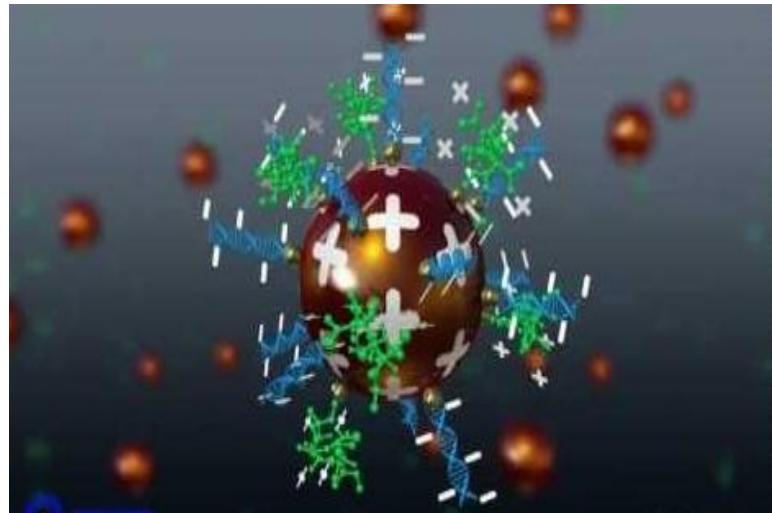




WALLIS - Zeta Potential Analyzer

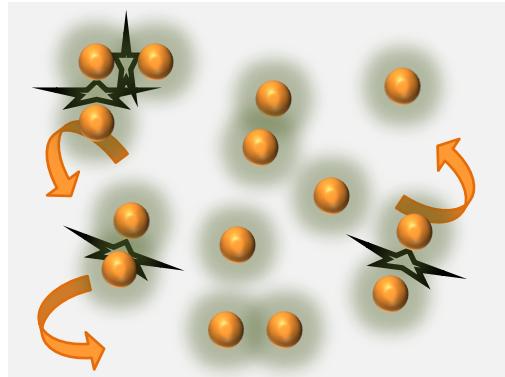


*An introduction to electrophoresis principle
for particle charge measurements*





Why measuring Zeta potential?

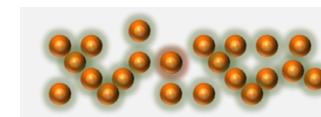


Charged particles
repel each other

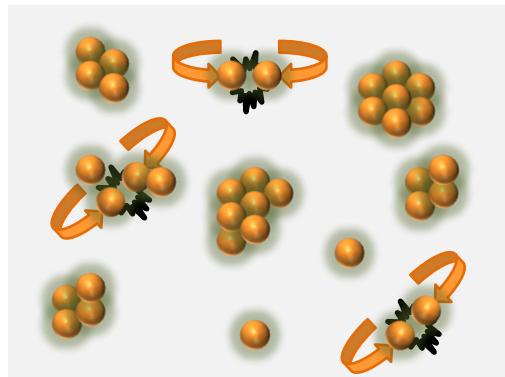
Colloidal solution stability ?



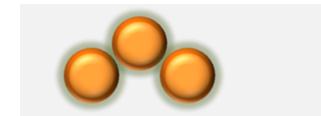
Stable systems



Flocculations



Uncharged particles
are free to collide and
aggregate



Coagulation



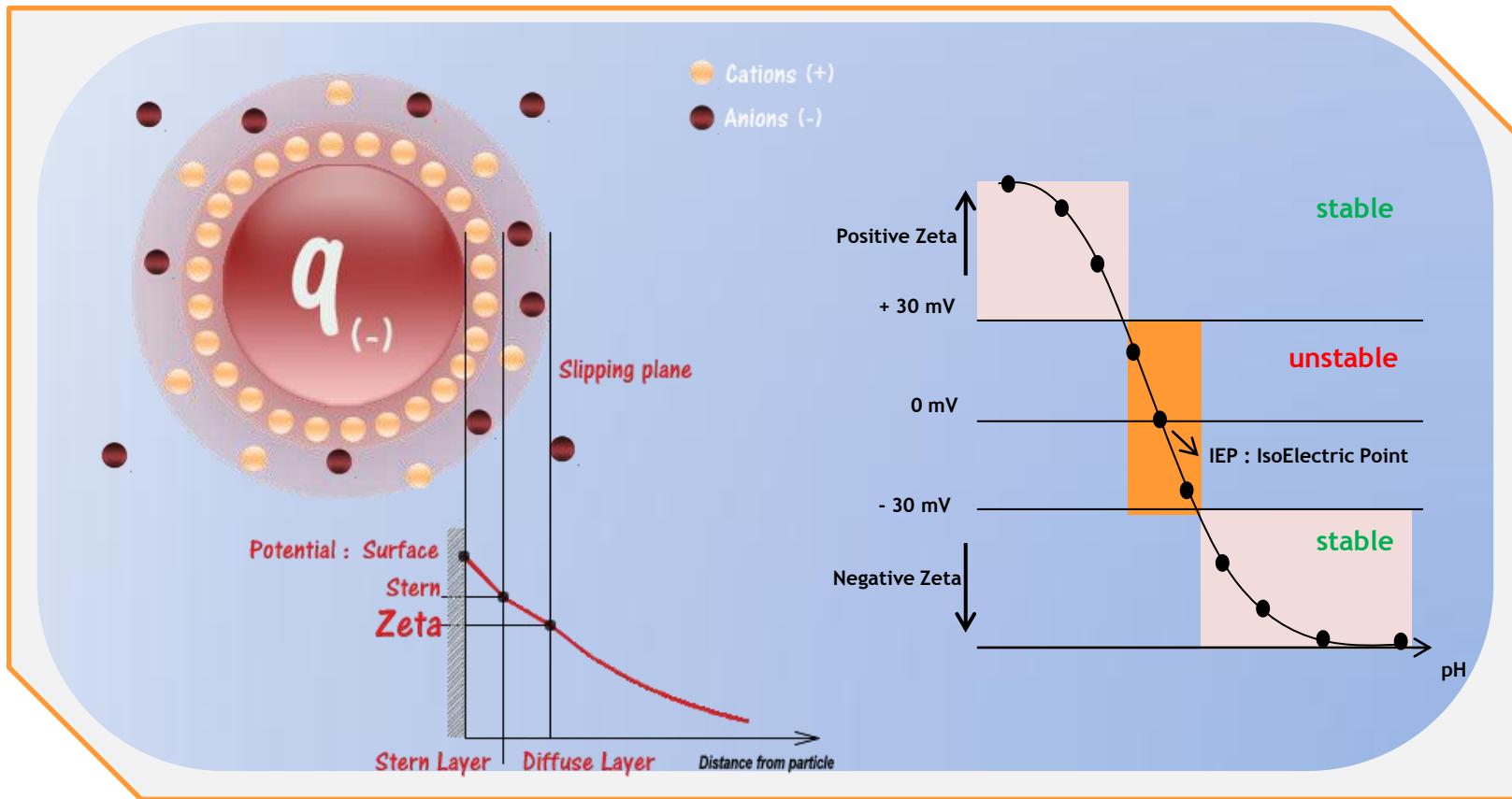
Sedimentation

- Electrostatic or charge stabilization : This effect uses more natural interactions between particles through the distribution of charged species (ions) in the solution.





Zeta Potential definition

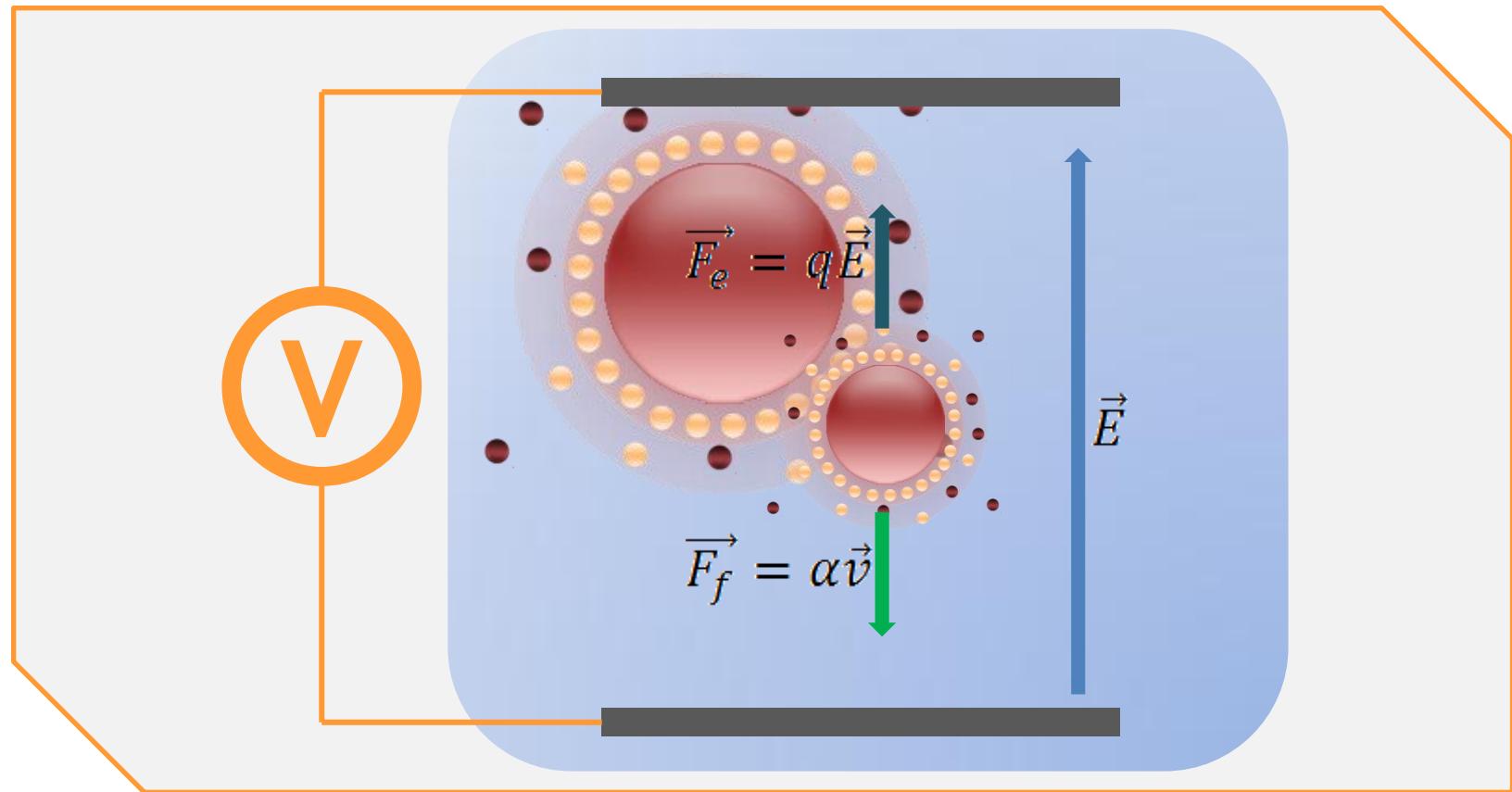


- If surface has - charge, then Cations are attracted to surface
- Anions attracted to Cations, builds electric double layer
- Slipping plane: distance from particle surface where ions move with particle
- Zeta Potential = potential (mV) at slipping plane





Electrophoresis Effect



Applying an Electric field: Only strongly attached ions move with the particle.

Particle velocity relies directly to its electrophoretic mobility under a known E-field



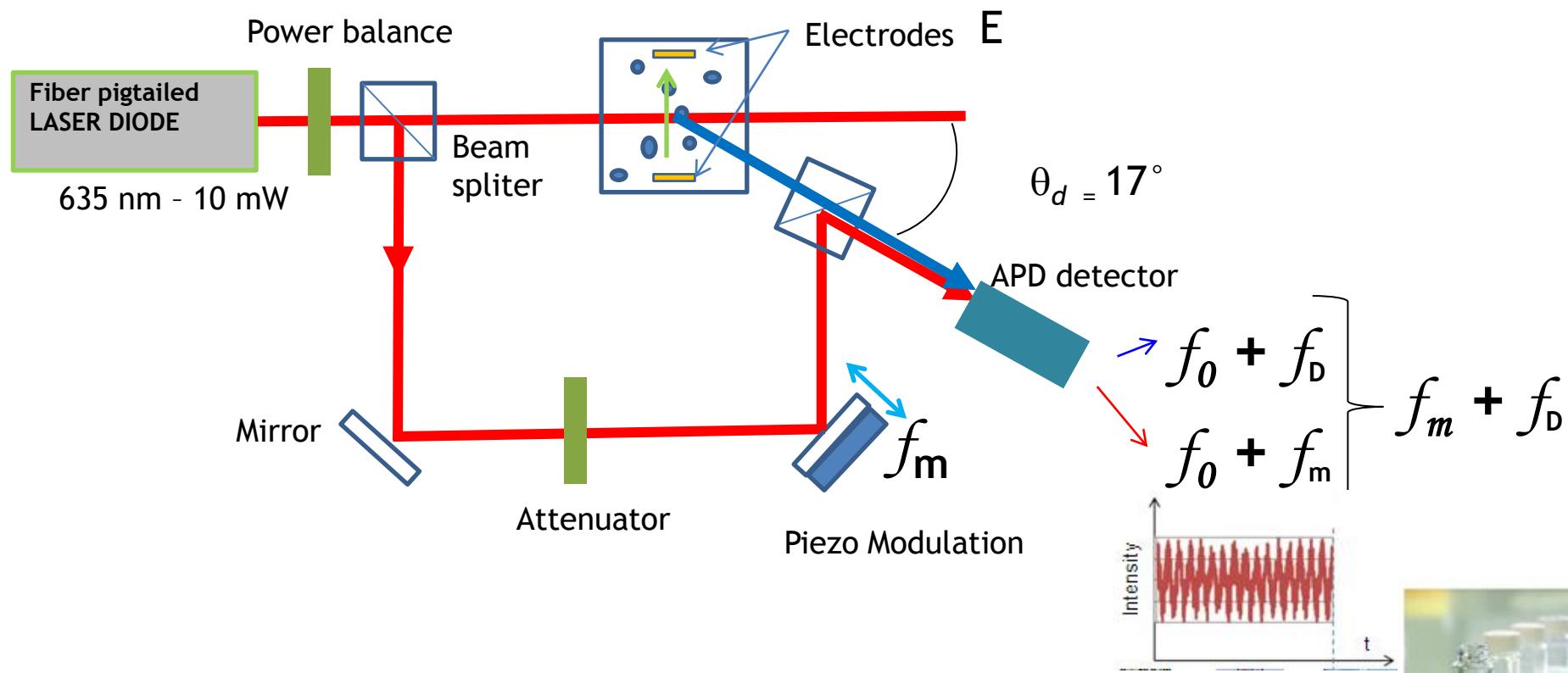


Laser Doppler Electrophoresis (LDE) principle

The Idea:

- measure the speed of the charged nano particles by applying a known electric fields
- use a laser and the Doppler shift to measure the averaged speed of the particles

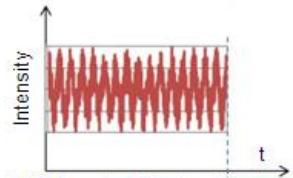
Heterodyne optical Interferometer





Measurement Sequence

Heterodyning Signal



FFT

Doppler shift

f_D

Measured

Electrophoretic
Mobility

μ_e

By LDE
(Laser Doppler
Electrophoresis)

Double Layer model

Huckel ?
Smoluchowski ?

$f(\kappa \cdot a)$
Henry function

Computed

Zeta
Potential

ζ





Measurement of mobility

Electrophoretic mobility

$$\mu_e = \frac{\lambda}{E \sin \theta_d} f_D$$

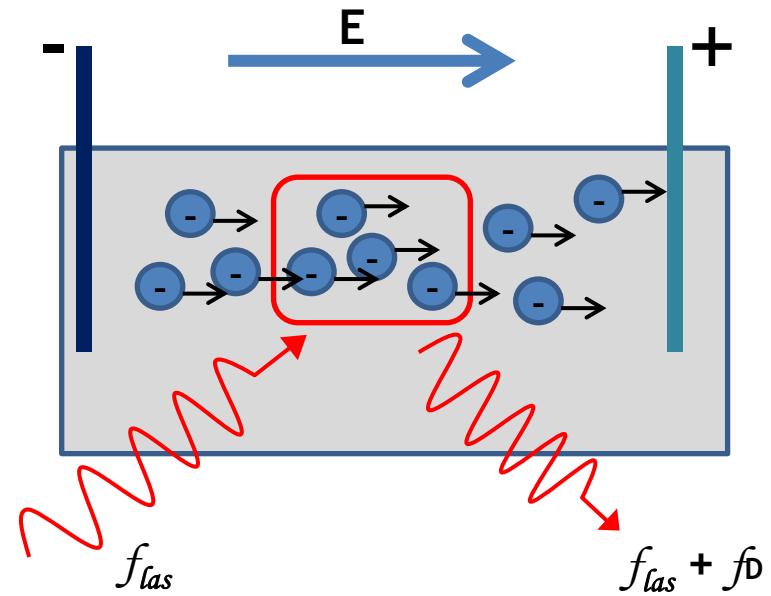
Where :

μ_e : electrophoretic mobility ($\mu\text{mcm/Vs}$)

E : applied electric field

f_{las} : laser frequency

f_D : Doppler frequency



Particle motion causes Doppler shift

Frequency -> mobility





Zeta Potential : Calculation of ZETA

Zeta potential

$$\zeta = \mu_e \frac{\eta}{\varepsilon} f(\kappa \cdot a)$$

Where :

ζ : Zeta Potential (mV)

μ_e : electrophoretic mobility

ε : medium permittivity

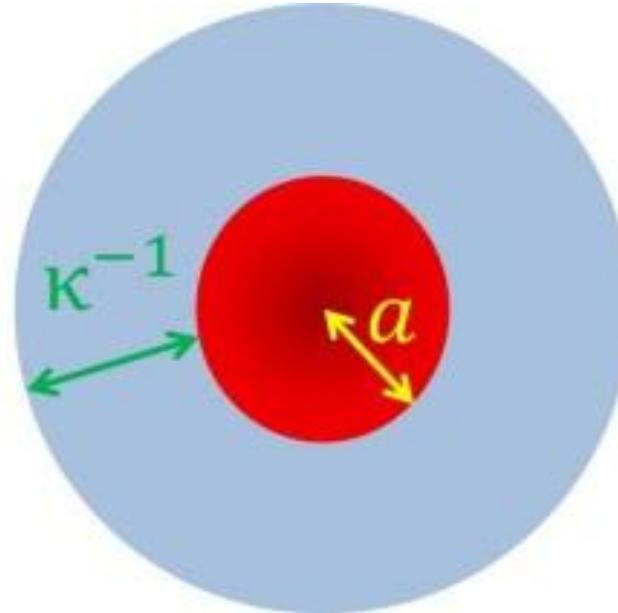
η : medium viscosity

a : particle radius

κ : invert of double layer thickness

κ^{-1} : Debye length

$f(\kappa \cdot a)$: Henry's function



Zeta is dependent of the $\kappa \cdot a$ factor value

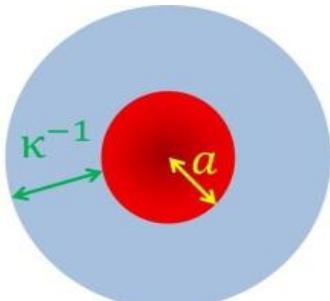
κ is dependent of the solvent





Zeta Potential : Fundamental equation

General cases



$$1 \leq f(\kappa \cdot a) \leq 1.5$$

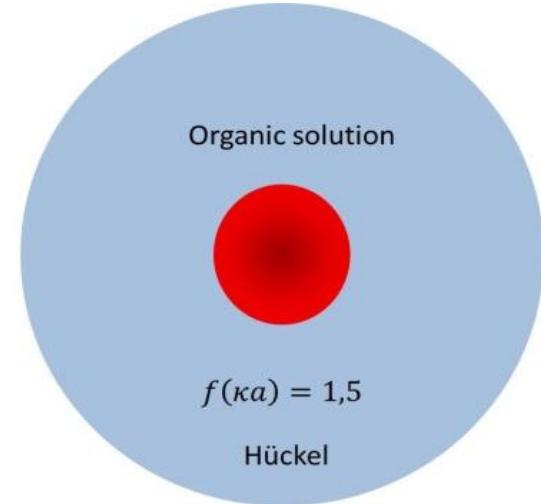
Aqueous solution



$$f(\kappa a) = 1$$

Smoluchowski

Organic solution



$$f(\kappa a) = 1.5$$

Hückel

Calculated Measured

$$\zeta = \mu_e \frac{\eta}{\epsilon} f(\kappa \cdot a)$$

Needs to know the value !

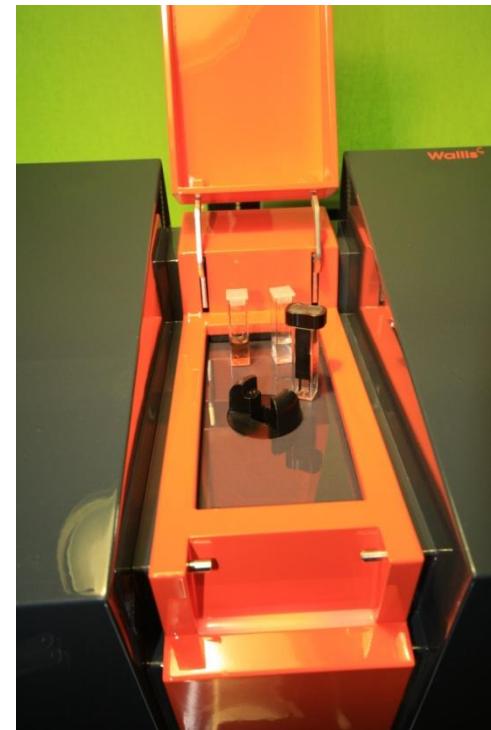
99% cases !!!

Zeta potential calculation is based on the knowledge of the double layer, define by Henry function $f(\kappa \cdot a)$.





WALLIS ζ : High-Resolution Zeta Potential Analysis



- Charge/zeta potential measurement of nano-particles in suspension
- Complementary tool to VASCO for colloid characterization
- High resolution analysis from -200mV to + 200mV

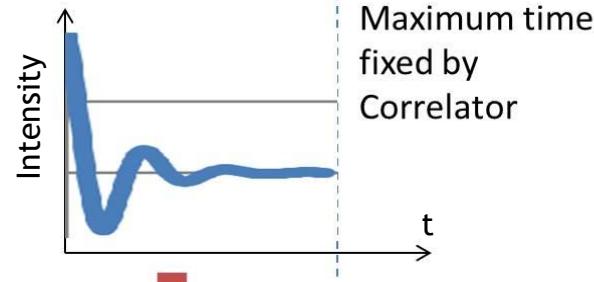




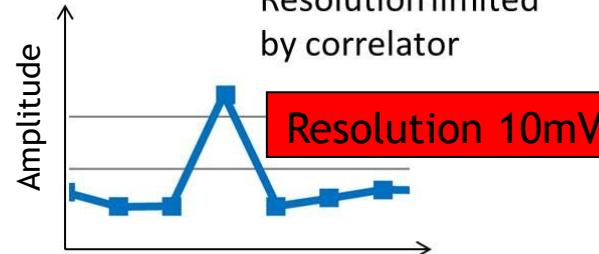
Direct acquisition : No correlator for higher resolution

With correlator
(other supplier)

correlator
Averaging



FFT

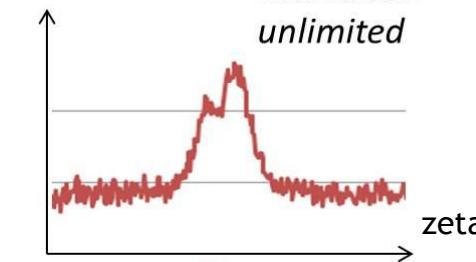


Maximum time
unlimited

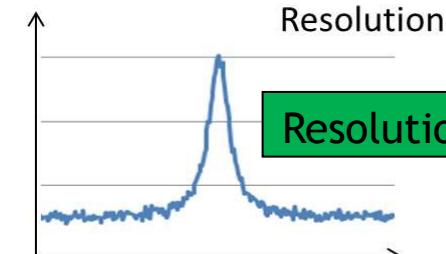
FFT

Without High
resolution acquisition
data board (Wallis)

Resolution
unlimited

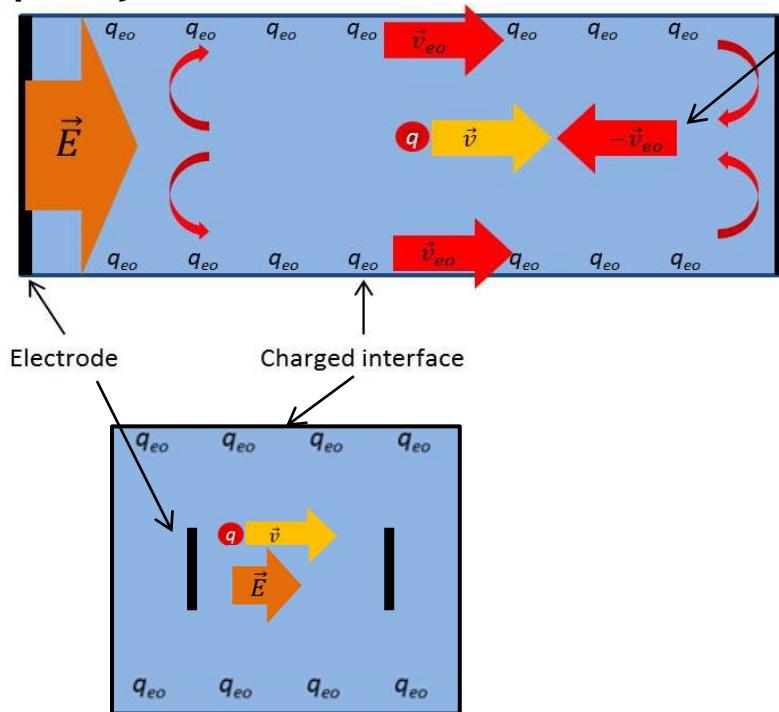


Averaging



Electrode Assembly

Capillary = 3 mm



Electro-osmosis effect

Connector

Hellma Cell

Quartz, Glass or
polystyrene polished

Vitreous Carbon
Electrodes

Laser beam

Min. sample
volume
 $750\mu L$

Dip cell = 10 mm

The Dip cell small electrodes configuration is based on established principles. No electro-osmosis in WALLIS cell ▶ The need to focus at any "stationary plane" is eliminated.





Electrode Assembly

Concept oriented for handling easiness



- Easy filling from above !
- No risk of bubbles ! (vs capillary cell)
- - Electrodes are independent (moderate cost)
 - Vitreous carbon electrodes (lifetime > 1 year - extreme resistance to chemical attack - low electrical resistance)
 - Conventional cleaning of electrodes (ultra sound or bath tub)
- - Life of a quartz cell (> 5 years)
 - Excellent optical quality (quartz and / or polystyrene polished !)
 - Compatible with organic solvent
 - Compatible with Hellma cell ...

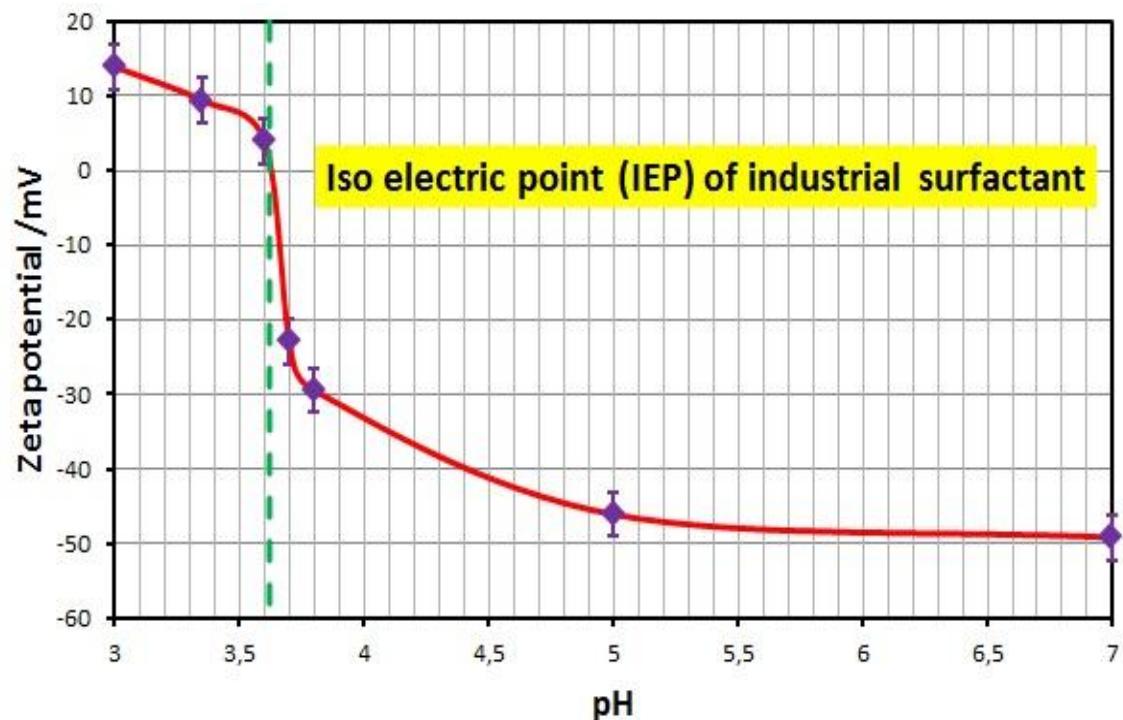




Example : sample of industrial surfactant

High resolution of Wallis allow high quality measurement for applications:

- Precise measurement of IEP
- Functionalization of colloid
- Repeatability of particles synthesis
- Sharp variation in particles stability





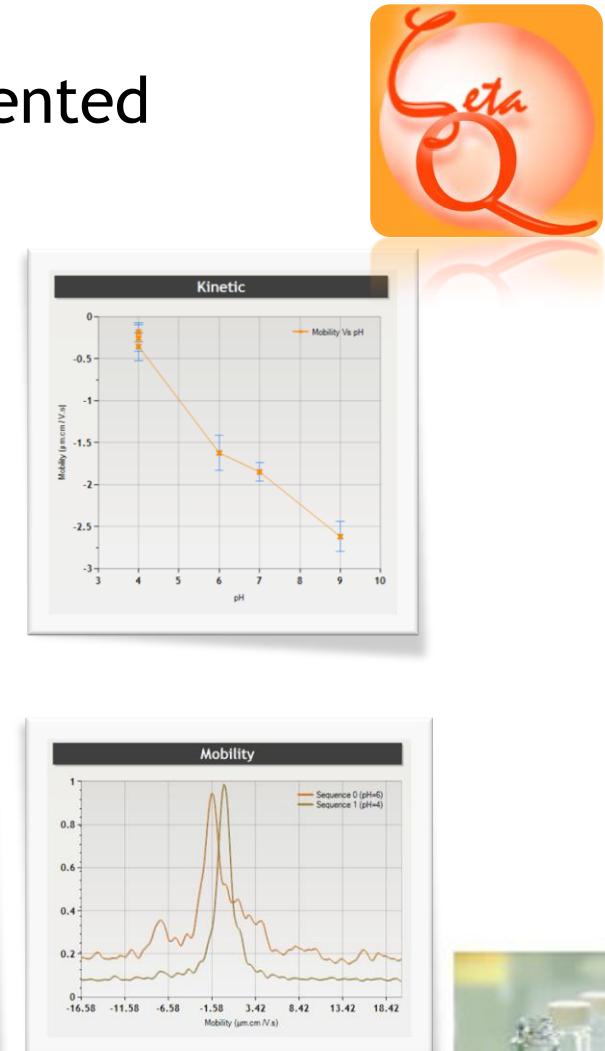
ZetaQ

- Unique and proprietary software
- User friendly and touch-screen oriented
- Database structure

The screenshot shows the ZetaQ software interface. At the top, there's a navigation bar with tabs: Mode, Settings, Acquisition, Analysis, and Report. Below this, a sidebar on the left contains four buttons: Experiment, Analyze Data, Parameters, and Users management. The main area is divided into sections: 'Zeta' (containing a 'Zeta potential' graph with a red peak at -4.22 mV) and 'Mobility' (containing a 'Zeta-calculation' section with Solvent set to Water and Smoluchowski selected). To the right of these is an 'Analysis' panel with a table of results:

Measure	Mobility ($\mu\text{m cm/V.s}$)	Zeta (mV)
Mobility -3 dev: 0.07	-3.72	0.93
- 12:18:51 26.82 °C		
<input checked="" type="checkbox"/> 1	-0.37	-4.65
<input checked="" type="checkbox"/> 2	-0.22	-2.79

Below the analysis panel are buttons for SOP, Back to viewer, Save experiment, and Report. At the bottom, status indicators show 'Disconnected' and '22.22 °C'. The version number V1.1.1.30101 is also present.





Thank you of your attention!

Customer support:

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