On the stability of the water surface in an external electric field

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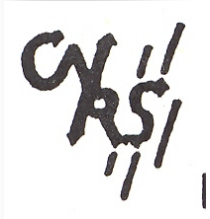
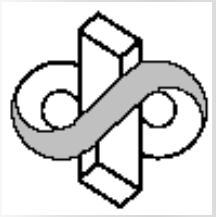
Cargese 2016

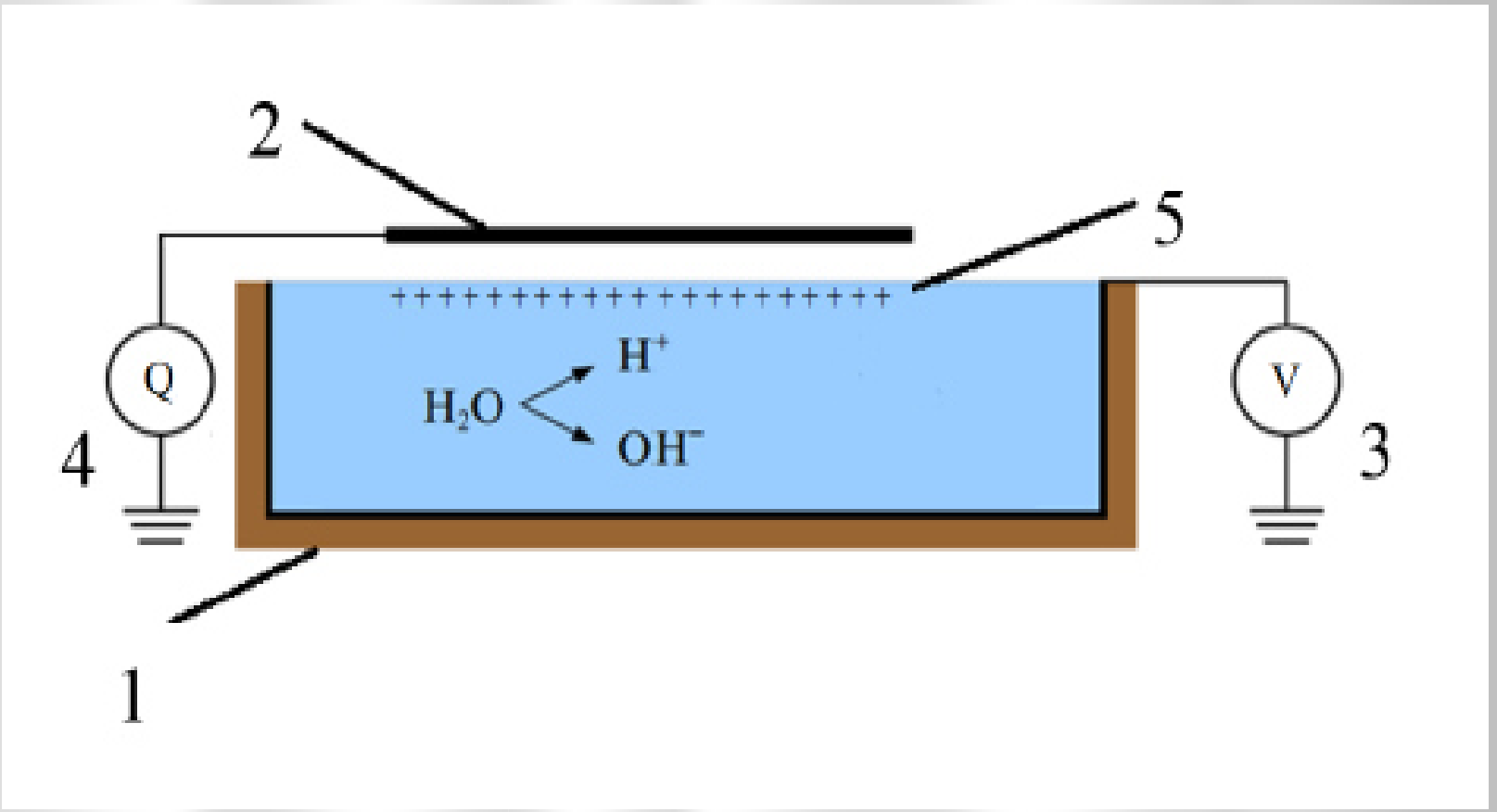




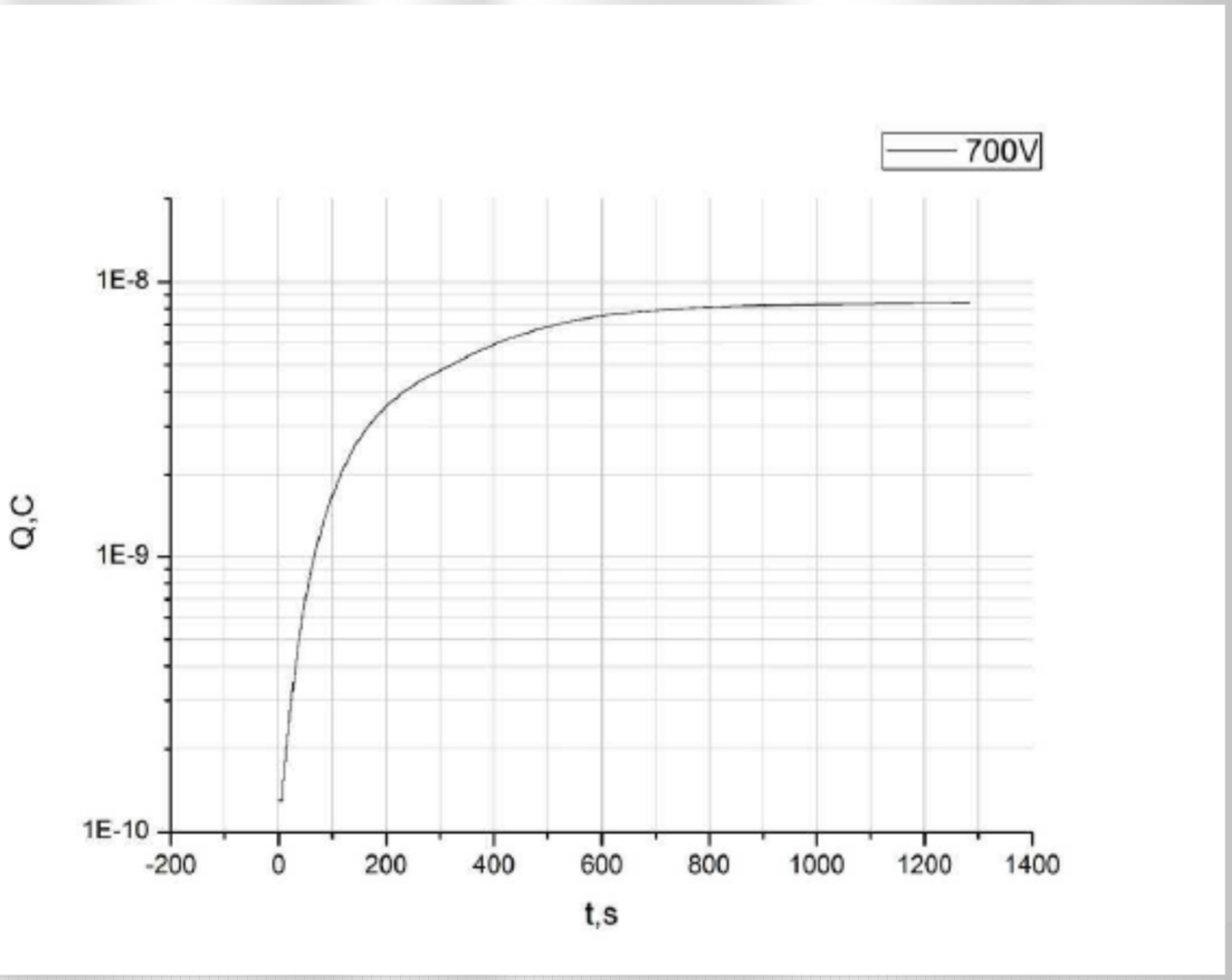
Outline

1. Screening of uniform electric field
2. Screening of point-like electric field
3. Summary

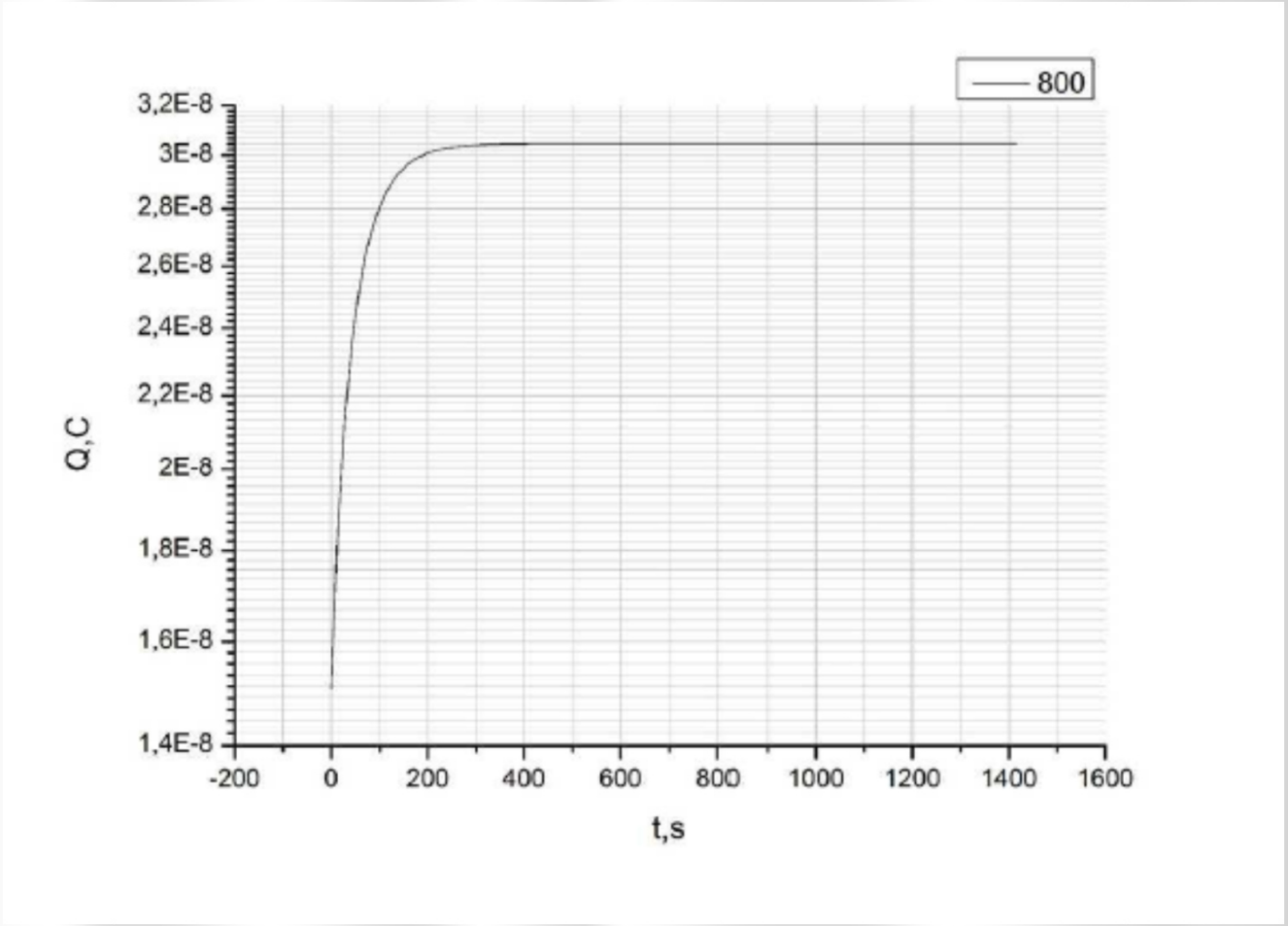
Experimental Setup



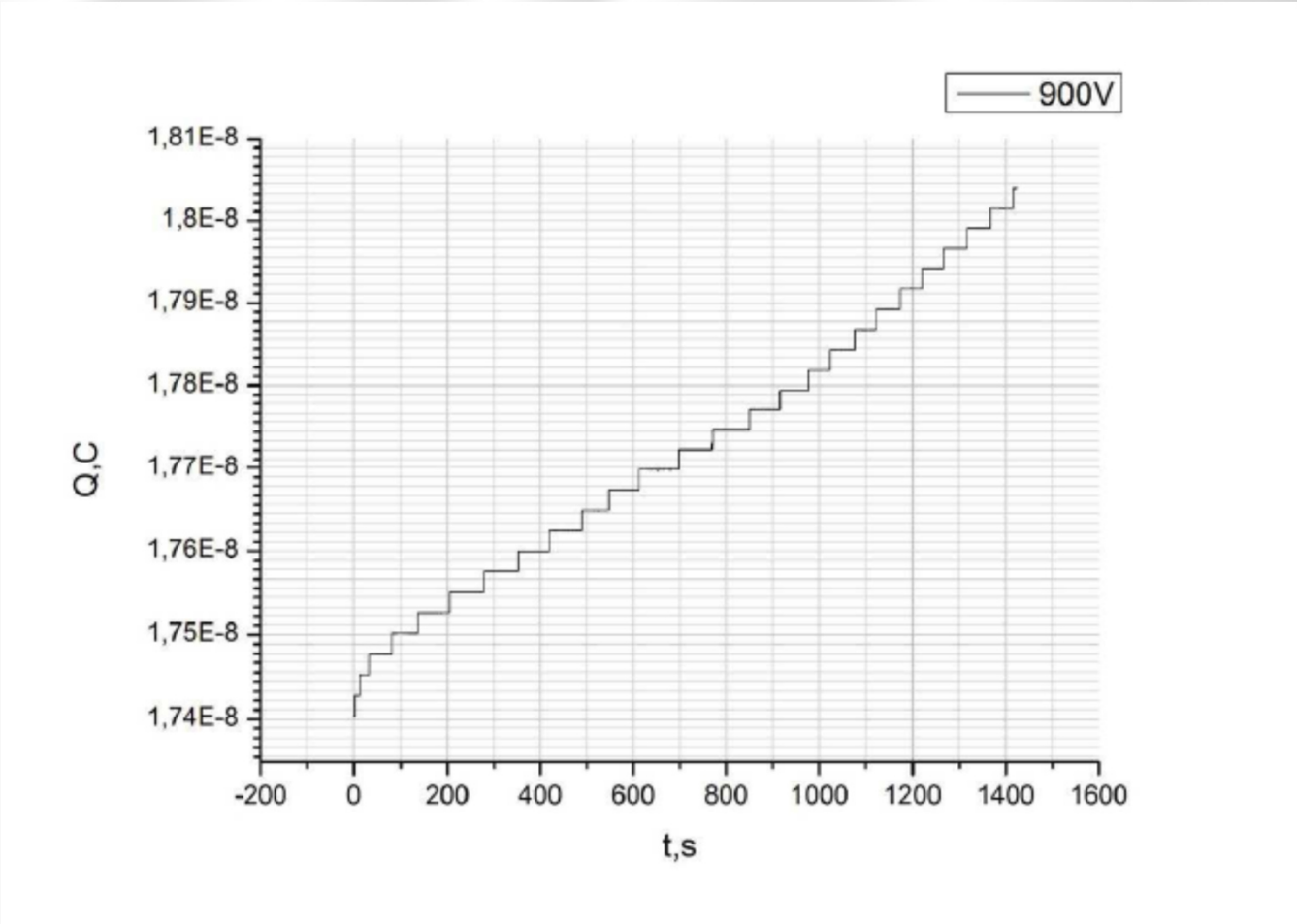
Time - resolved screening below the critical field



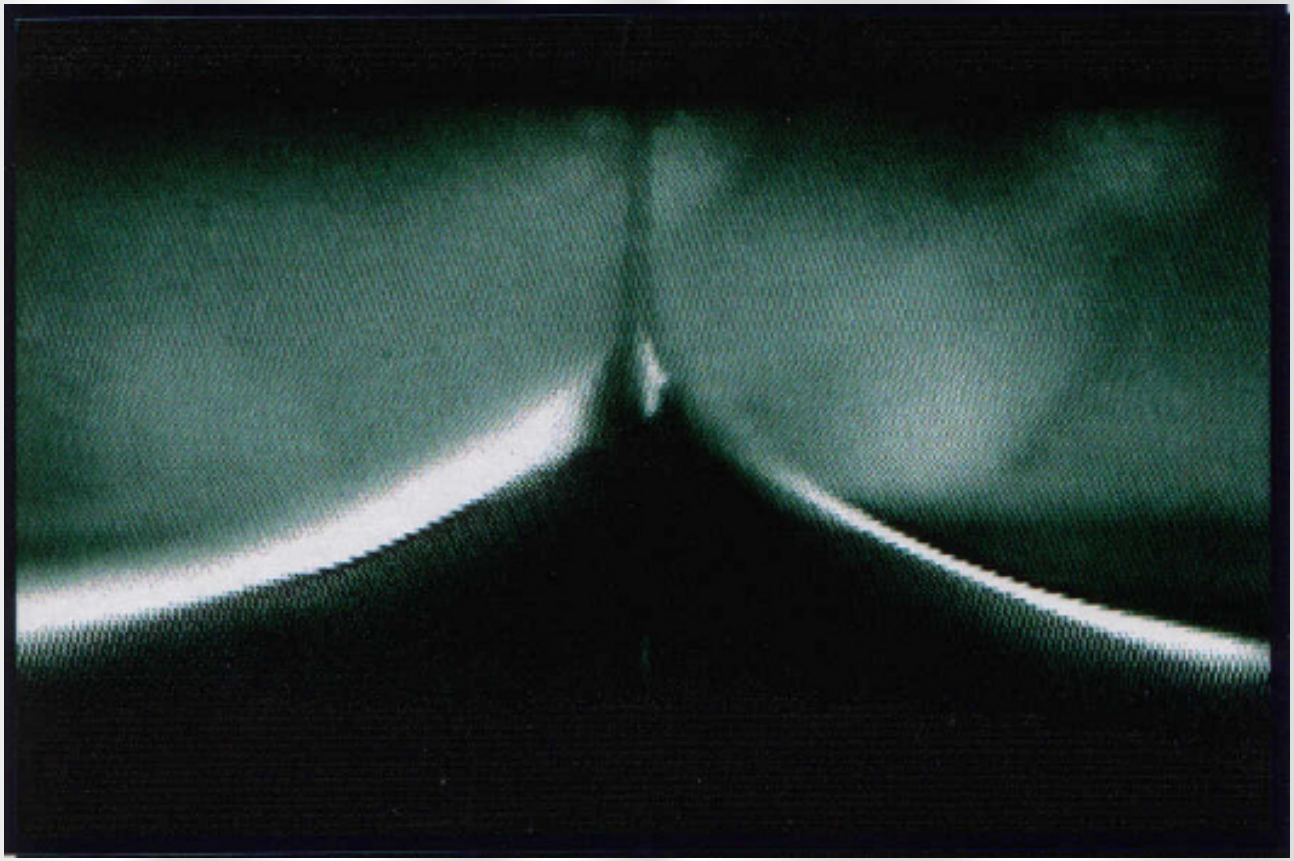
Time - resolved screening close to (still below) the critical field



Time-resolved screening above the critical field

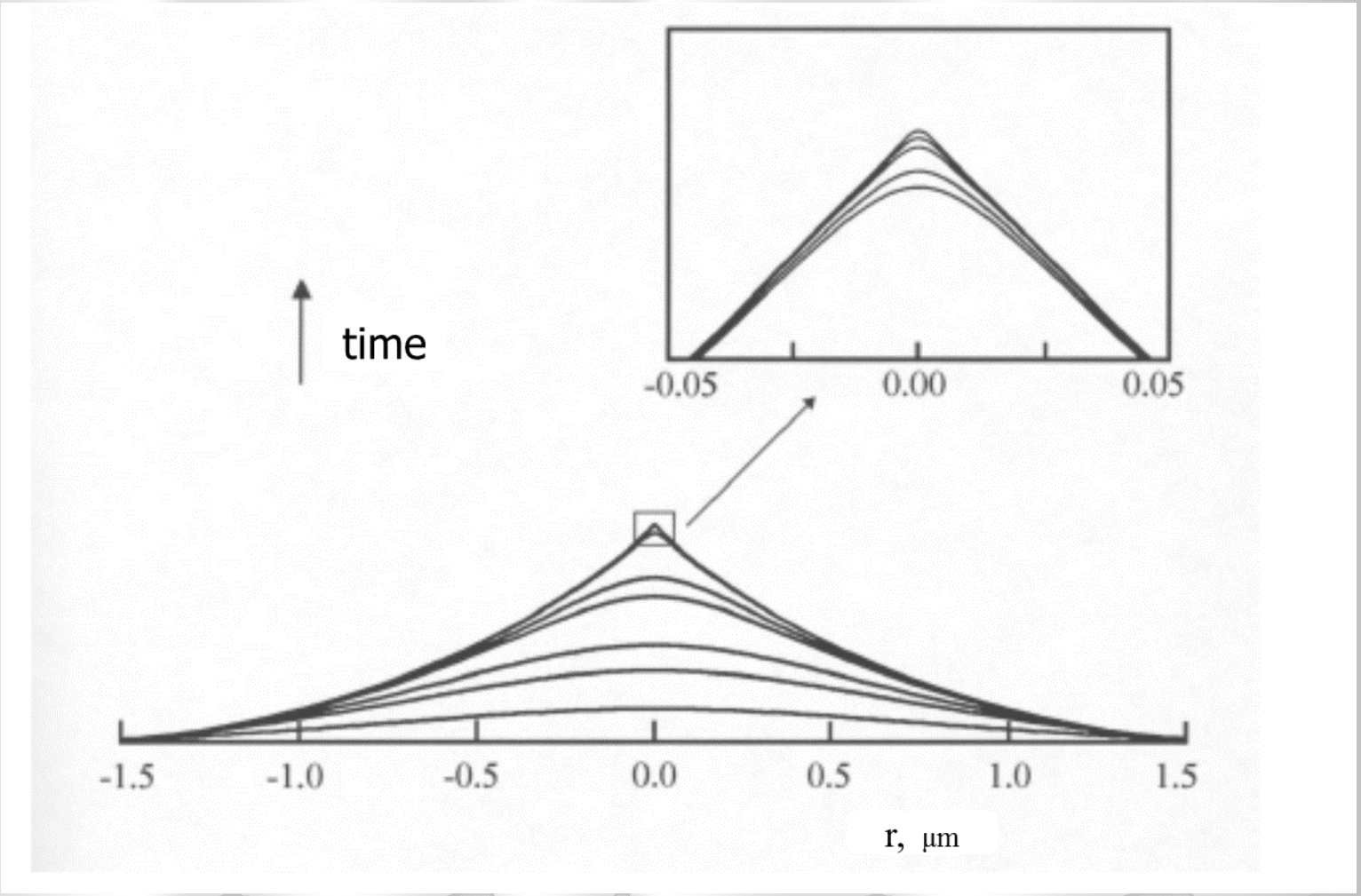


Current jet formation

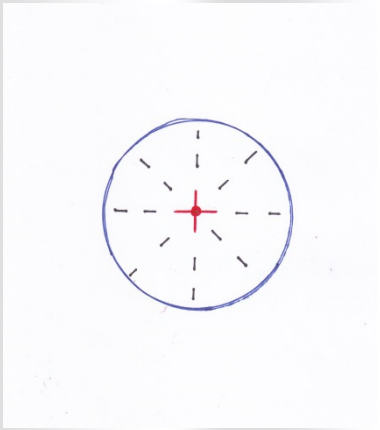


$$\tau_{jet} \sim (10^{-3} - 10^{-4}) sec$$

Taylor cone



Debye screening of point-like charge



$$\Delta\varphi = \frac{4\pi}{\epsilon}\sigma(r),$$

$$\sigma(r) = |e|[n_+(r) - n_-(r)]$$

$$n_\pm(r) = n_0 \exp\left[e_\pm\varphi(r)/T\right].$$

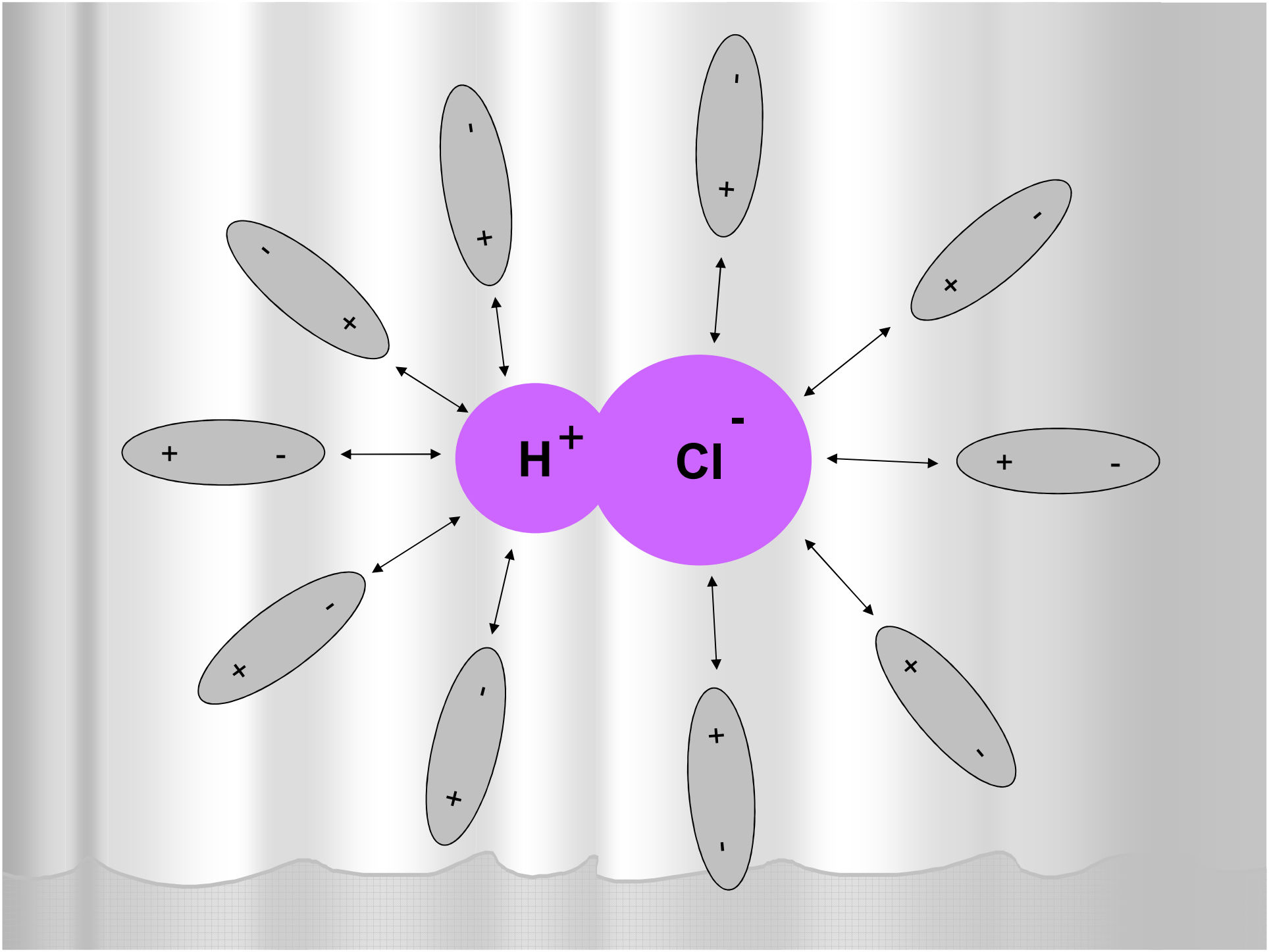
$$r\varphi(r)_{|r\to 0} \to Z, \quad \varphi(r)_{|r\to\infty} \to 0$$

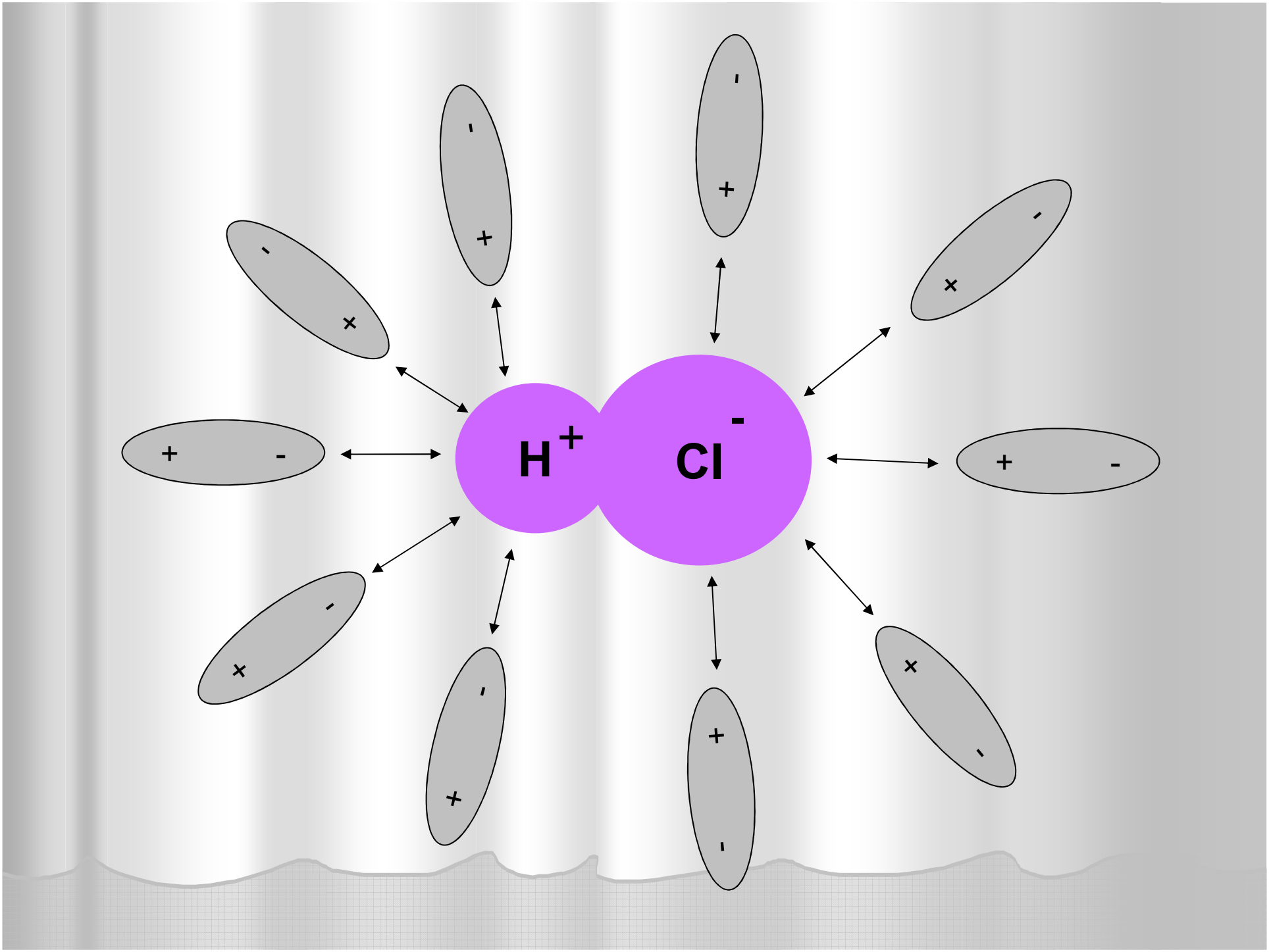
$$e^2/(\epsilon R_{Br}T) \sim 1, \quad R_{Br} \leq 10^{-7}cm, \quad R_{Br} - B'erum \;\; length$$

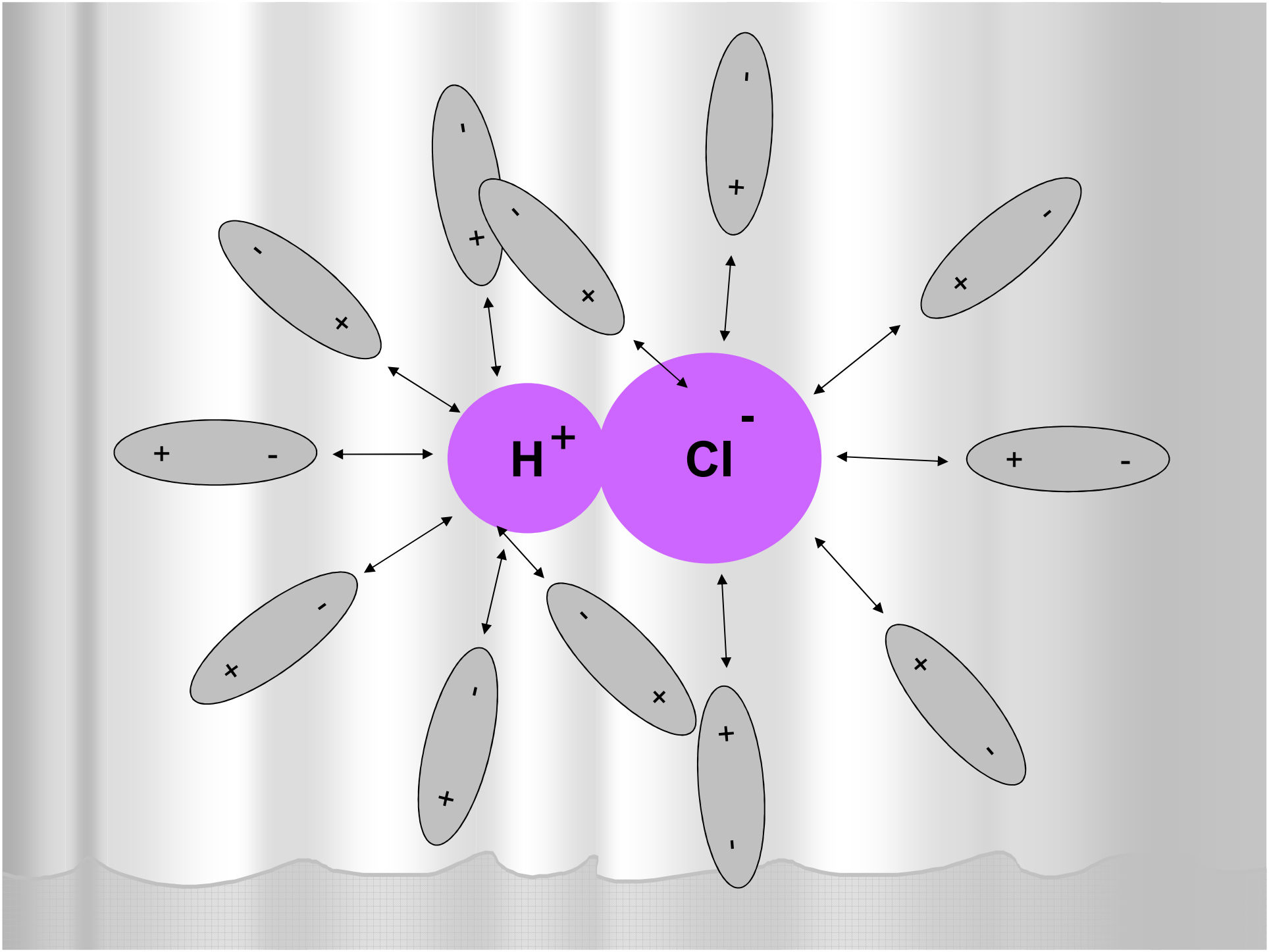
Oswald law for CH_3COOH (acetic acid)

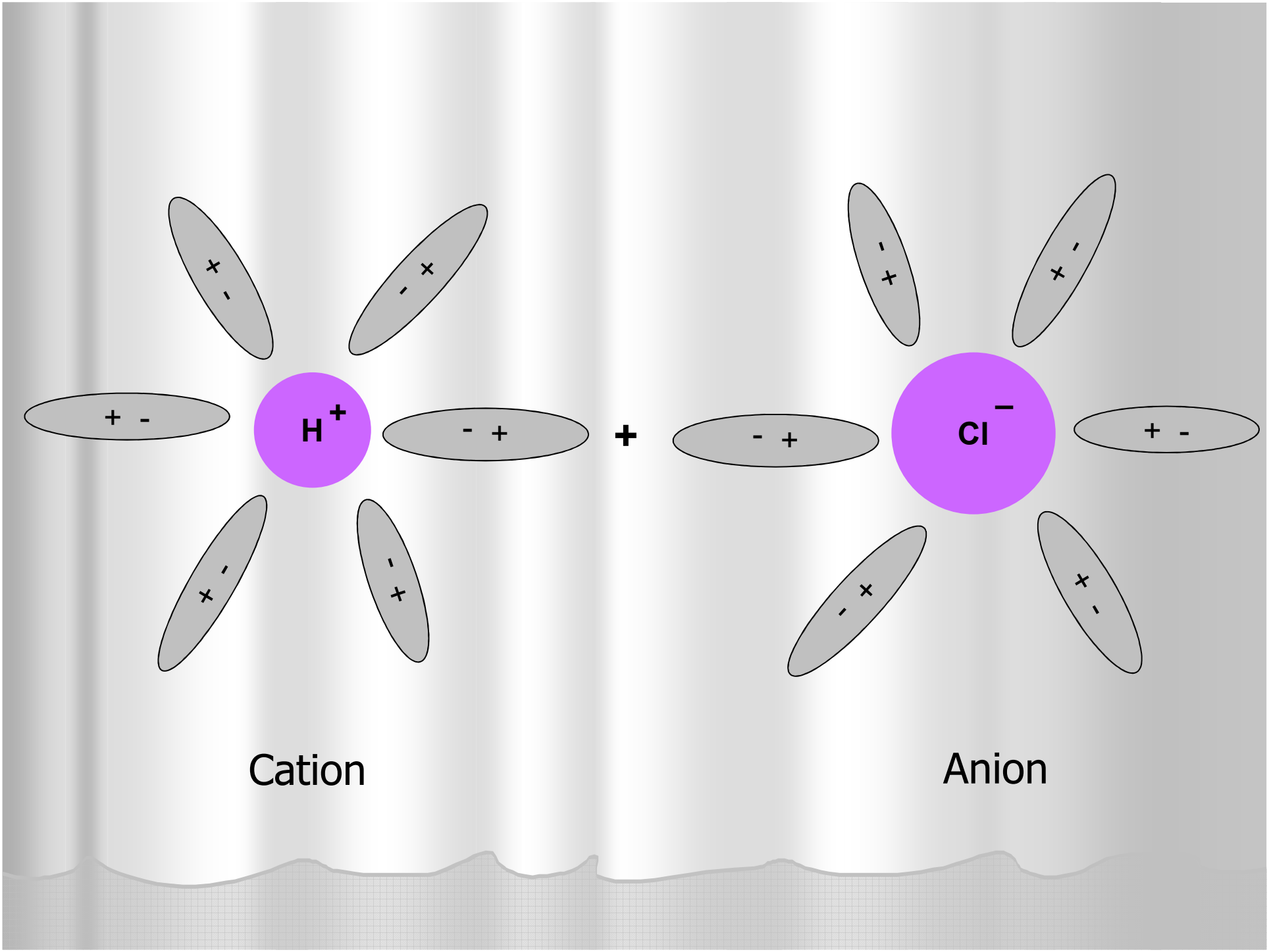
$$K(T) = \frac{\alpha^2 C}{1-\alpha}.$$

C, mol / l	α	K
0.000028	0.539	$1.77 \cdot 10^{-5}$
0.000111	0.328	$1.78 \cdot 10^{-5}$
0.000218	0.248	$1.78 \cdot 10^{-5}$
0.001030	0.124	$1.80 \cdot 10^{-5}$
0.05	0.019	$1.84 \cdot 10^{-5}$
0.10	0.0135	$1.85 \cdot 10^{-5}$

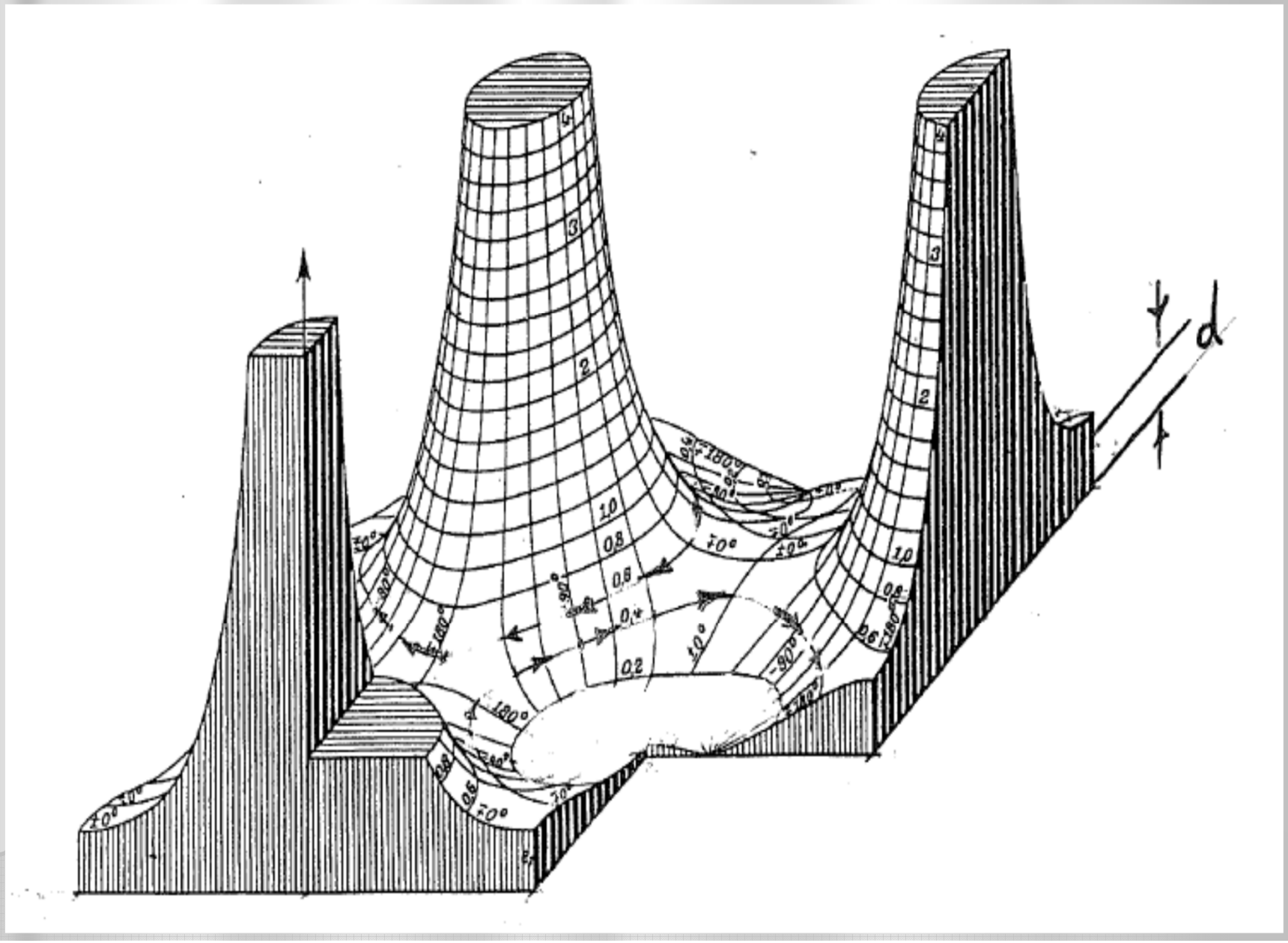

H+
Cl-


H+
Cl-

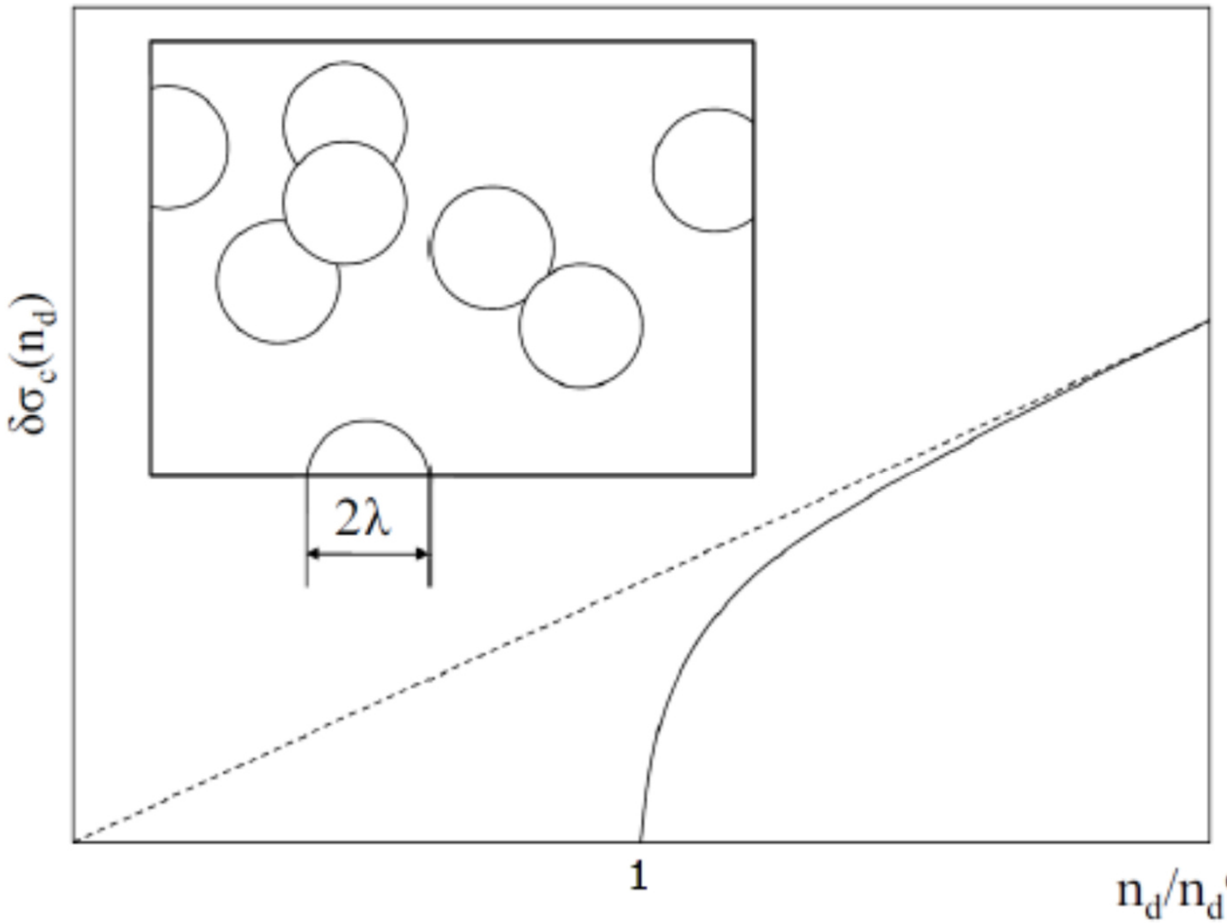

H+
Cl-


H+
Cl−
Cation
Anion

The spatial distribution of the charge density



Conductivity of dilute electrolyte



Summary:

Structure of dilute electrolyte has to be very non uniform in space.

Conductivity is not linear function of donor's density.

Dipole moment in electric field is very big.