Universität Rostock Traditio et Innovatio

HelmholtzZentrum münchen
Deutsches Forschungszentrum für Gesundheit und Umwelt

JOINT MASS SPECTROMETRY CENTRE

Mass spectrometry applying soft photo-ionisation for real time characterisation of transients from flash pyrolysis of biomass

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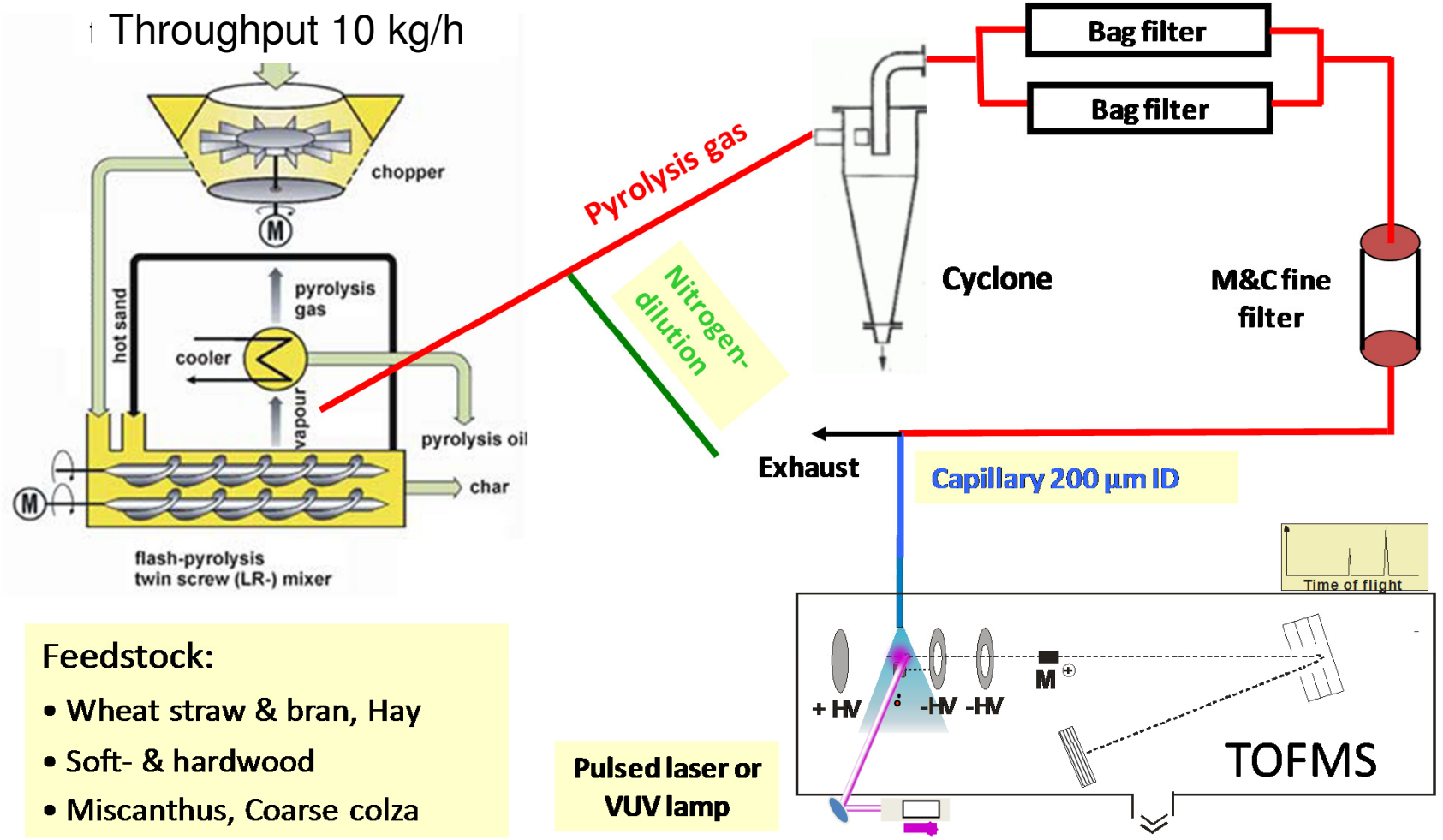
Intention and purpose for fast MS analysis in biomass pyrolysis

- Which species are present in pyrolysis gas prior to condensation?
- Does the composition of pyrolysis gas influence product quality?
- Is it feasible to employ real time methods for characterisation and even control of biomass pyrolysis?

- Selected application: Technical biomass pyrolysis facility at Karlsruhe Institute of Technology (first step of bioliq® process)
- Monitoring of gaseous pyrolysis products of a large variety of biomass (wood, straw, rapeseed residue, corn cob, Miscanthus, palm frond etc.)

Experimental setup



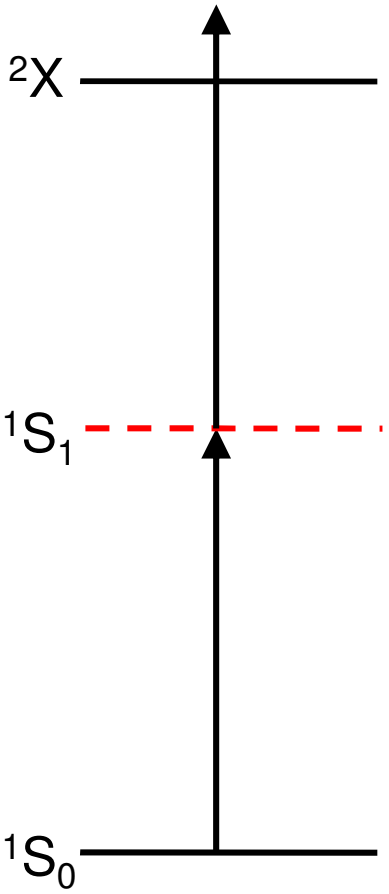
Feedstock:

- Wheat straw & bran, Hay
- Soft- & hardwood
- Miscanthus, Coarse colza

Scheme of the on-line process analysis

Ionisation by absorption of two UV-photons

- Resonance Enhanced Multiphoton Ionisation (REMPI)



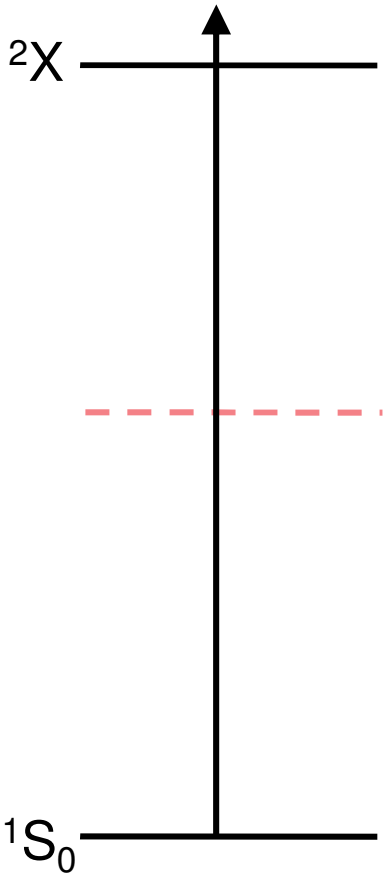
Resonance Enhanced Multiphoton Ionisation:

- Photon-Energy 4 - 6 eV

- Selective and sensitive ionisation of (poly)aromatic compounds

Ionisation by absorption of one VUV-photon

- Single photon ionisation (SPI)



Single Photon Ionisation:

- Photon energy 8 - 11 eV
- „General“ ionisation of organic compounds

VUV- und UV- photon sources

Laser generated UV-photons

- **Nd:YAG Laser (266 nm)**

• compact
• high energy density

Pulsed ionisation

Lamp generated VUV-photons

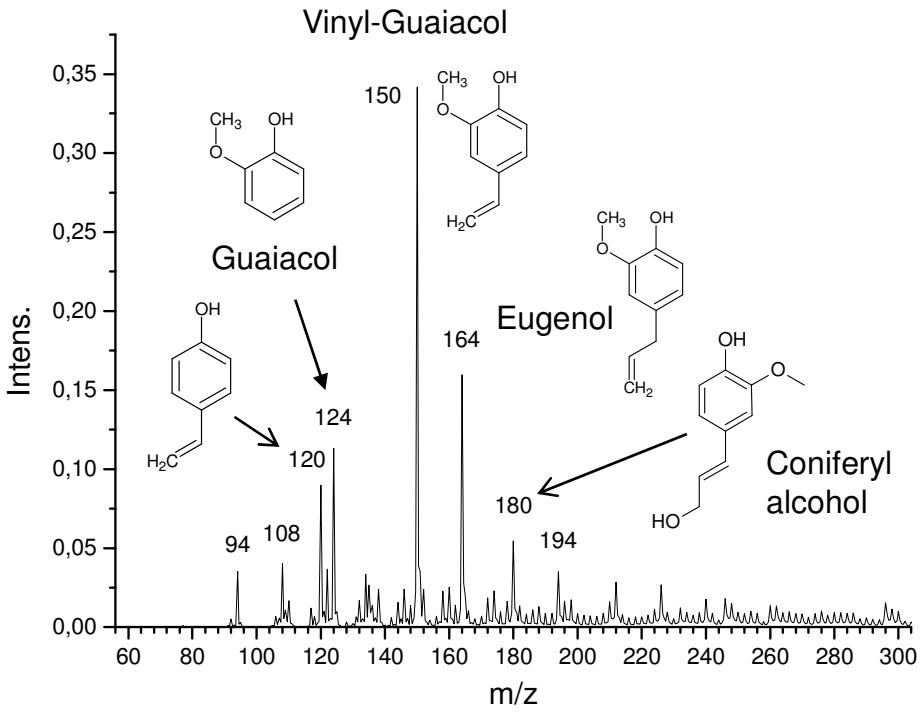
- **Electron beam pumped rare gas excimer lamp (EBEL)**

• brilliant light source
• high photon yield
• robust and easy to operate

Continous ionisation

Flash pyrolysis of wheat straw

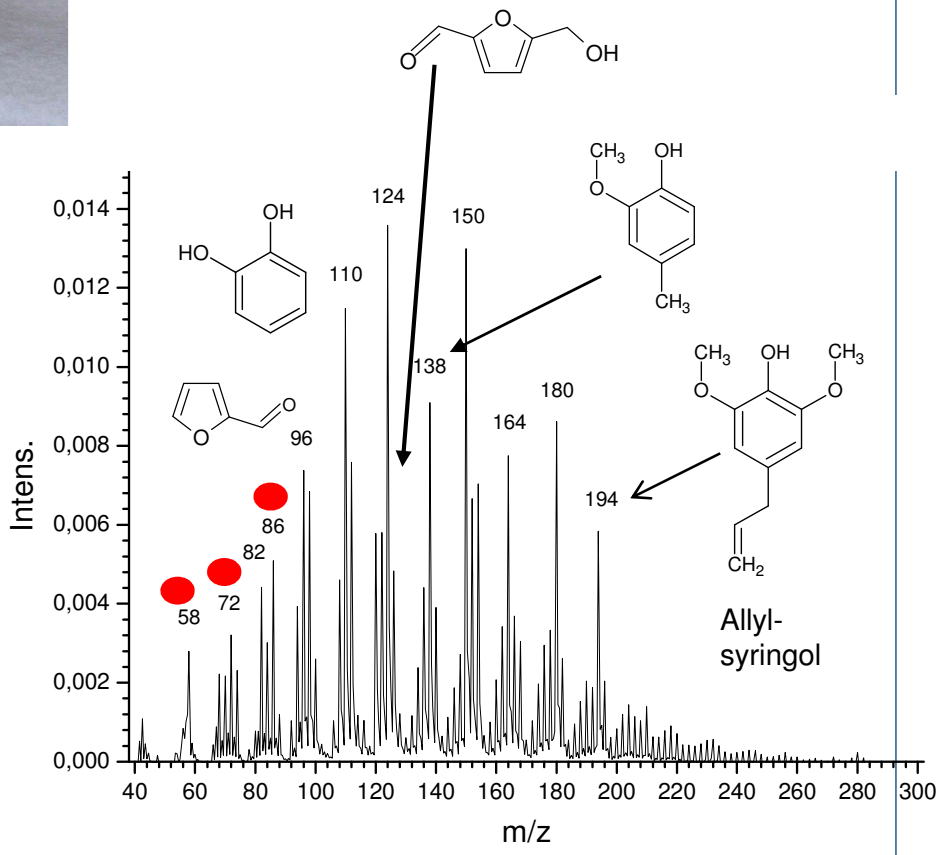
REMPI-MS



Phenol derivatives (from lignin)

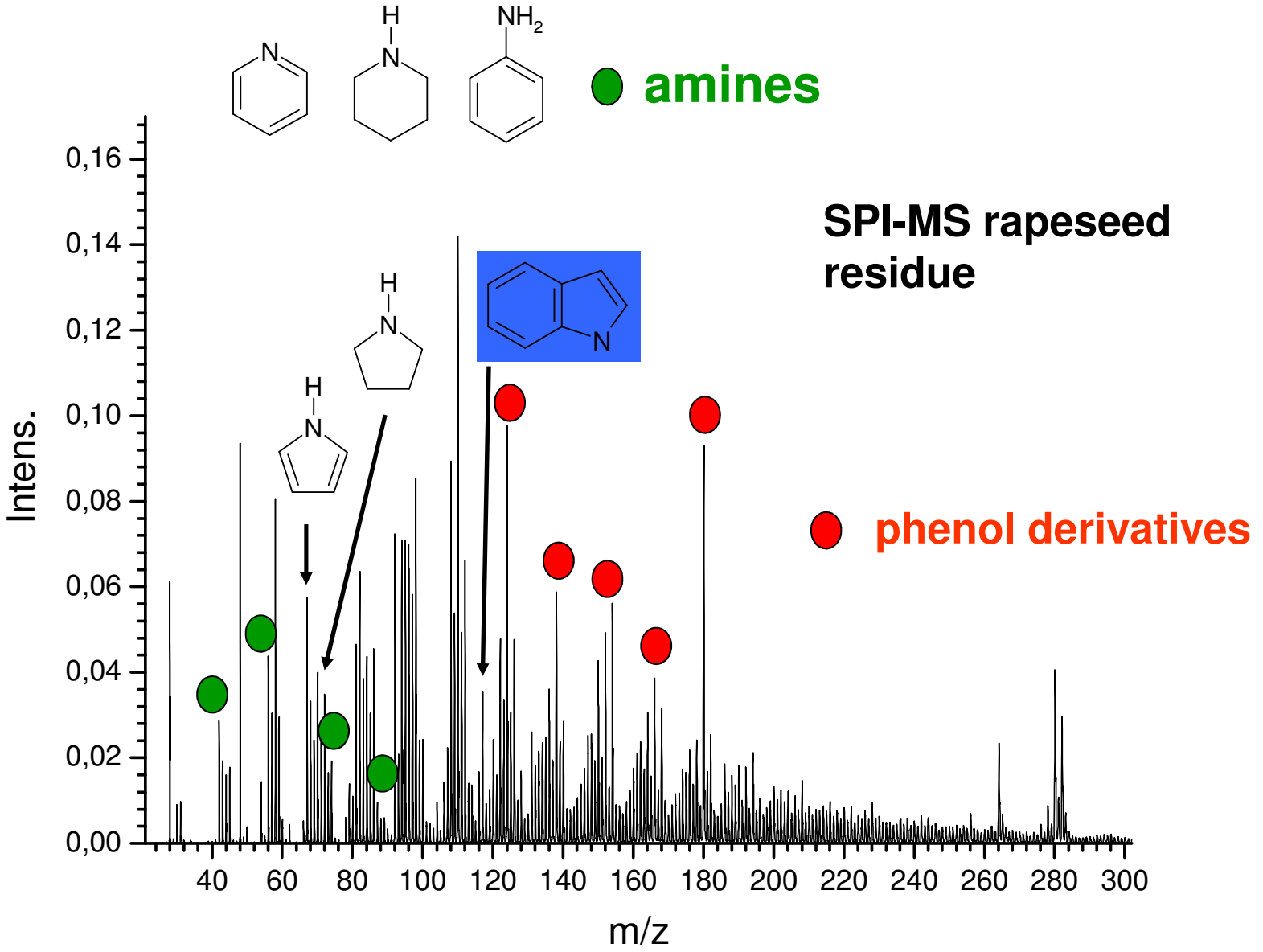
SPI-MS

● Ketons/Aldehydes



In addition furan derivatives (from cellulose)

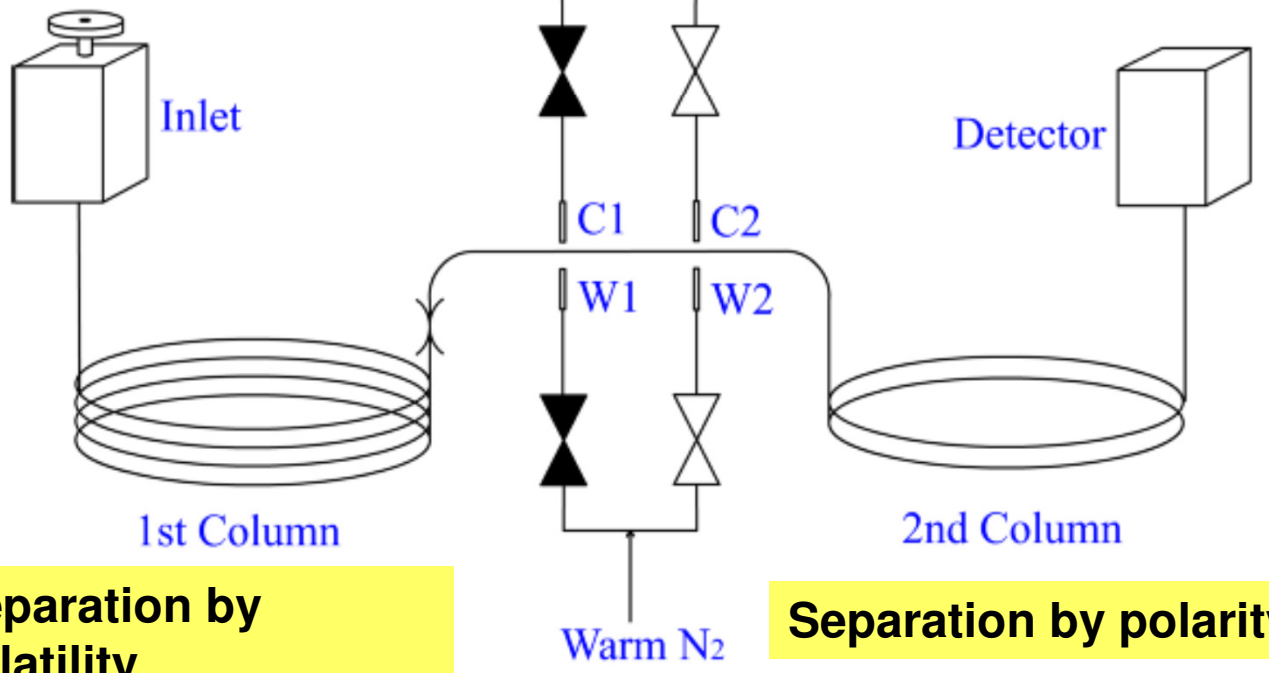
Flash pyrolysis of rapeseed residue



Current status and future work

- On-line PI-MS succesfully adapted and applied for detection of gaseous biomass pyrolysis products
- Correlation of on-line data with respective composition of bio-oil and/or tar
- Analysis of these condensation products imaginable by
  - Pyrolysis combined with GCxPI-MS or GC-MS or PI-MS
  - Comprehensive two-dimensional GCxGC
  - High resolution mass spectrometry

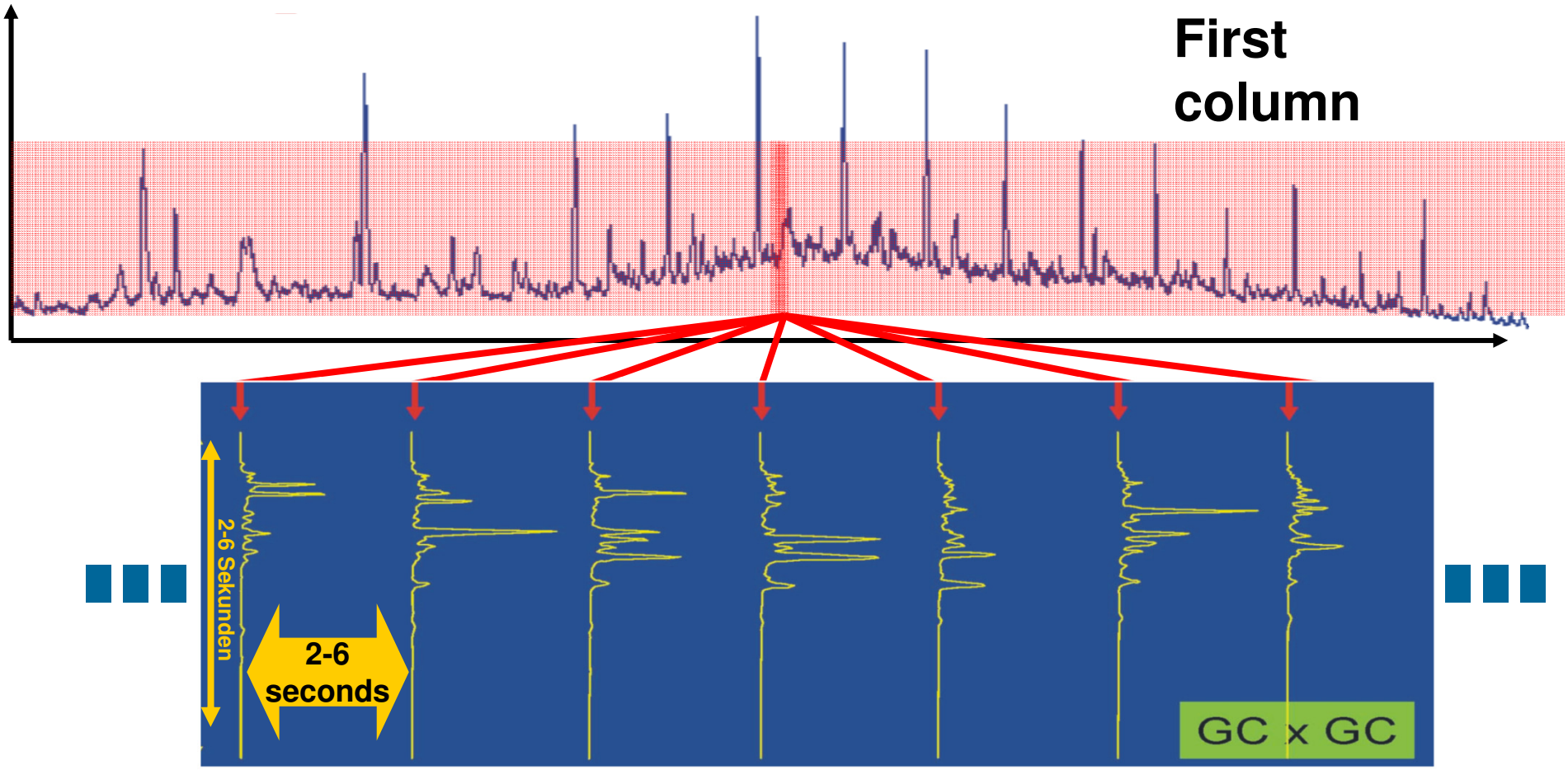
GCxGC



Modulator for separation of fractions

Separation by volatility

Separation by polarity


First
column
2-6 Sekunden
2-6
seconds
GC x GC
Second
column