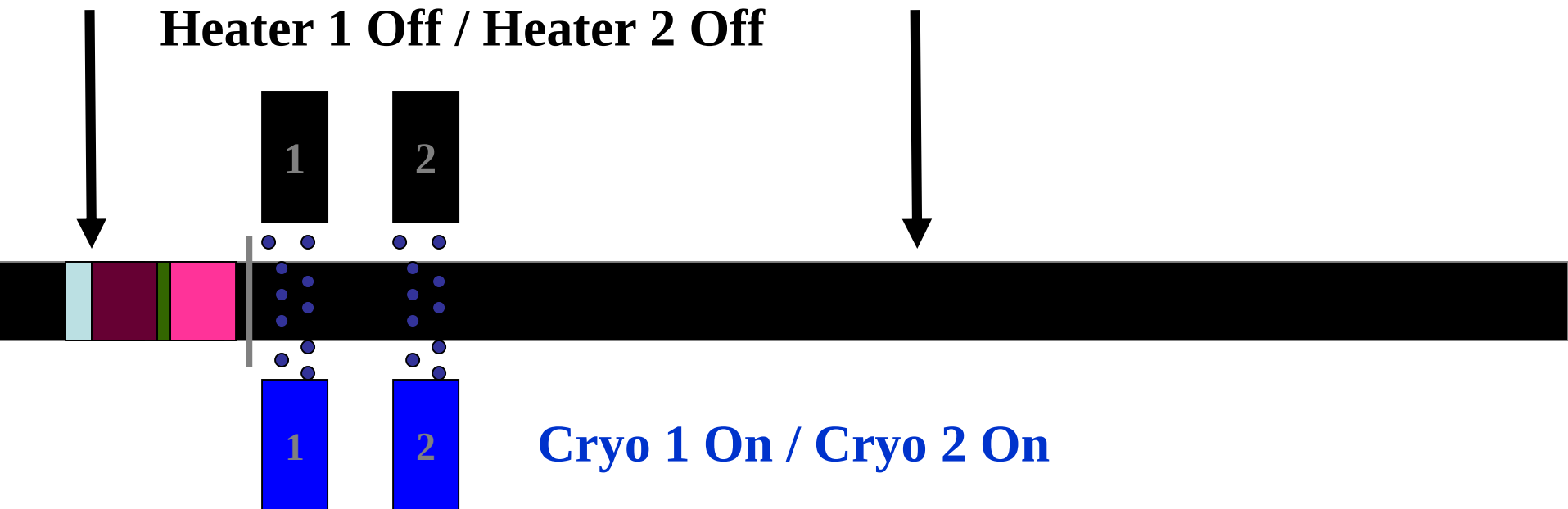


Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



Modulation phase 1: partial separation on column 1

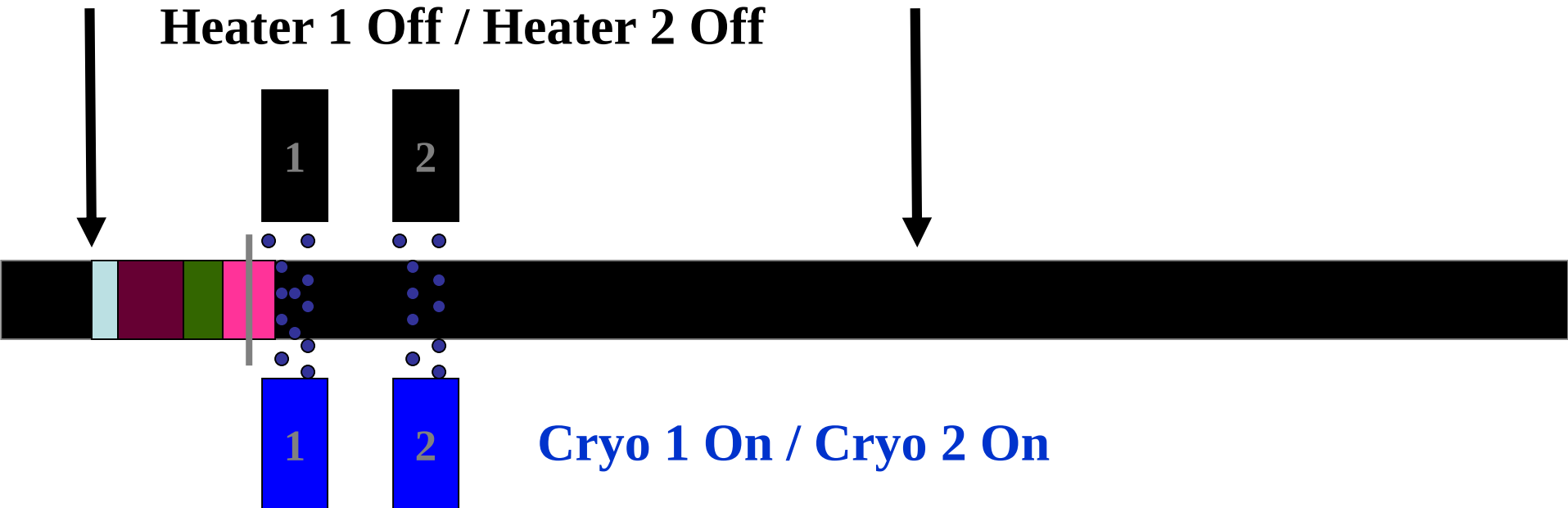


Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



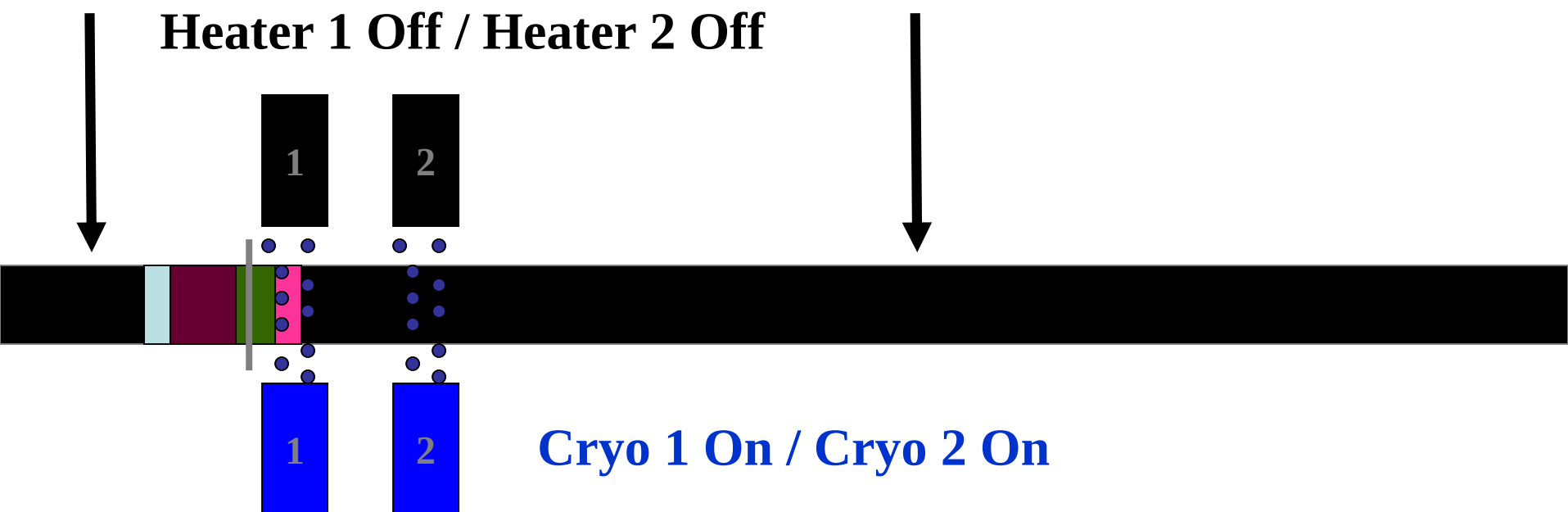
Modulation phase 2: analytes are trapped in part 1

Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



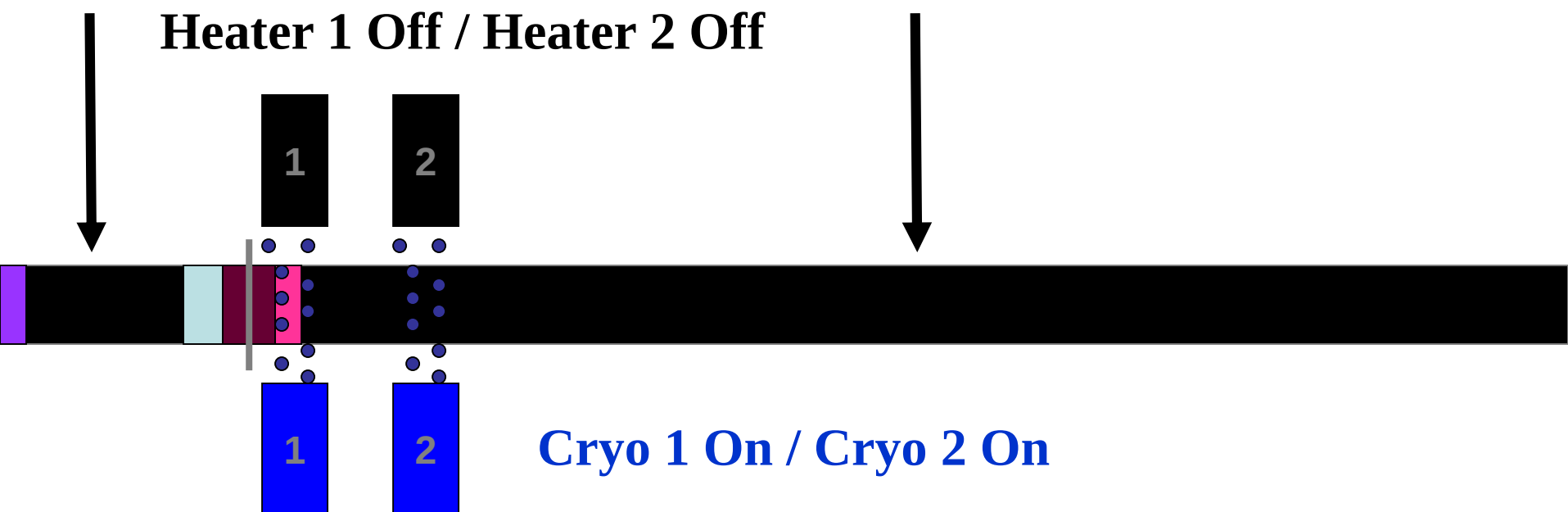
Modulation phase 2: analytes are trapped in part 1

Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



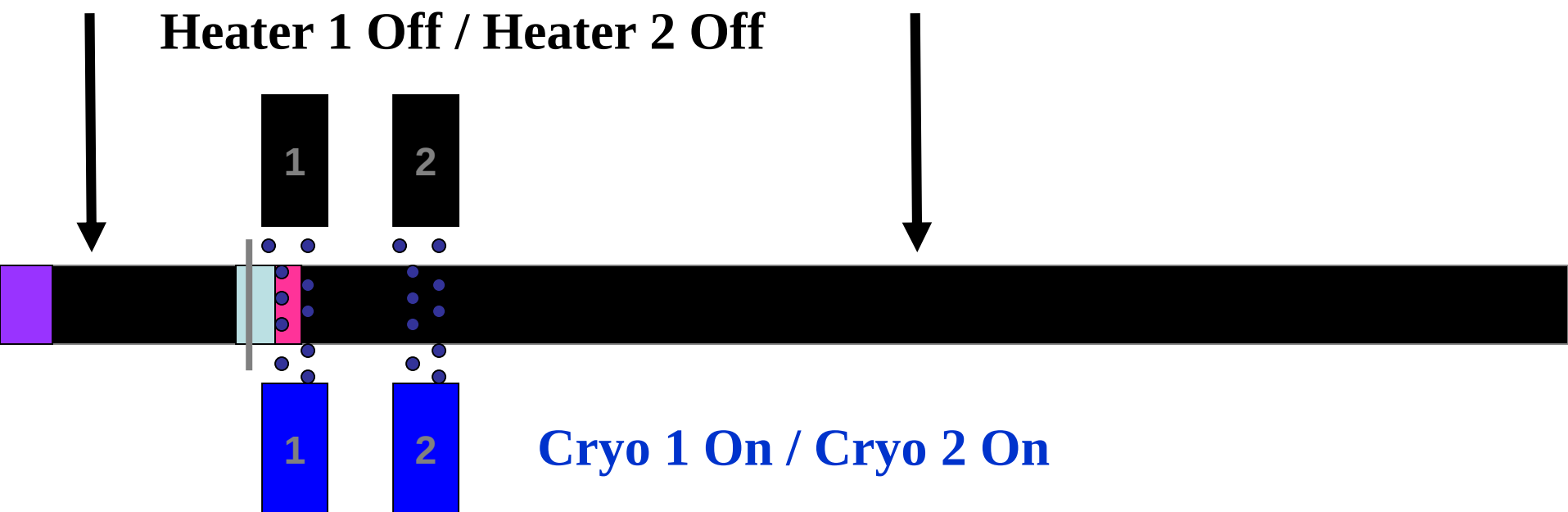
Modulation phase 2: analytes are trapped in part 1

Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



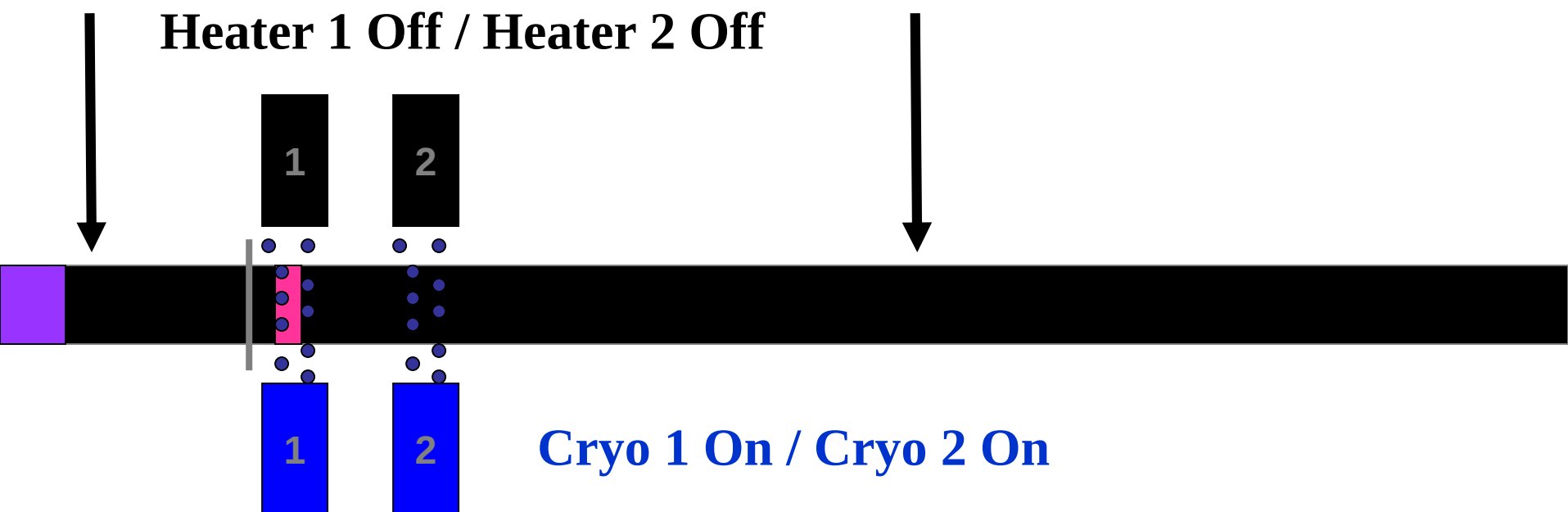
Modulation phase 2: analytes are trapped in part 1

Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



Modulation phase 2: analytes are trapped in part 1

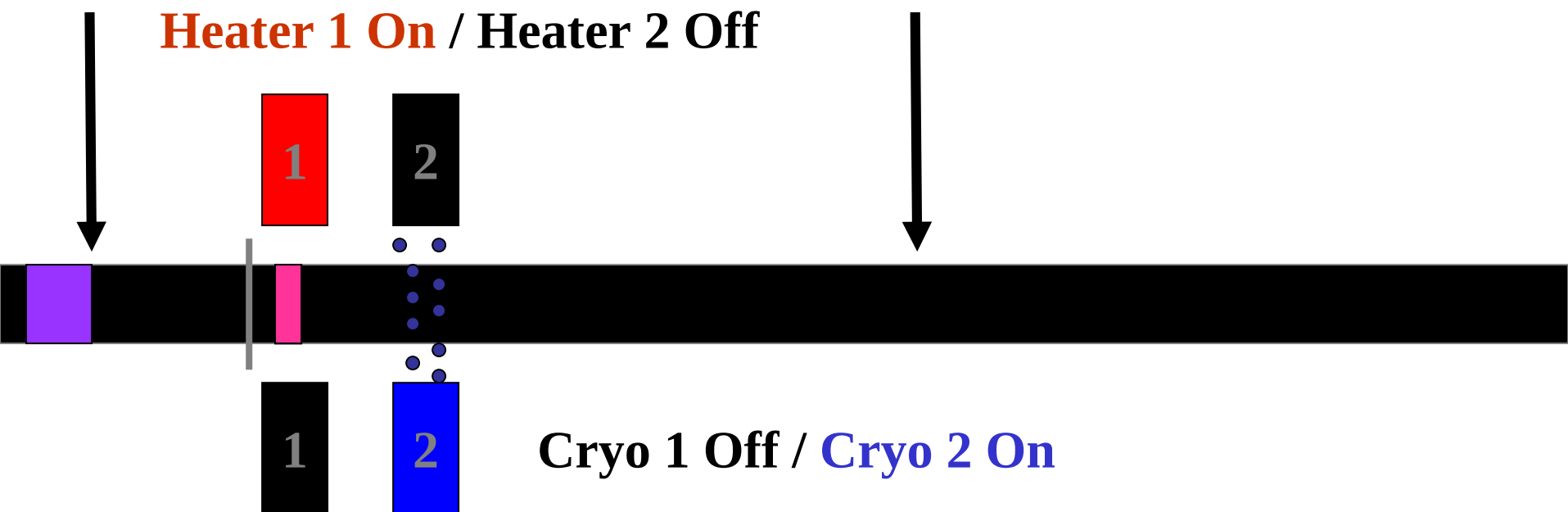


Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



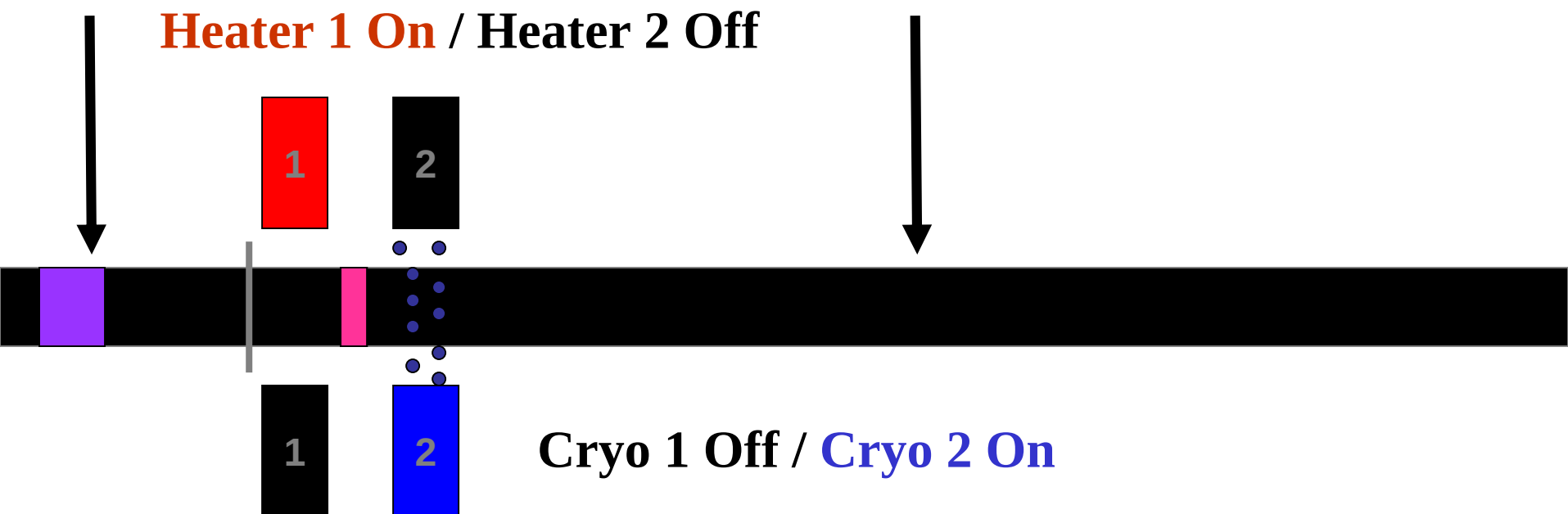
Modulation phase 3: analytes are released into part 2

Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



Modulation phase 3: analytes are released into part 2

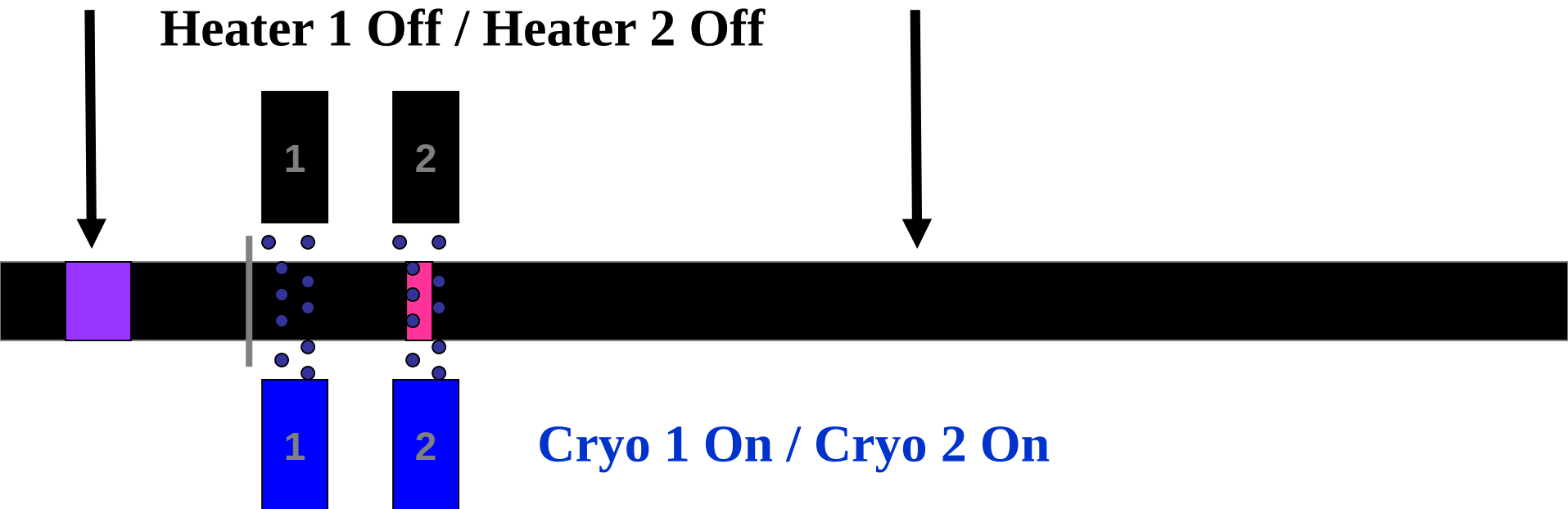


Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



Modulation phase 4: part 1 returns to trapping mode
Analytes trapped in part 2 are ready for release to column 2

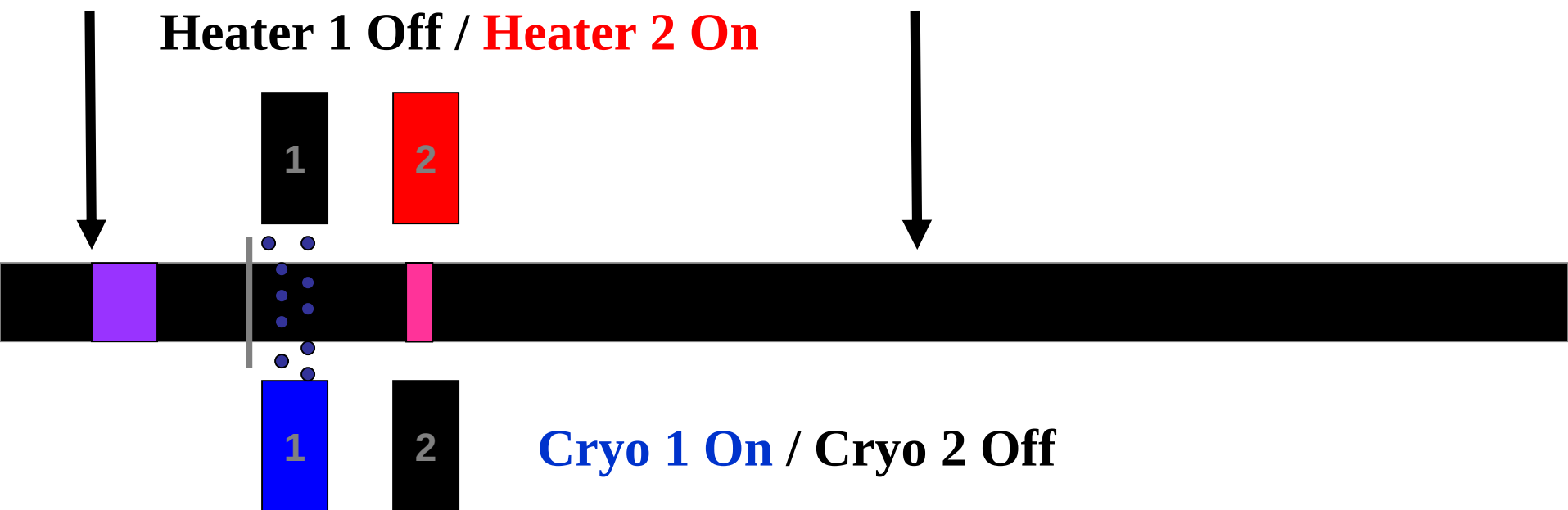


Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



Modulation phase 5: analytes are trapped in part 1
Analytes trapped in part 2 are released to column 2

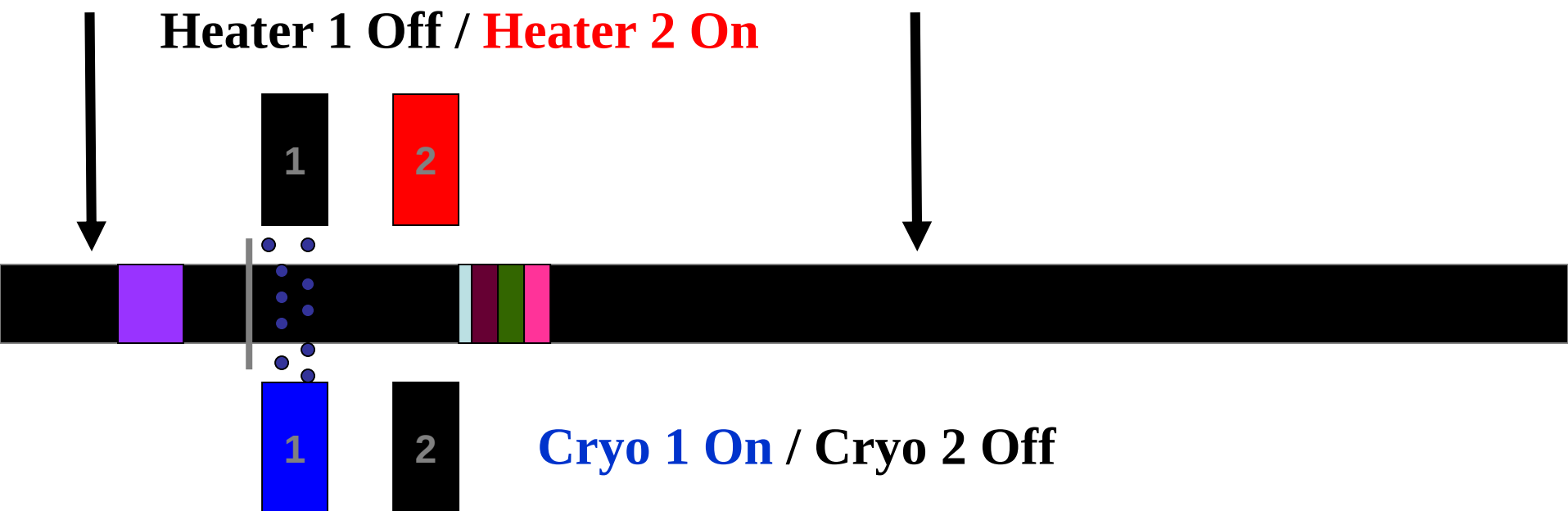


Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase



Modulation phase 5: analytes are trapped in part 1
Analytes are quickly separated on column 2

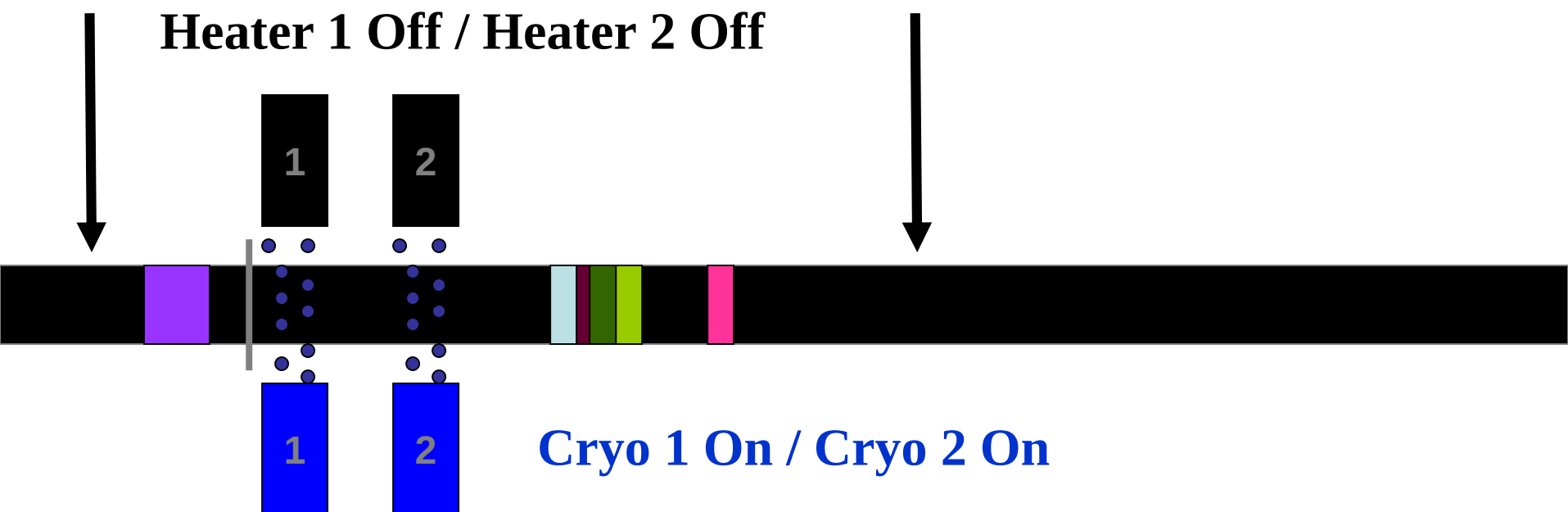


Comprehensive two-dimensional gas chromatography (GC x GC)

Principle of modulator function

Column 1: nonpolar phase

Column 2: polar phase

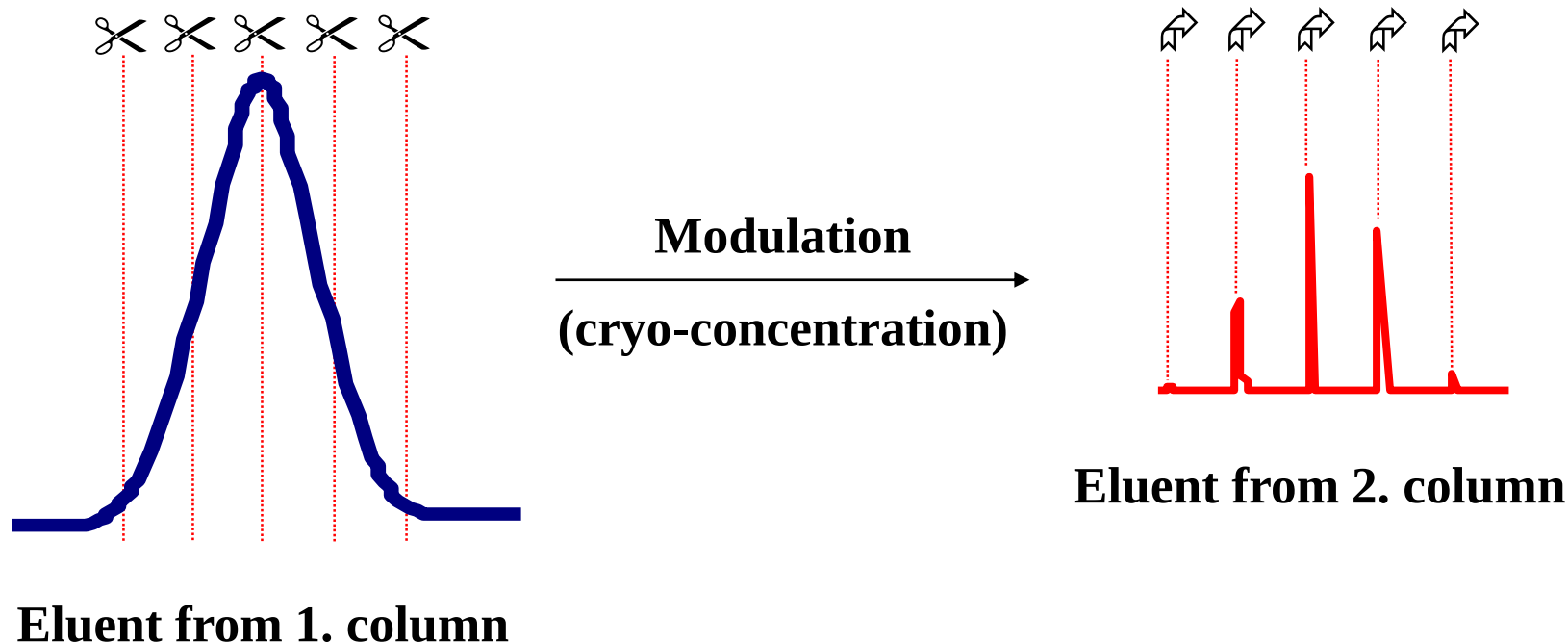


Modulation phase 6: analytes are trapped in part 1
Analytes are quickly separated on column 2

Comprehensive two-dimensional gas chromatography (GC x GC)

Modulator transfers part of eluent from 1. column in defined periods.

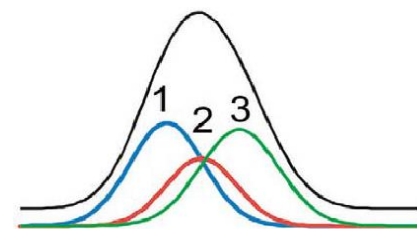
Cryogenically focused portions are transferred to 2. column, which is followed by fast separation on 2. column.



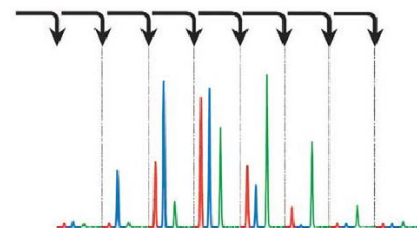
GC x GC - creation of chromatograms - various forms

1D chromatogram

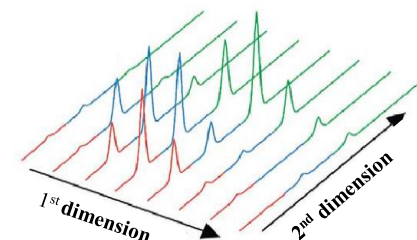
(1. column output)



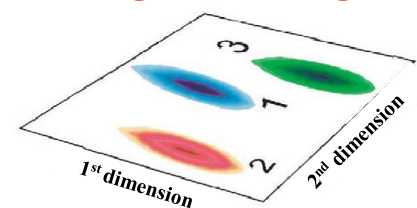
MODULATION



TRANSFORMATION



VIZUALIZATION



2D chromatogram basic

(2. column output)

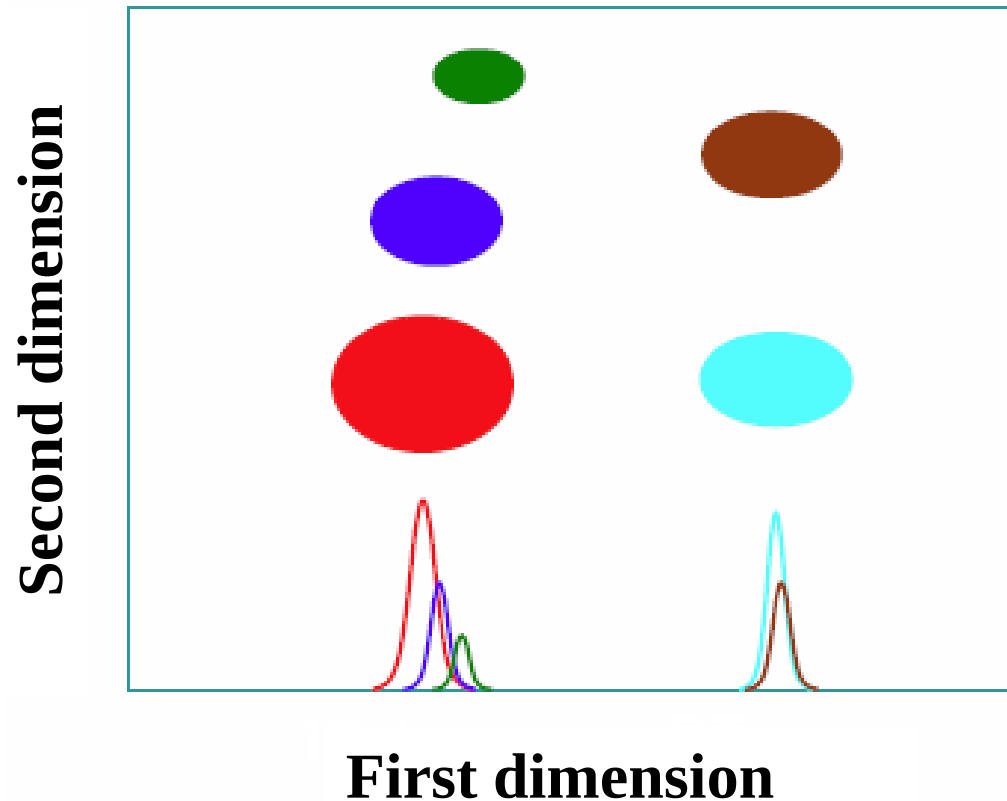
2D chromatograms composed in parallel

2D contour plot of chromatogram



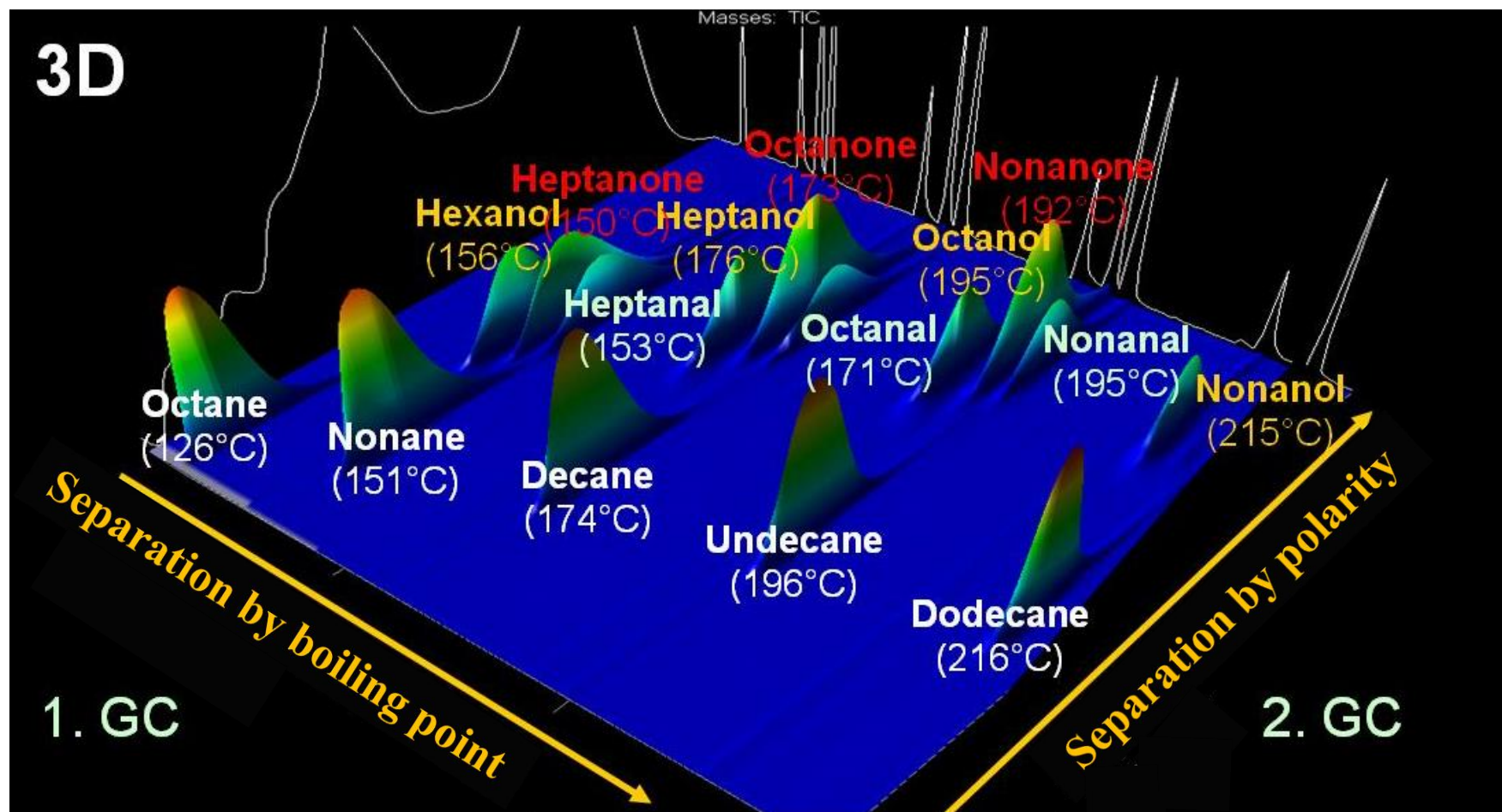
Comprehensive two-dimensional gas chromatography (GC x GC)

GC x GC - creation of chromatograms - various forms



Comprehensive two-dimensional gas chromatography (GC x GC)

GC x GC - creation of chromatograms - various forms



Comprehensive two-dimensional gas chromatography (GC x GC)

GC x GC - creation of chromatograms - various forms

