



NEW PERSPECTIVES IN PERFORMING LONG SERIES OF CAPILLARY ELECTROPHORESIS ANALYSES USING STREAMING POTENTIAL CONTROL

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CAPILLARY ELECTROPHORESIS SYSTEM

CAPEL-205

- Pharmacological industry
 - medicines formulations,
 - pharmacokinetics
- Environmental analysis
 - pesticides, inorganic ions
- Food industry
 - preservatives, dyes, target compounds, beverages, etc.
- Forensic studies
 - drugs of abuse, explosives,
 - lethal markers, etc.
- Chemical industry
- Biotechnological research
 - peptides, proteins, DNA / RNA,
 - affinity studies, immunoanalyses

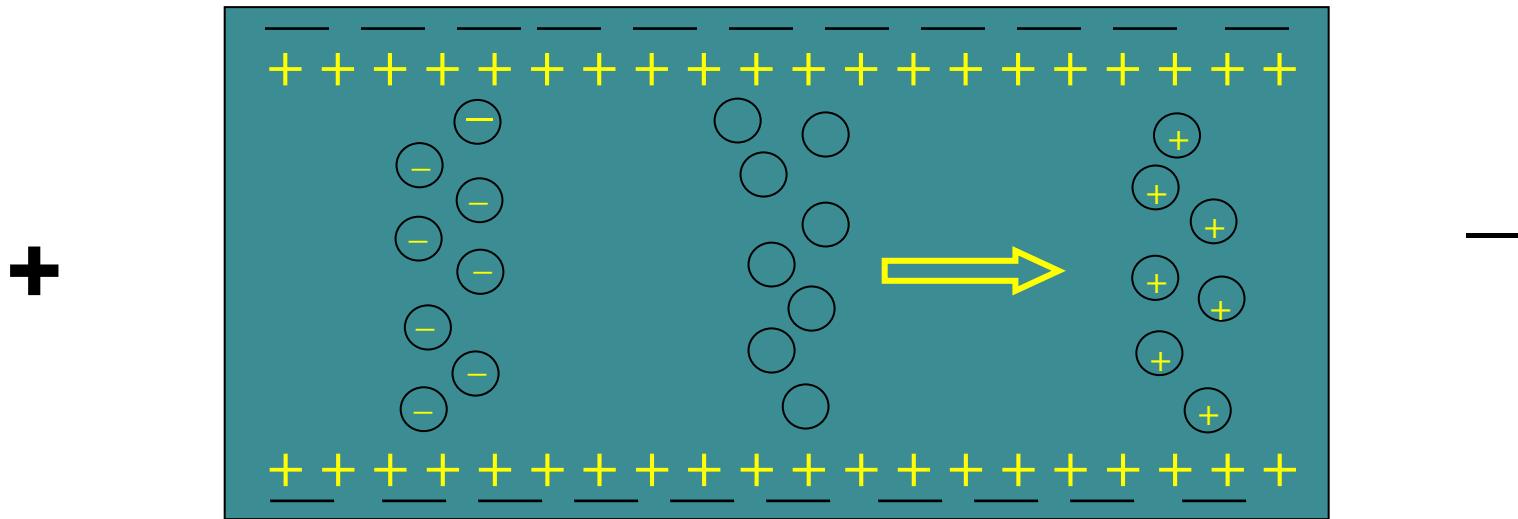


MIGRATION TIME STABILITY IN CE

- Migration time stability is one of the most important parameters in CE, especially in long series of analyses
- The state of the inner capillary surface (ζ - potential) defines the migration time stability
- The inner capillary surface is typically conditioned by the long rinsing steps without any control of the results

=> It is necessary to have an objective control of the state of the capillary surface before each analysis

ELECTROOSMOTIC FLOW (EOF)

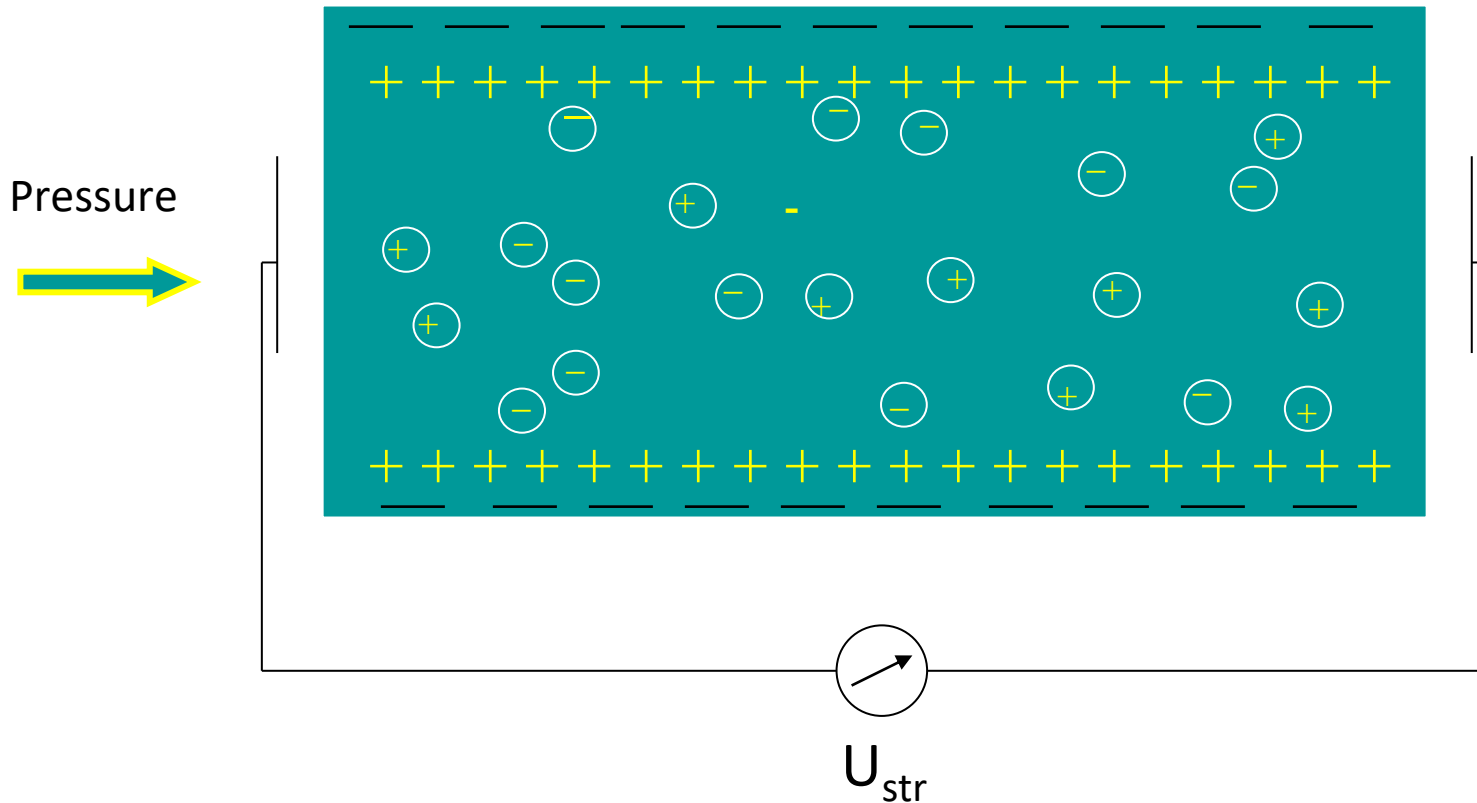


pH > 3.0

Both anions and cations can be analyzed in one run

STREAMING POTENTIAL (SP)

Quincke, 1857



SP appears when electrolyte is pressed through a fused silica capillary

WHY DO WE NEED TO MEASURE USTR ?

Helmholtz-Smoluchovski eq.

$$U_{str} = P\varepsilon\zeta / 4\pi\eta\chi$$

P - applied pressure,
 ε - dielectric constant,
 ζ - zeta-potential of the surface,
 η - solution viscosity,
 χ - solution conductivity

$$U_{str} \sim U_{EOF}$$

$$T_{mig} \sim U_{EOF}; \mu_{elf}$$

Under identical CE conditions, EOF velocity is the only parameter which influences migration reproducibility

Idea: monitor capillary surface conditions by measuring U_{str}

HOW TO IMPLEMENT SP MEASUREMENT IN A COMMERCIAL CE INSTRUMENT

Hardware:

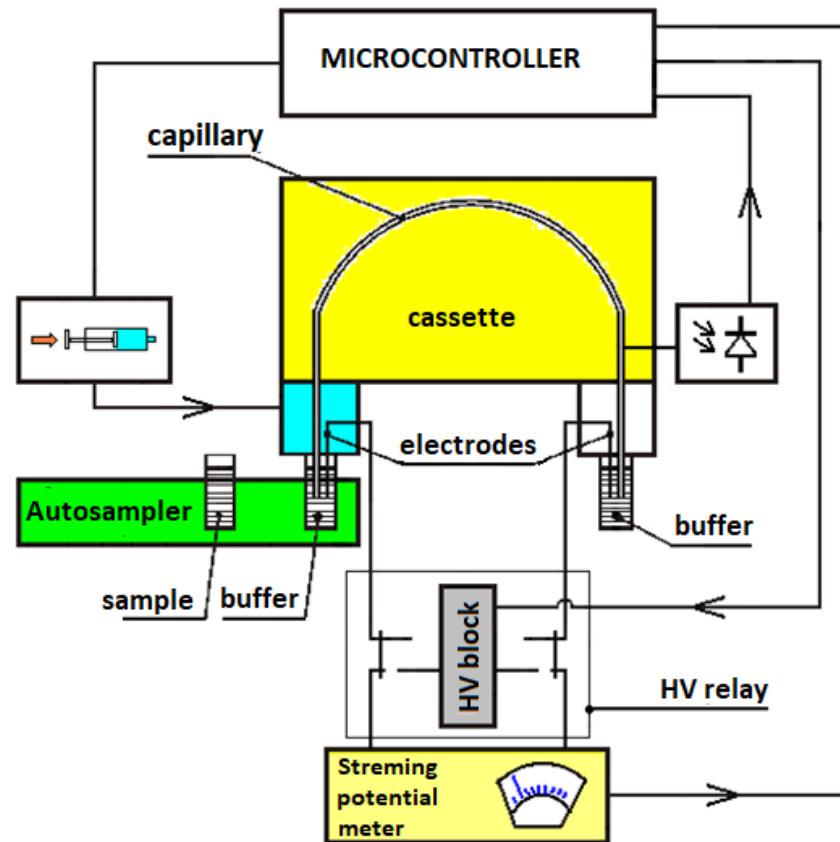
- Differential amplifier
- Relays

Software:

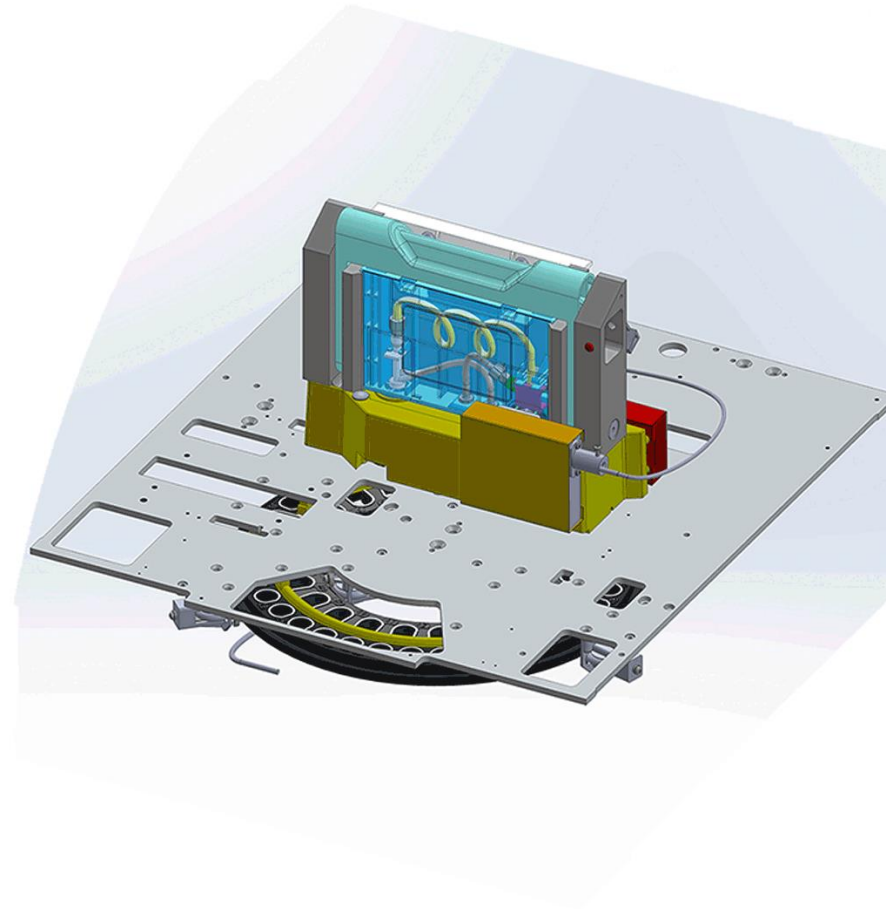
- Exemplary U_{str} is determined for “clean” capillary and saved in the memory
- Capillary rinse runs till the saved U_{str} value is achieved



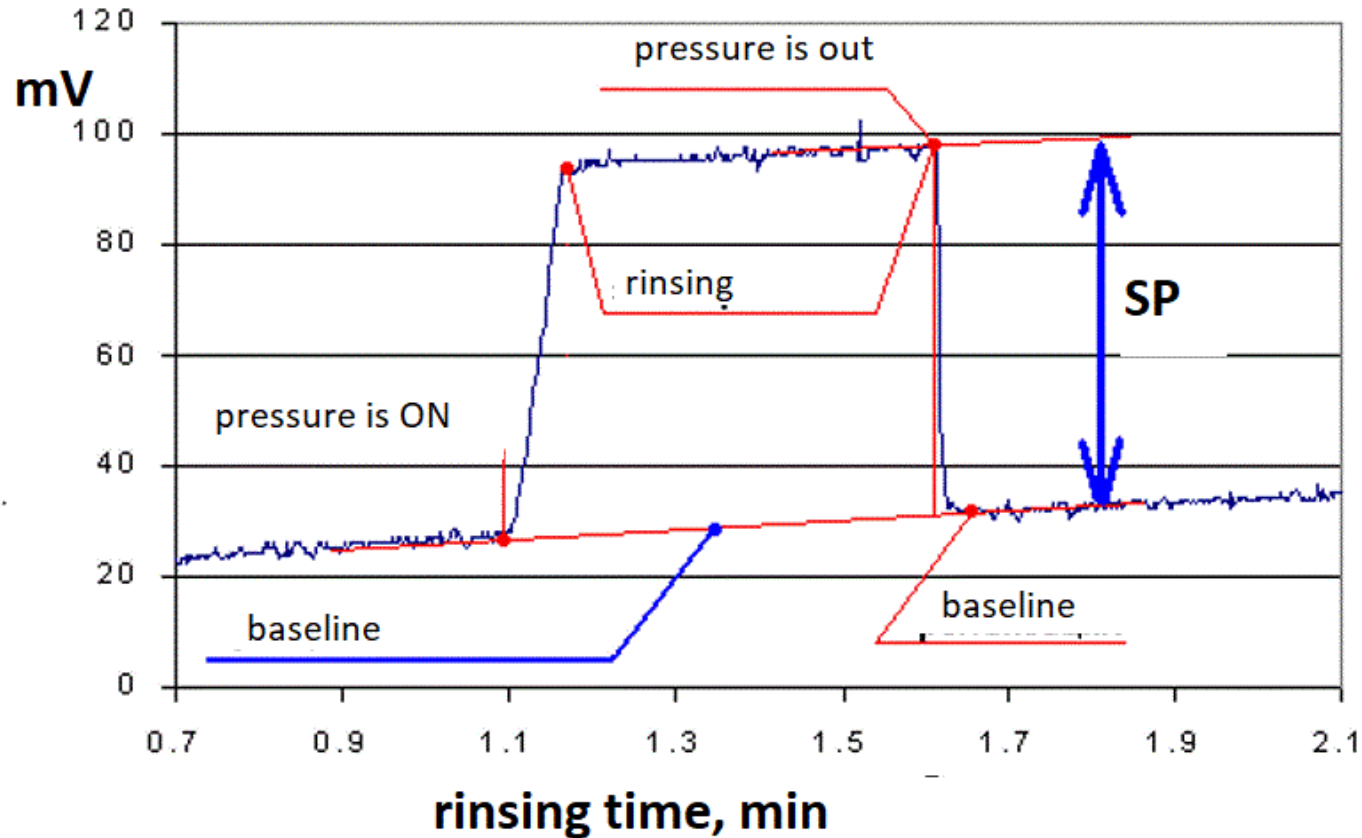
HARDWARE: INSTRUMENTAL DESIGN



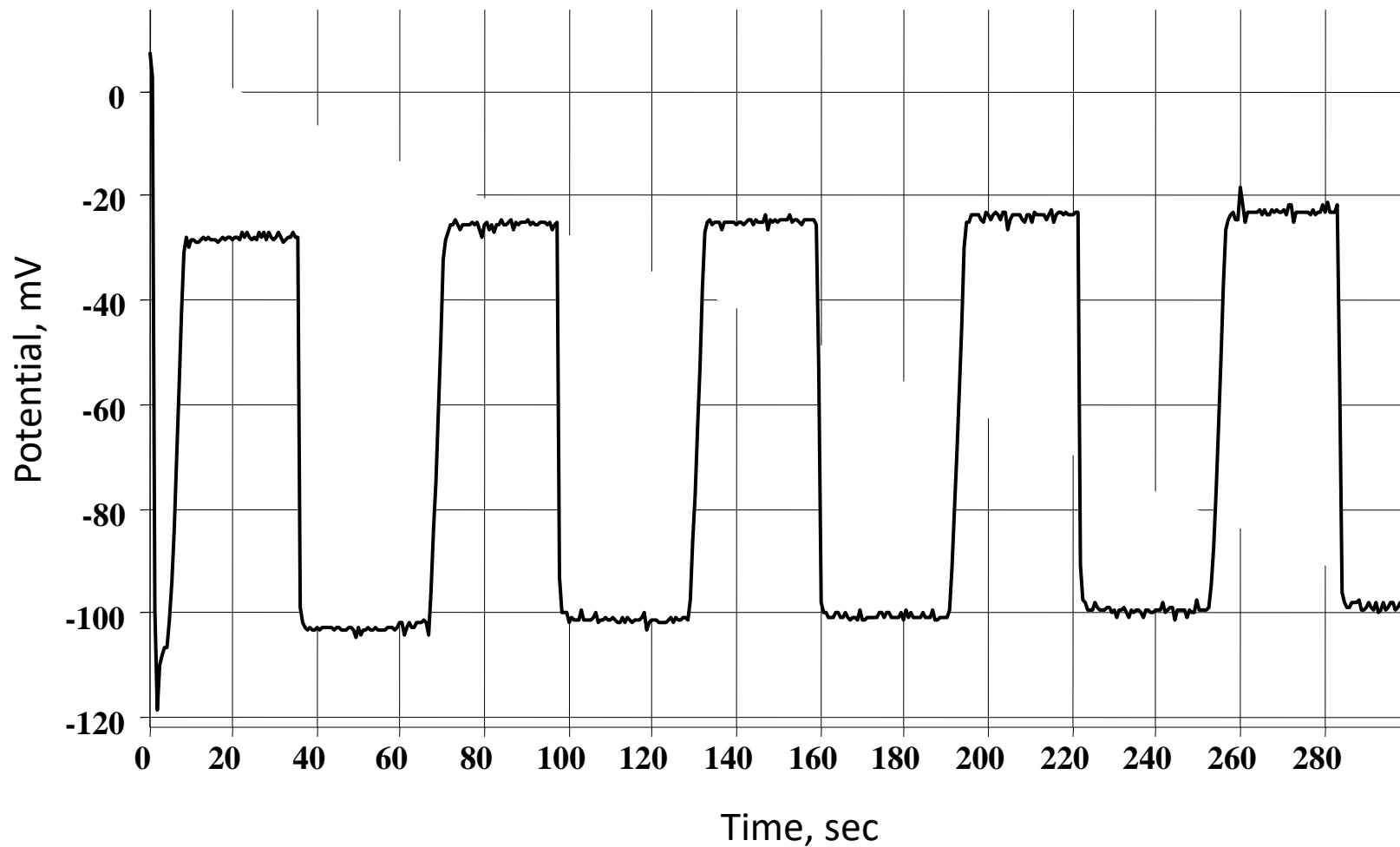
CE SYSTEM: INSTRUMENT DESIGN



STREAMING POTENTIAL MEASUREMENT



SERIES OF SP MEASUREMENTS



STREAMING POTENTIAL MEASUREMENT. IMPLEMENTATION IN THE SOFTWARE


- Capillary is thoroughly rinsed and “exemplary” SP value is measured and saved
- SP is measured after the next (analysis + rinse) and compared with the exemplary value
- Software decides what to do according to the comparison results and a pre-set scheme

SOFTWARE DESIGN

Program: G:\Lumex\Elforun 205\Elforun205\IQ-test\IQ.prg

Operation	Parameters	Cycle	Inlet	Outlet	Time	Pressure	Voltage	Wave length	Temp.	Status
<input checked="" type="checkbox"/> Rinse with SP control		1								Done
Cycle	<input checked="" type="checkbox"/>									
Operation type	Measurement									
SP exemplary value, mV	80.4									
Threshold max, %	95									
Threshold min, %	90									
Measurement of SP, iterations	5									
Time of filling	1									
Inlet, rinse	3									
Inlet, Dip	2									
Inlet, SP	4									
Outlet, rinse	36									
Outlet, Dip	38									
Outlet, SP	37									
Up outlet vial	<input checked="" type="checkbox"/>									
Main, time	1									
Additional, number	5									
Additional, time	1									
Intensive	<input checked="" type="checkbox"/>									
Reagent, Inlet	1									
Reagent, time	2									
Water, left	2									

Elforun. Capel N 1455

 Rinse is successfully finished.
Value SP = 81.32 mV (101.14% from limit value).

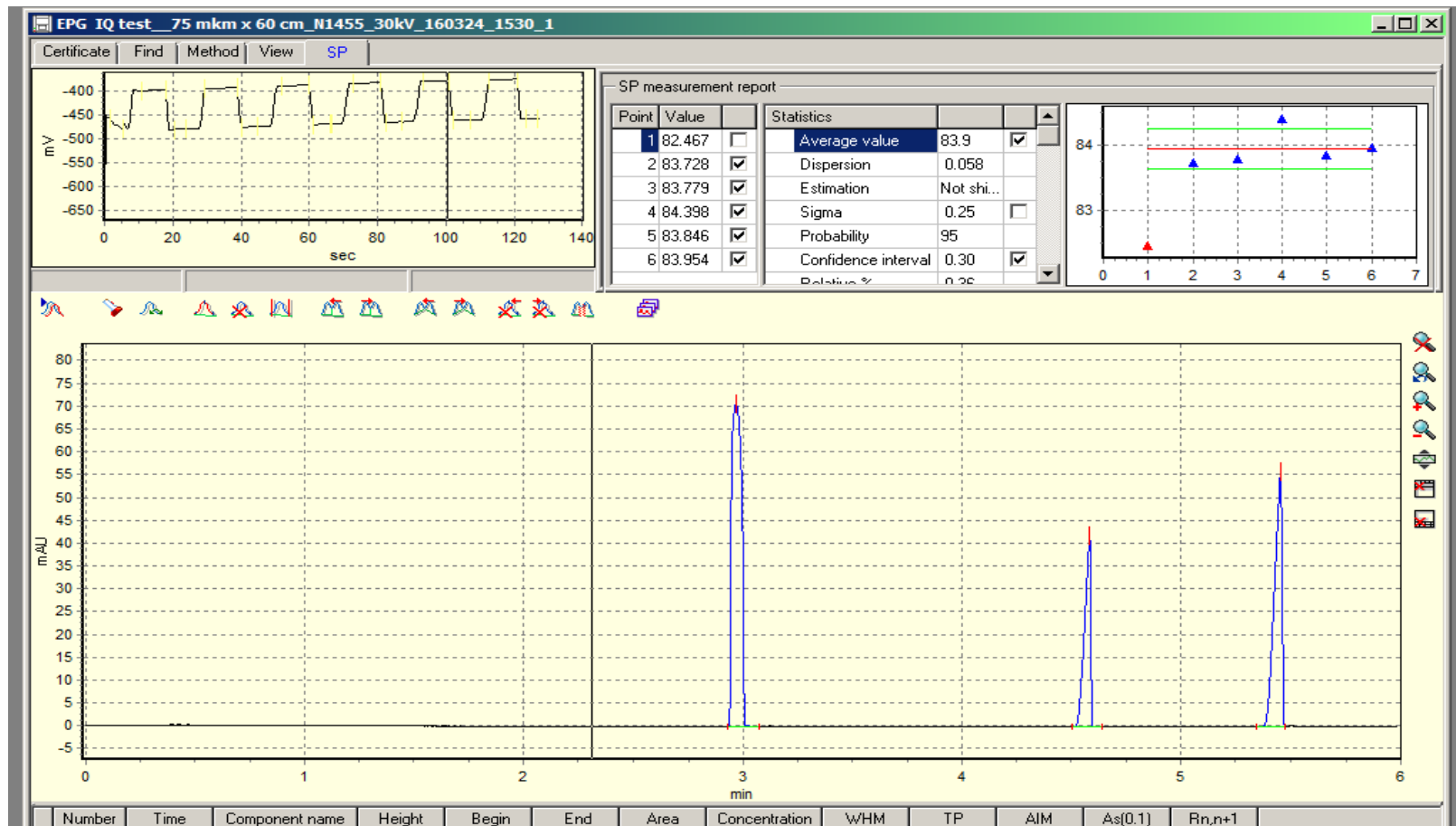
OK

Operations

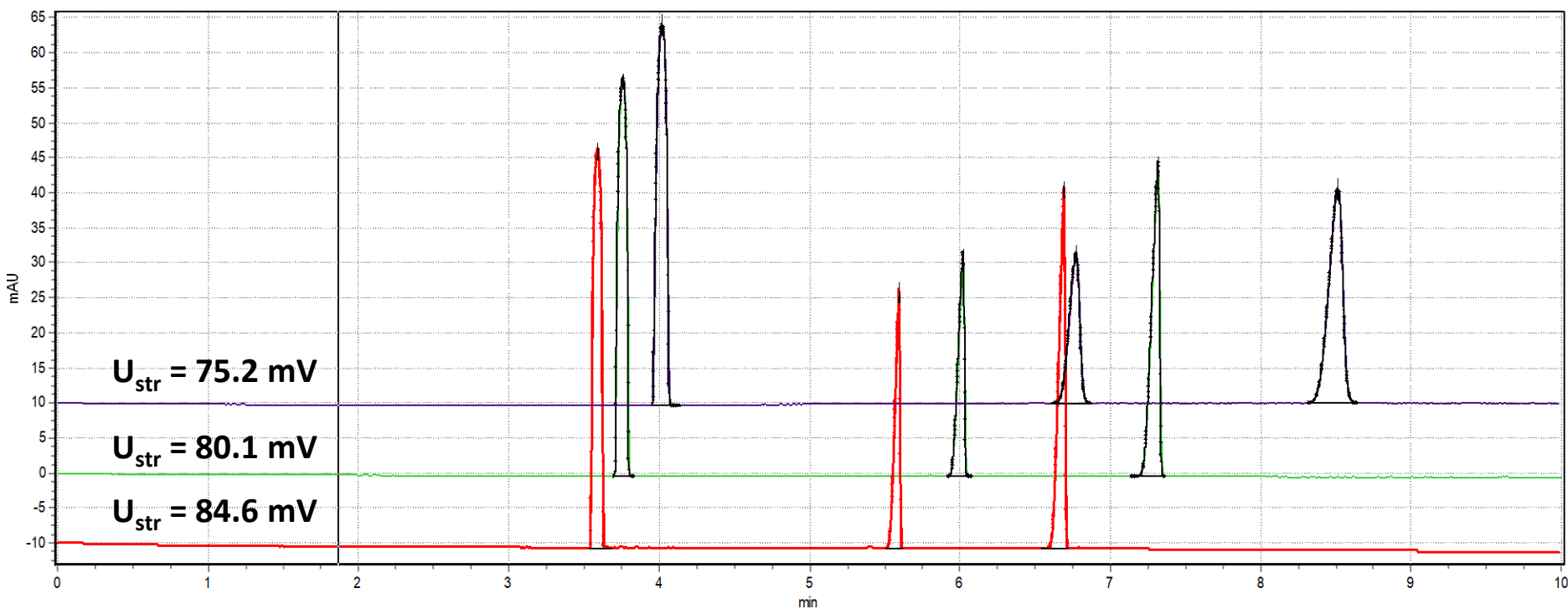
- Temperature
- Wave length
- Rinse
- Rinse with SP
- Injection
- Sweeping
- Analysis Stage
- Autosampler
- Cycle end
- Pause
- Delete
- Clear
- Save
- Load
- Show all
- Close all
- To end

Run Close

SOFTWARE DESIGN: STANDARD EOF DIRECTION

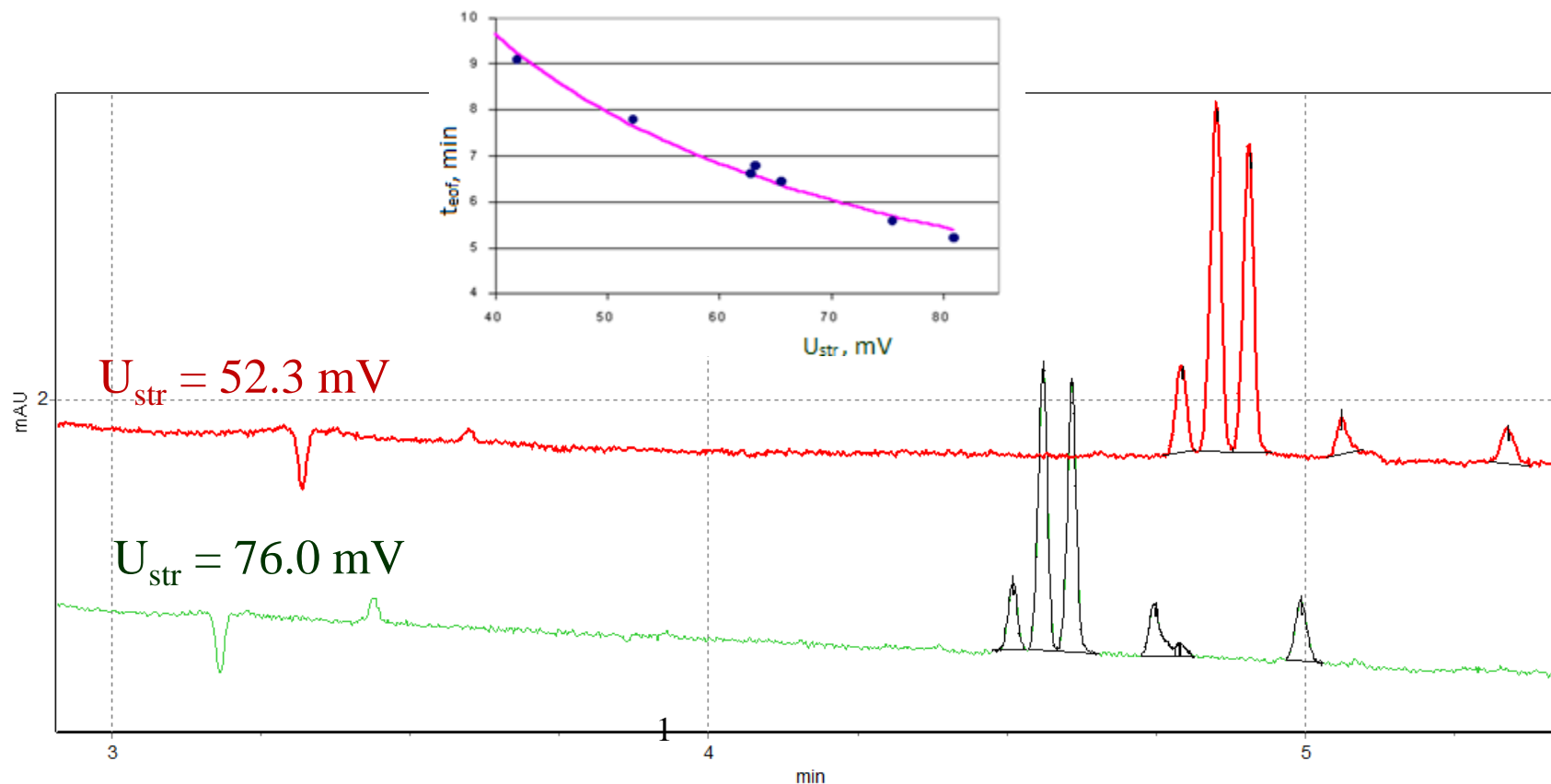


CE SEPARATION OF IQ STANDARD UNDER DIFFERENT SP VALUES



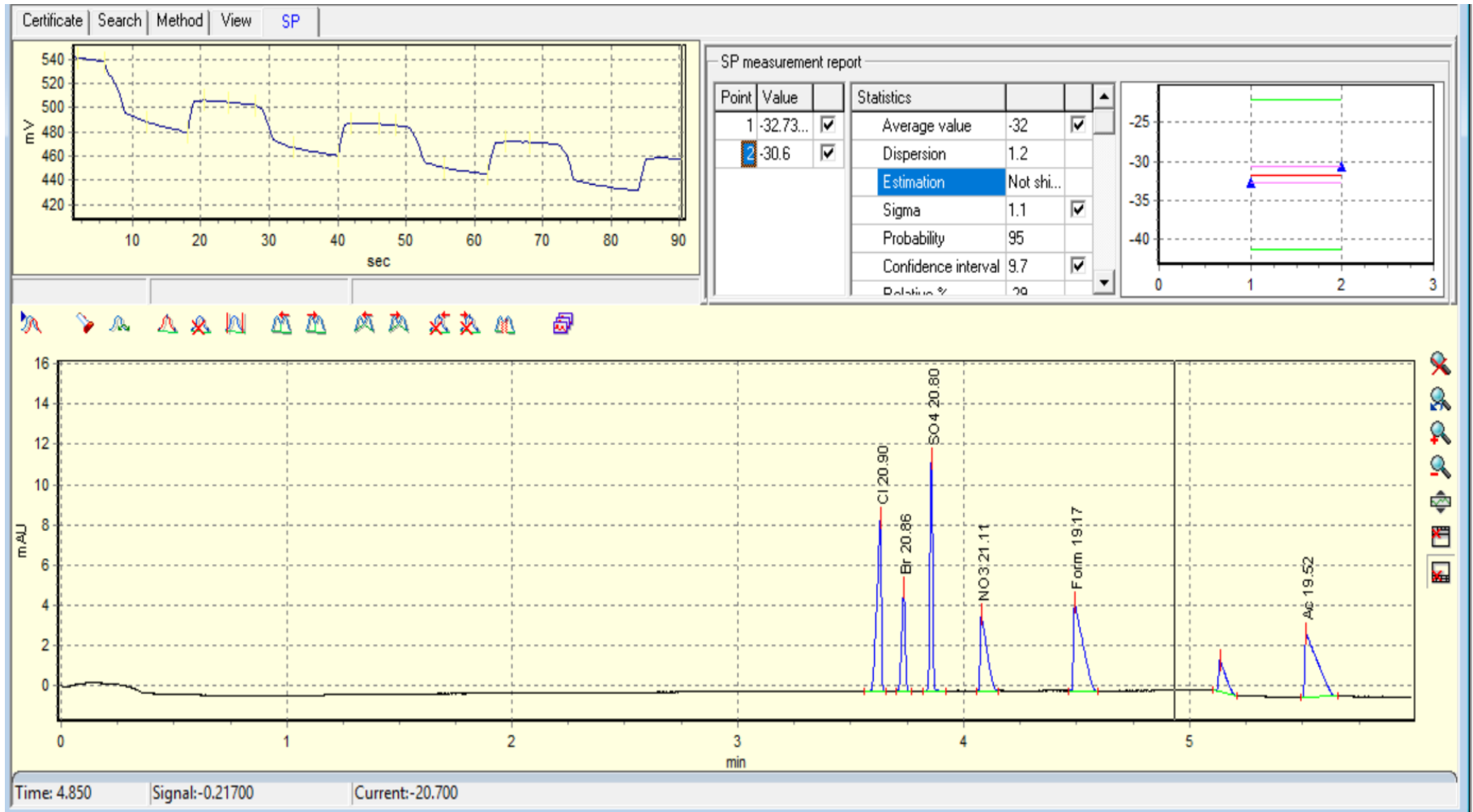
Sample: benzyl alcohol, benzoic acid, phenylantranilic acid

CE SEPARATIONS OF WINE SAMPLES AT DIFFERENT STREAMING POTENTIALS



Determination of organic acids in red wine

SOFTWARE DESIGN: REVERSED EOF



WHERE THIS CAN BE USED



For the fundamental research

- ζ -potential determination
- New coating design
- System peaks predictions
- EOF and ELF behavior predictions...



For the routine analyses

- Save the long sequence of analyses if the capillary is contaminated after any run
- Improve run-to-run MT reproducibility
- Develop new analytical protocols...

CONCLUSIONS

- ✓ Measuring U_{str} enables increasing run-to-run reproducibility
- ✓ U_{str} allows a decrease in rinsing time
- ✓ On-line control of capillary surface quality before CE analysis
- ✓ U_{str} can be measured very fast and gives information on the existing EOF even when it is strongly suppressed