

**MOLECULAR ASSEMBLIES  
MEDIATED BY ELECTROMAGNETIC FIELDS  
IN HIGHLY DILUTED AQUEOUS SOLUTIONS:  
ACCORDANCE OF EXPERIMENTAL AND  
PREDICTED BY ELECTRO-DYNAMIC THEORY DATA**

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**KAZAN, 2014**

Beginning **since 2006 year** we investigate highly diluted aqueous solutions of different compounds and as we think we have obtained not only interesting but **very important results**.

Our **first** publications were made in **2008-2009 years**.  
**First** publication concerning **EMF influence** was made in **2011 year**.  
Now we have **more than 20 papers** including review articles.  
All of these ones have **English version**.

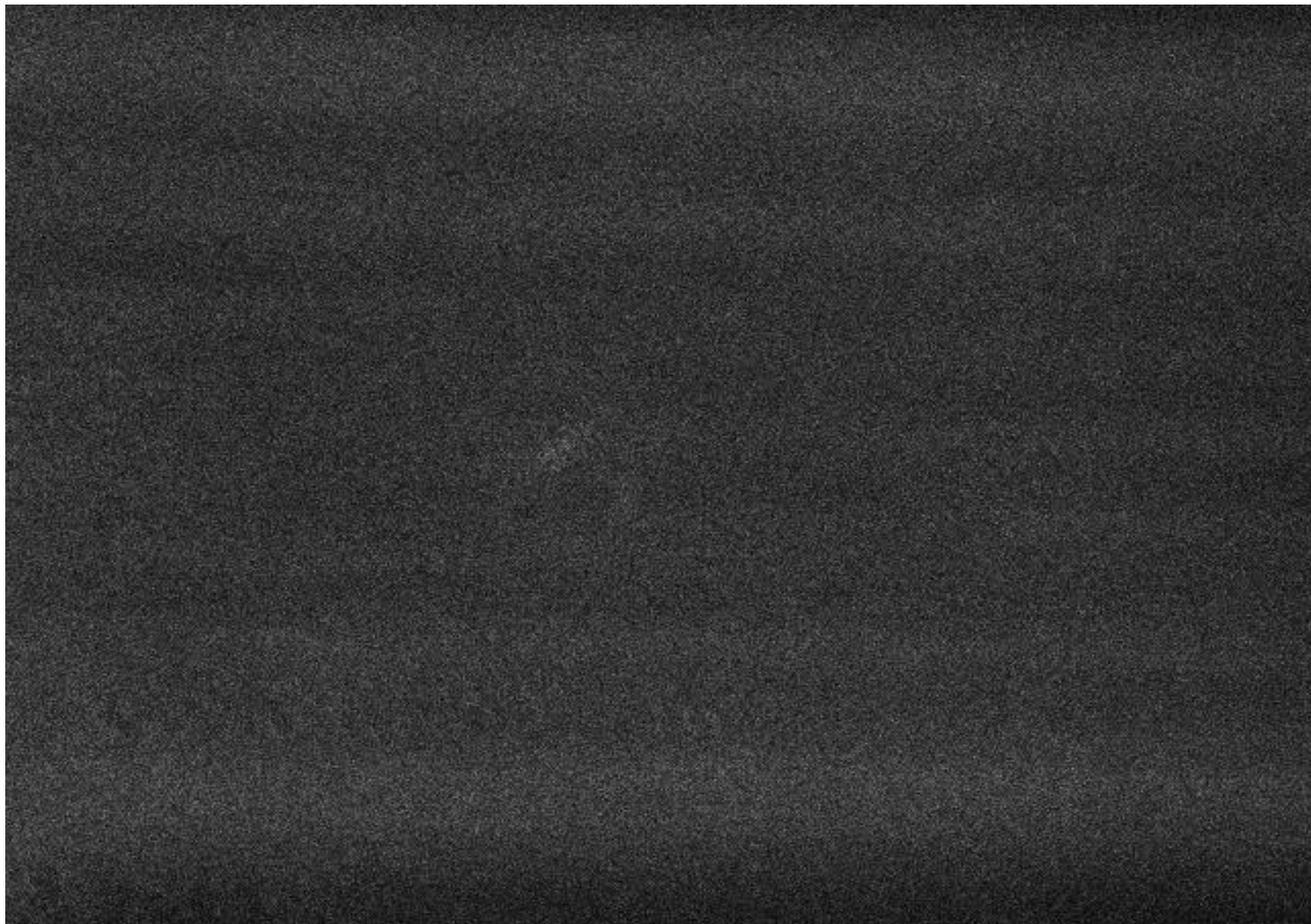
Key point of results of our investigations was establishment of **THE FORMATION OF RATHER LARGE-SCALE MOLECULAR ENSEMBLES MEDIATED BY ELECTROMAGNETIC FIELDS**, which determine all properties of such solutions.

Molecular ensembles were detected by **DLS – method**.

I am beginning my communication with the demonstration of VIDEO obtained by relative new method

«**NANOPARTICLE TRACKING ANALYSIS (NTA)**» (2004)  
Using Nano Sight (Amesbury, United Kingdom) equipment



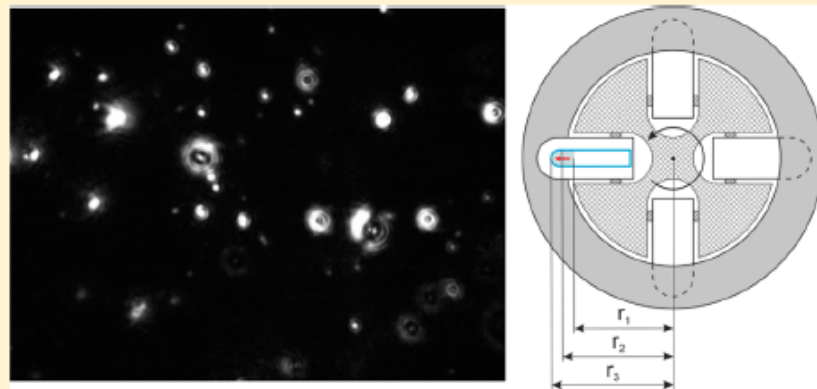


# Large-Scale Inhomogeneities in Solutions of Low Molar Mass Compounds and Mixtures of Liquids: Supramolecular Structures or Nanobubbles?

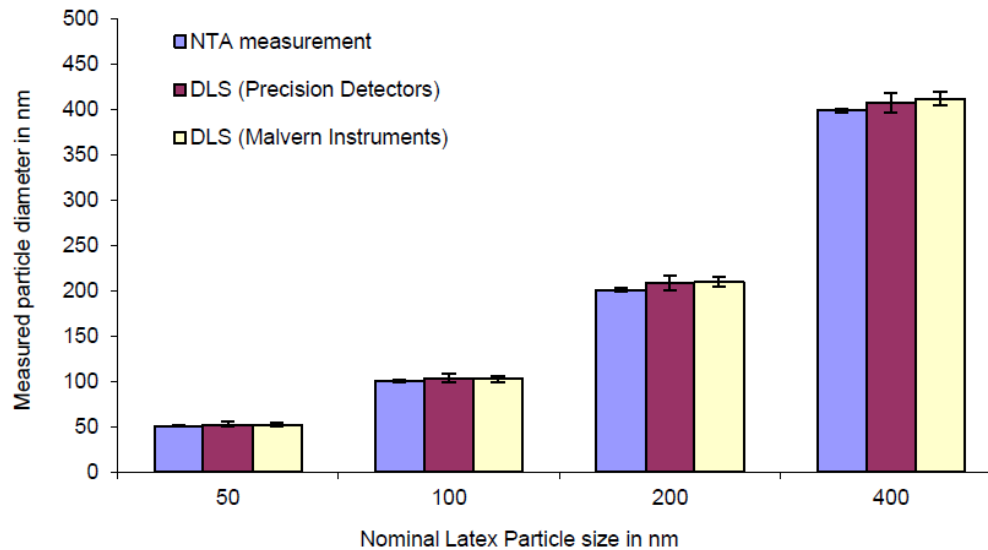
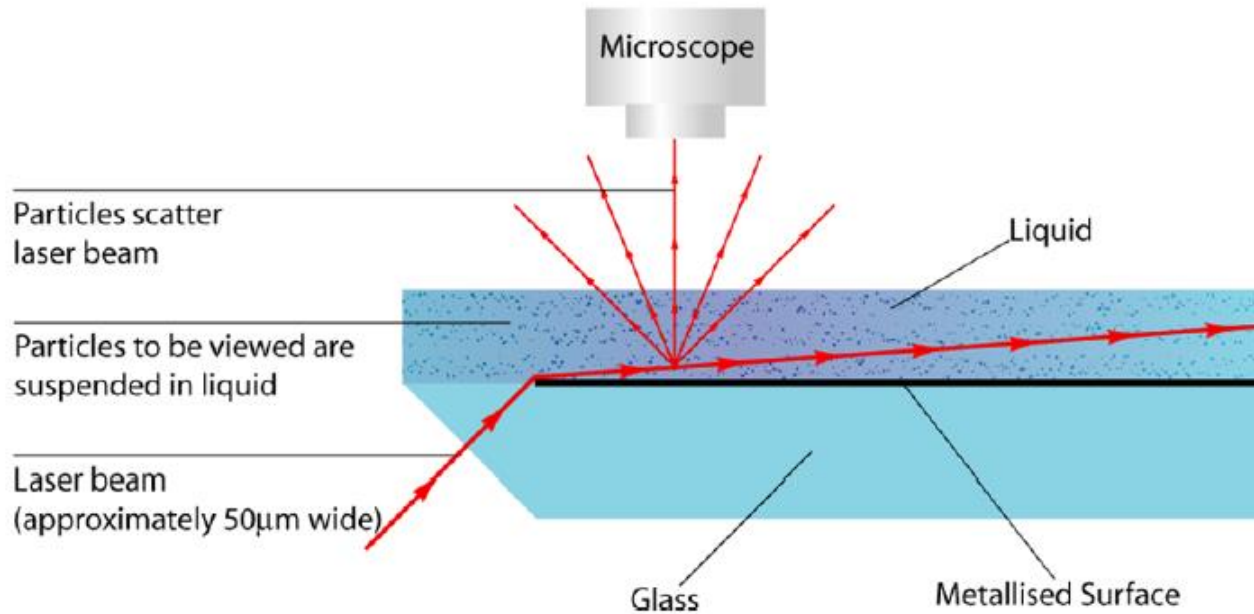
Marián Sedlák\* and Dmytro Rak

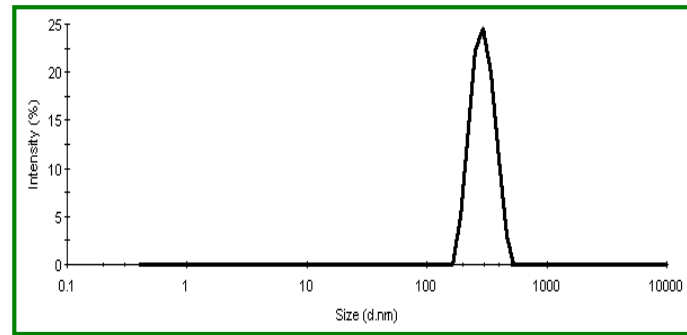
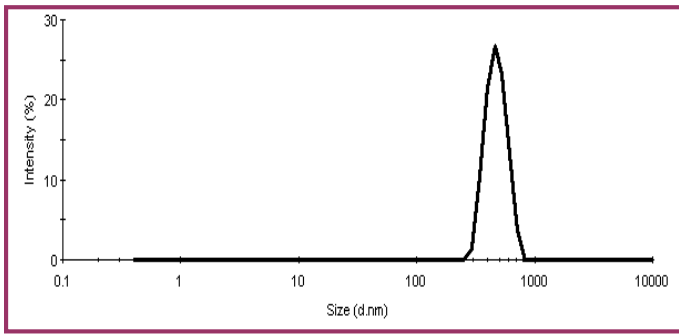
Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Košice, Slovakia

**ABSTRACT:** In textbooks, undersaturated solutions of low molar mass compounds and mixtures of freely miscible liquids are considered as homogeneous at larger length scales exceeding appreciably dimensions of individual molecules. However, growing experimental evidence reveals that it is not the case. Large-scale structures with sizes on the order of 100 nm are present in solutions and mixtures used in everyday life and research practice, especially in aqueous systems. These mesoscale inhomogeneities are long-lived, and (relatively slow) kinetics of their formation can be monitored upon mixing the components. Nevertheless, the nature of these structures and



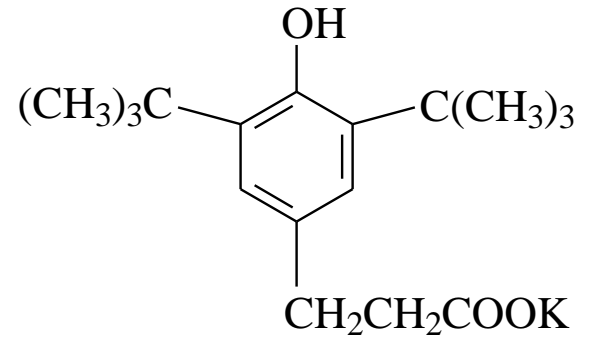
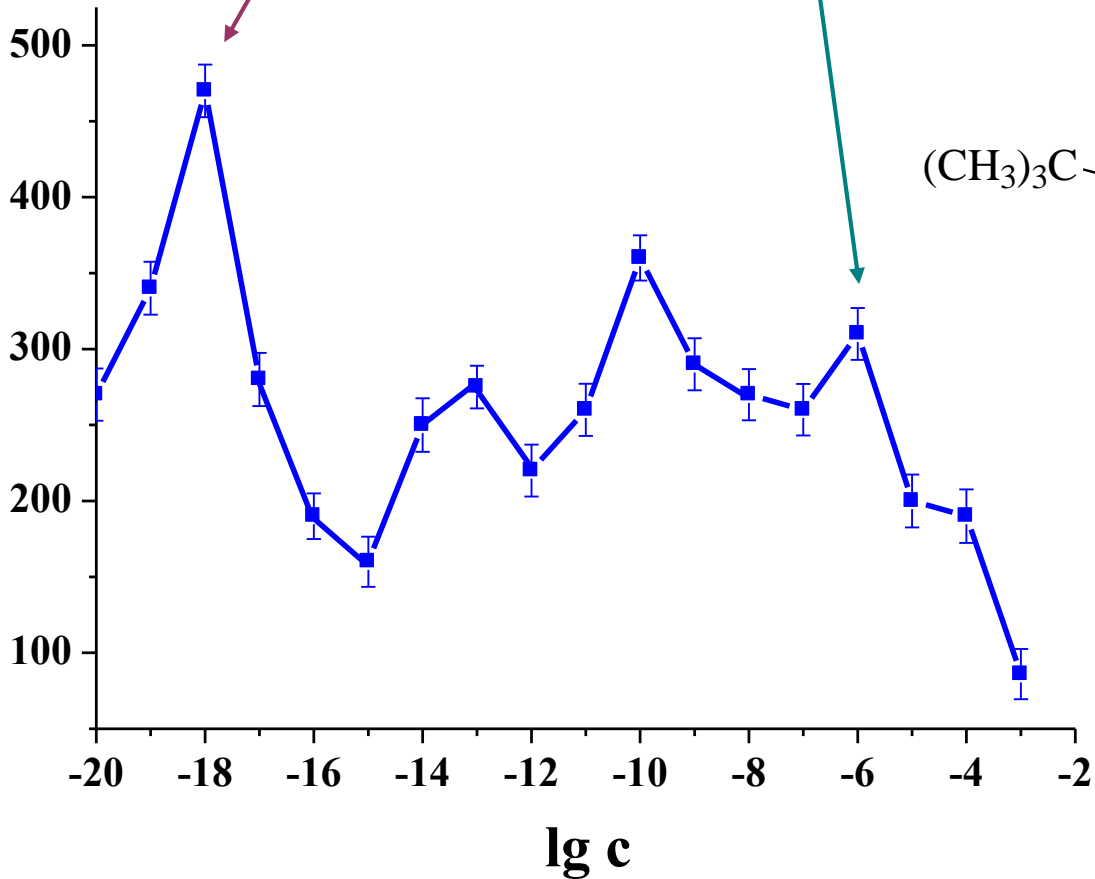
# Schematic of the optical configuration used in NTA





**D, nm**

**DLS  
STUDY**



**Phenozan potassium salt**

**ALMOST HUNDRED COMPOUNDS**

**WERE STUDIED BY SEVERAL PHYSICAL,  
PHYSICOCHEMICAL AND BIOLOGICAL METHODS  
(COMPLEX INVESTIGATION !)**

**IN  $10^{-2}$  –  $10^{-20}$  M CONCENTRATION INTERVAL**



**ANTIOXIDANTS**

**PLANT GROWTH REGULATORS**

**NEUROMEDIATORS**

**VITAMINS**

**HORMONES**

**ANTICEPTICS**

**ANXIOLITICS**

**COMPOUNDS WITH KNOWN AND UNKNOWN  
BIOLOGICAL PROPERTIES**

**Parameters and properties**

**D - size**

**particles**

**$\zeta$  - potential**

\_\_\_\_\_

**X – electro-conductivity**

**solutions**

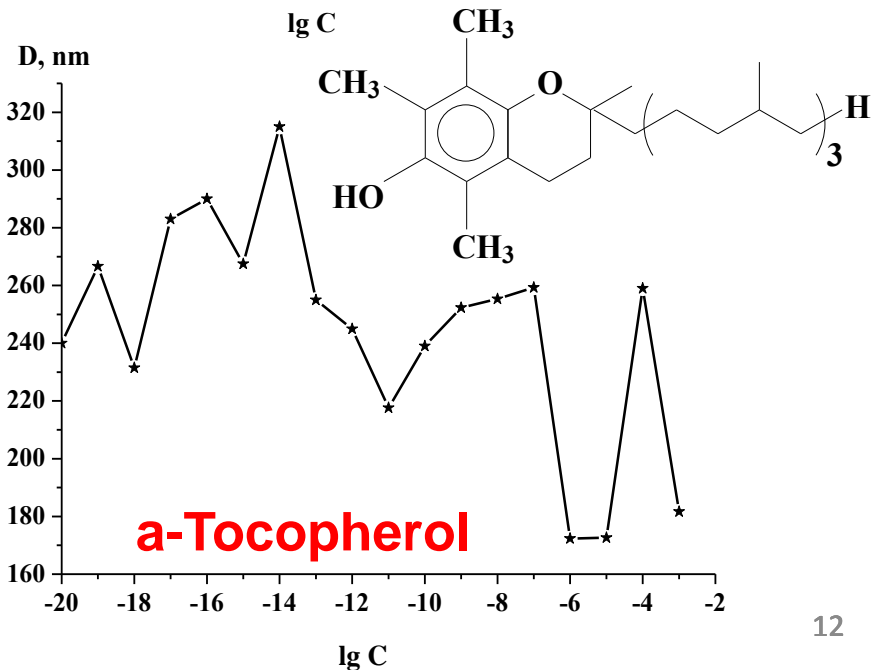
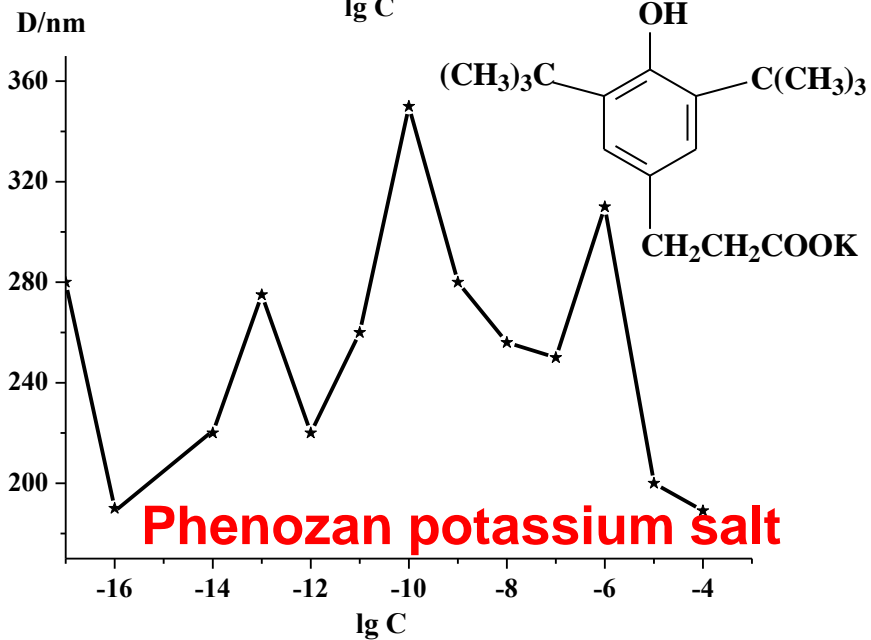
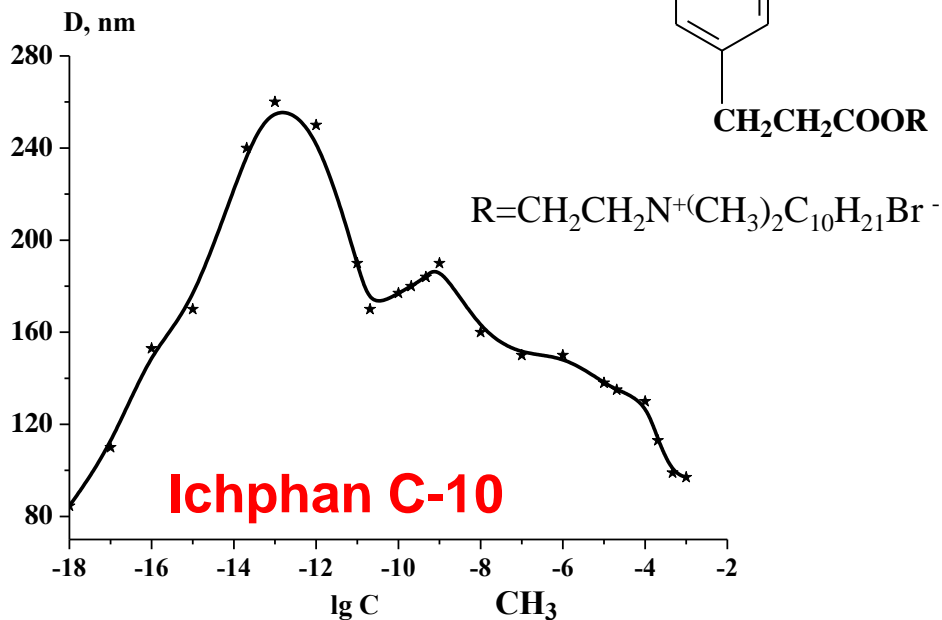
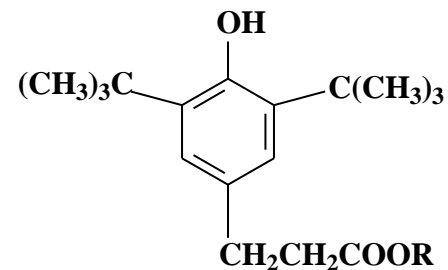
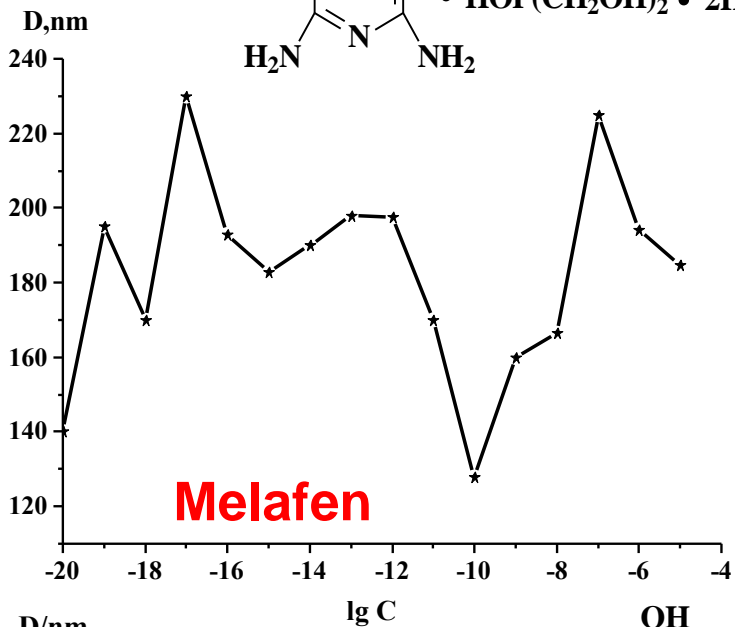
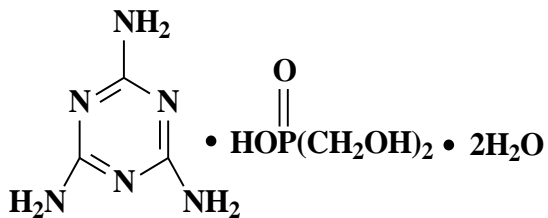
**$\alpha$  - optical activity**

**catalytic activity**

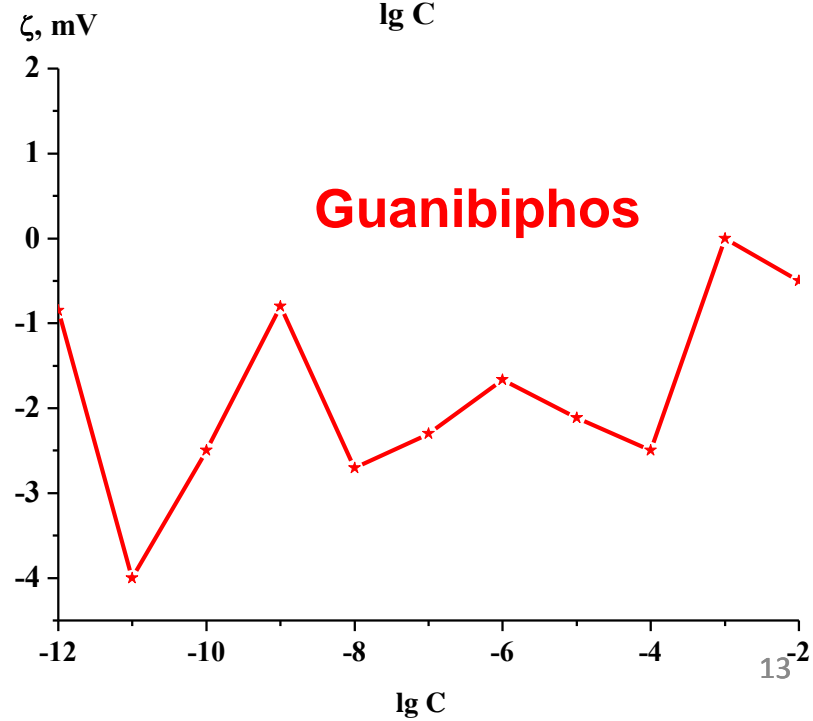
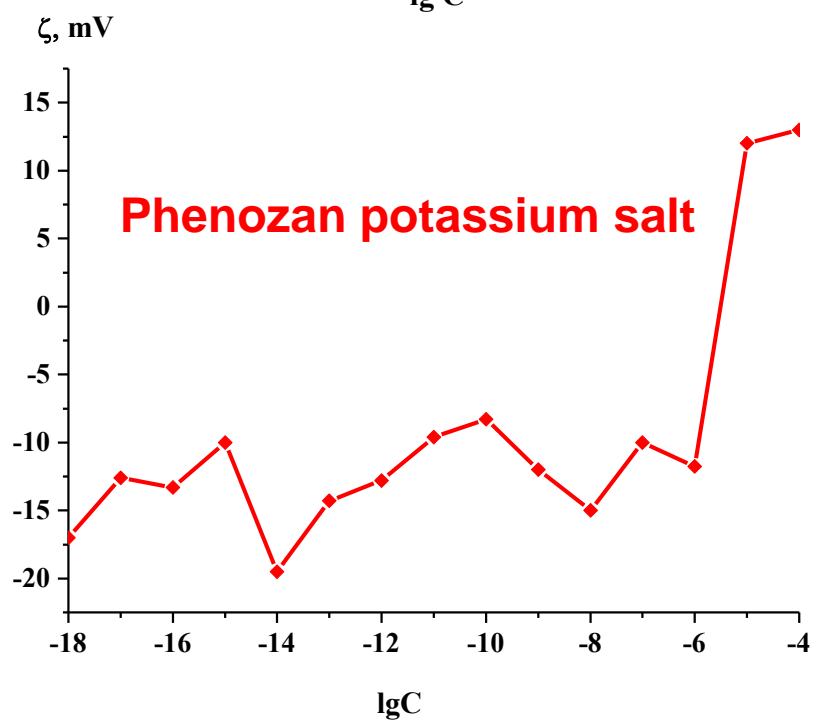
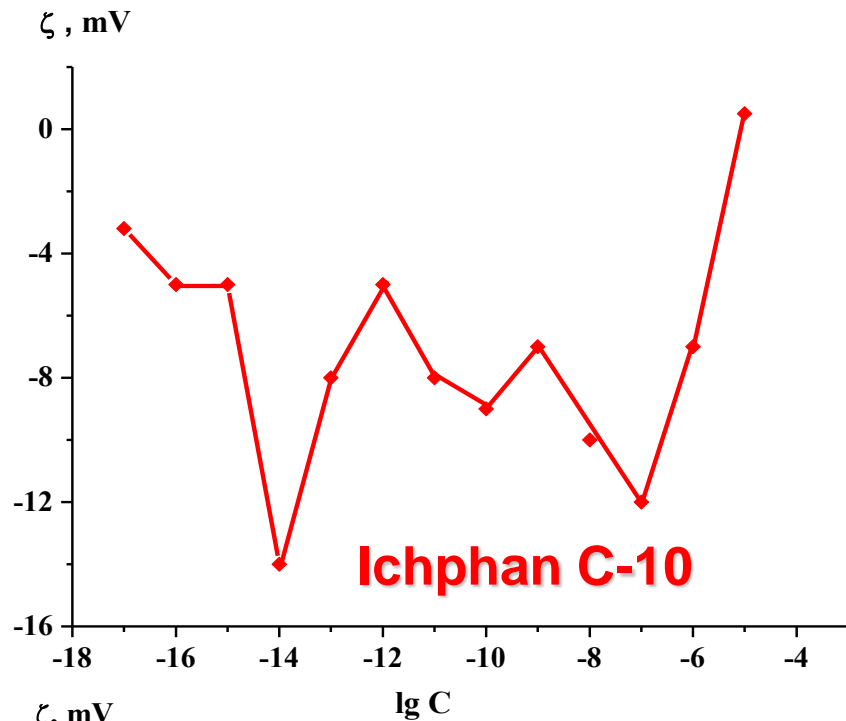
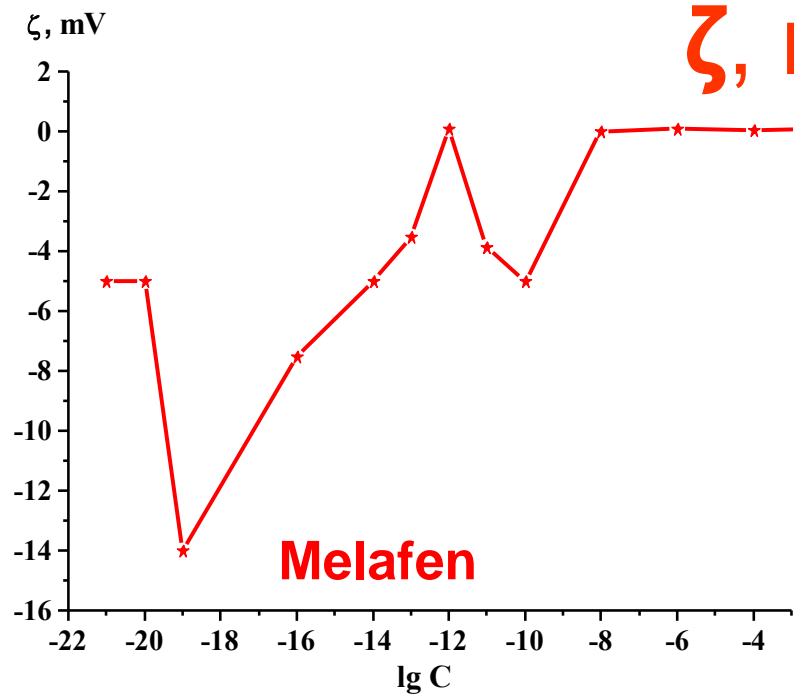
**biological activity**

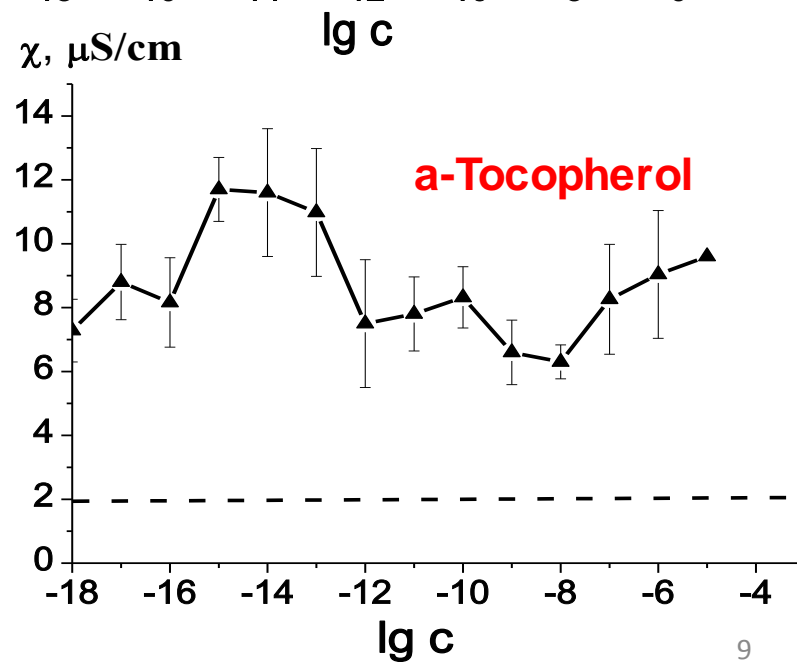
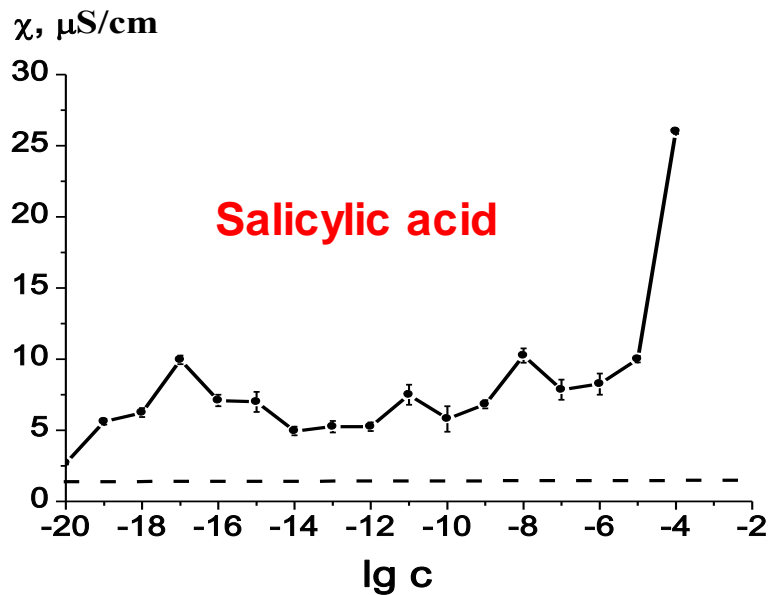
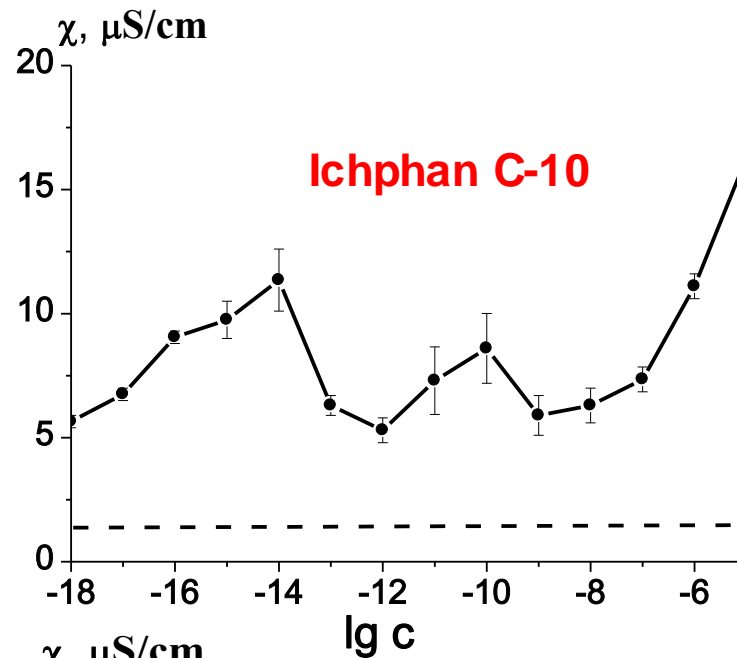
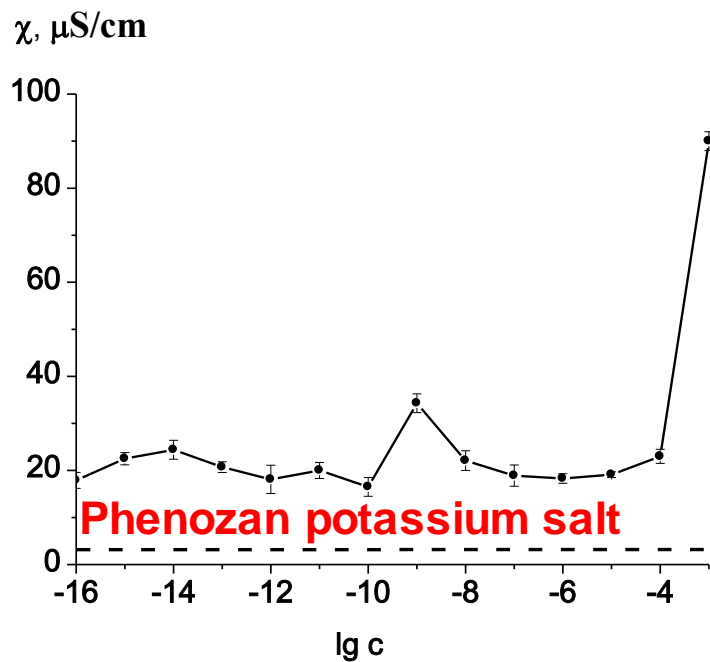
**change of sign of influence of biological activity**

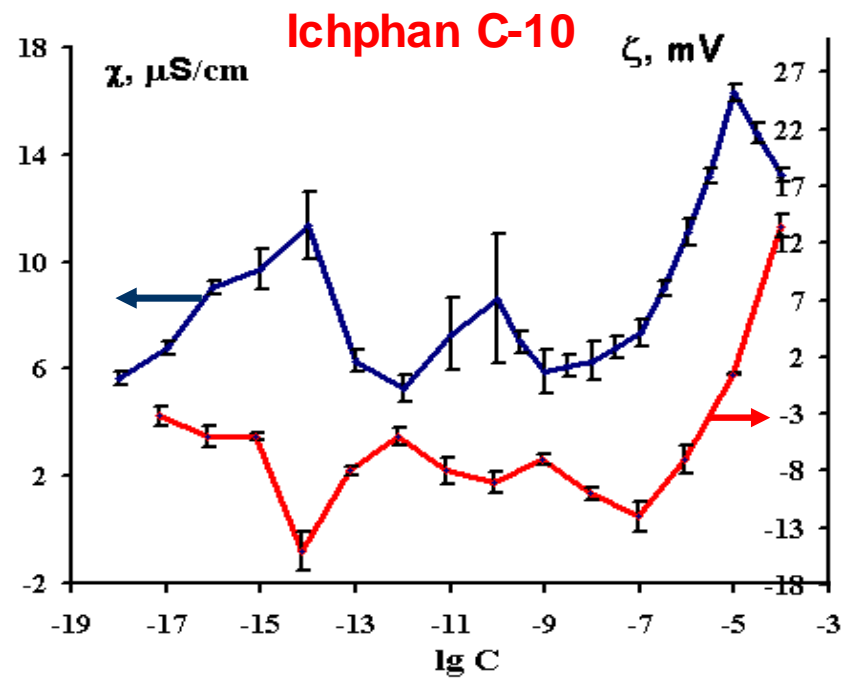
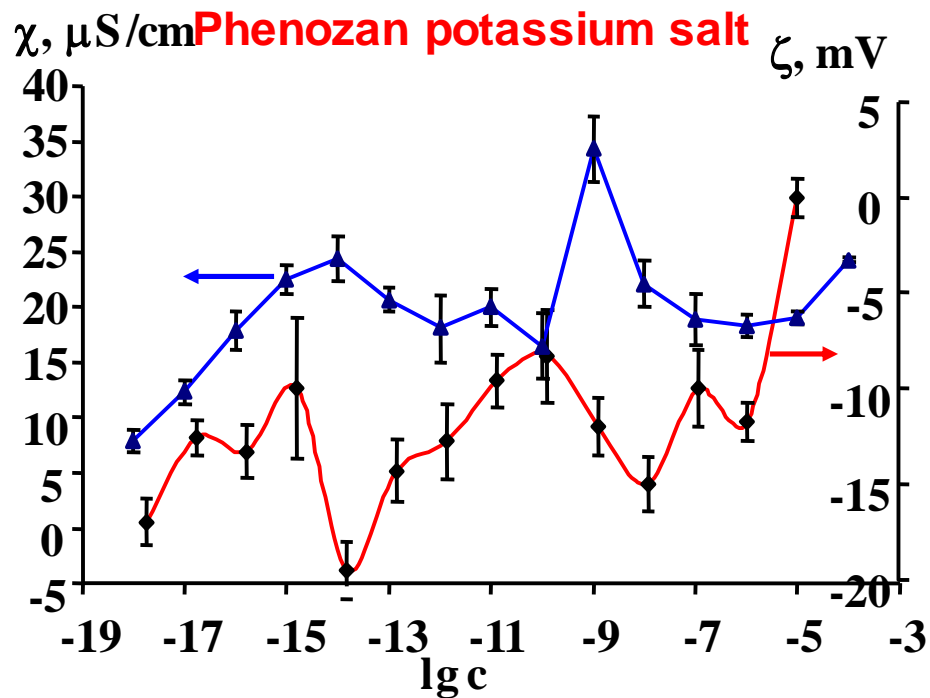
# D, nm

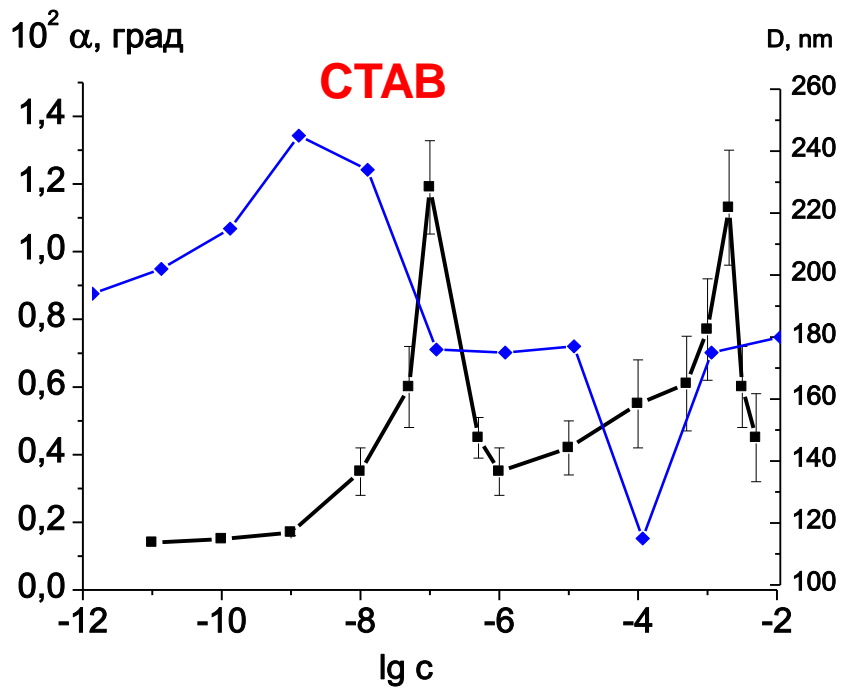


$\zeta, \text{mV}$

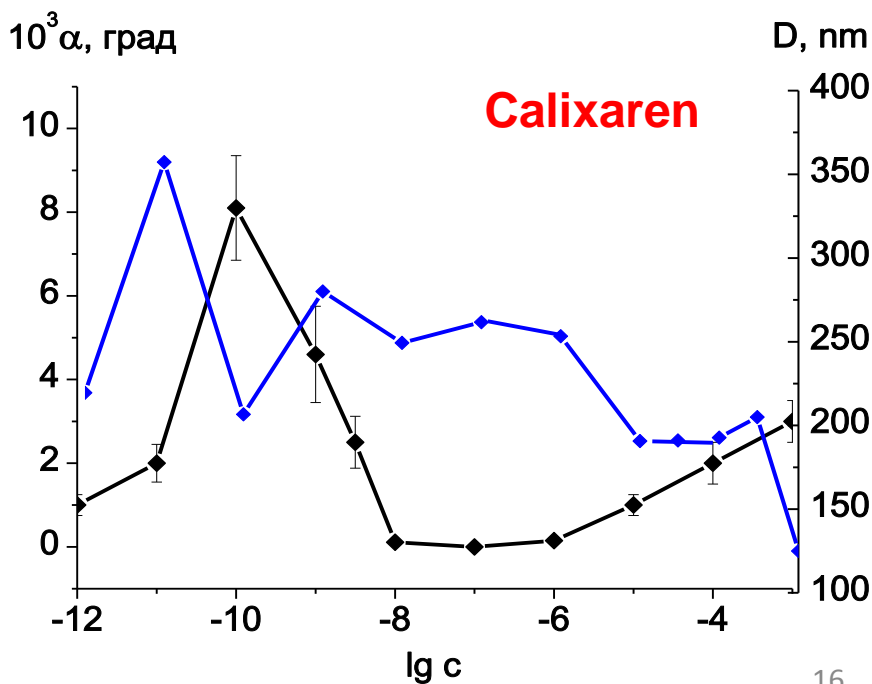
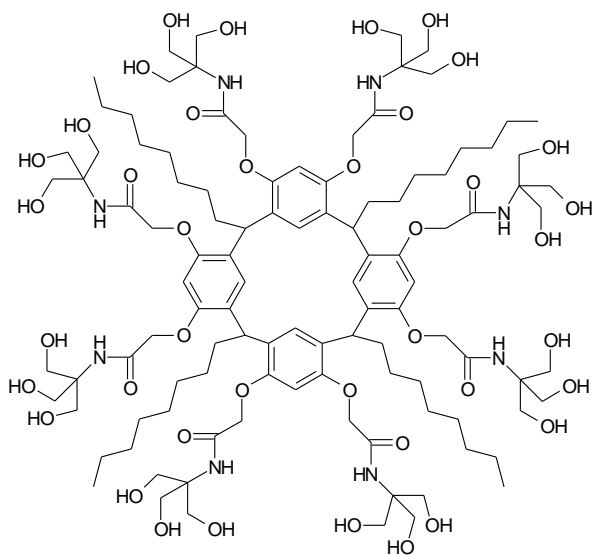
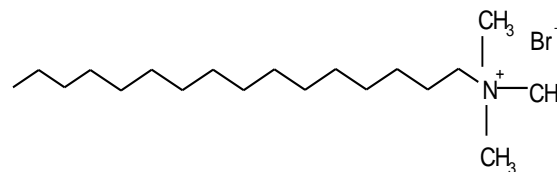








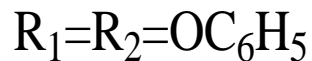
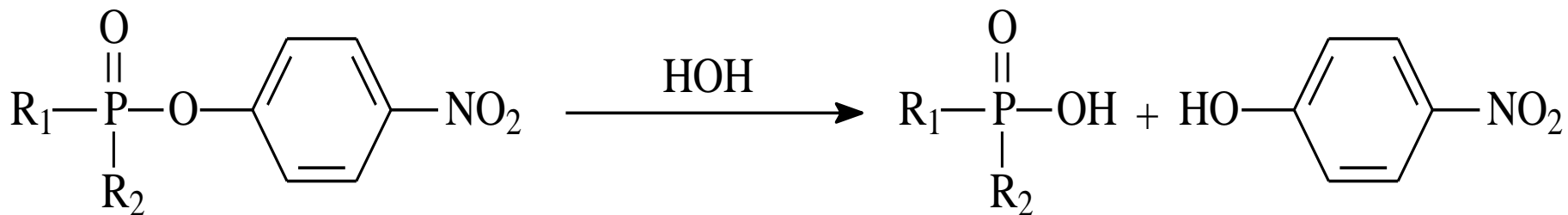
**Perkin Elmer 341**  
 $\alpha^{30}_D, l=0.56 \text{ dm}$   
 $\pm 0.002^0$



# CATALYTIC EFFECT OF CTAB DILUTED SOLUTIONS

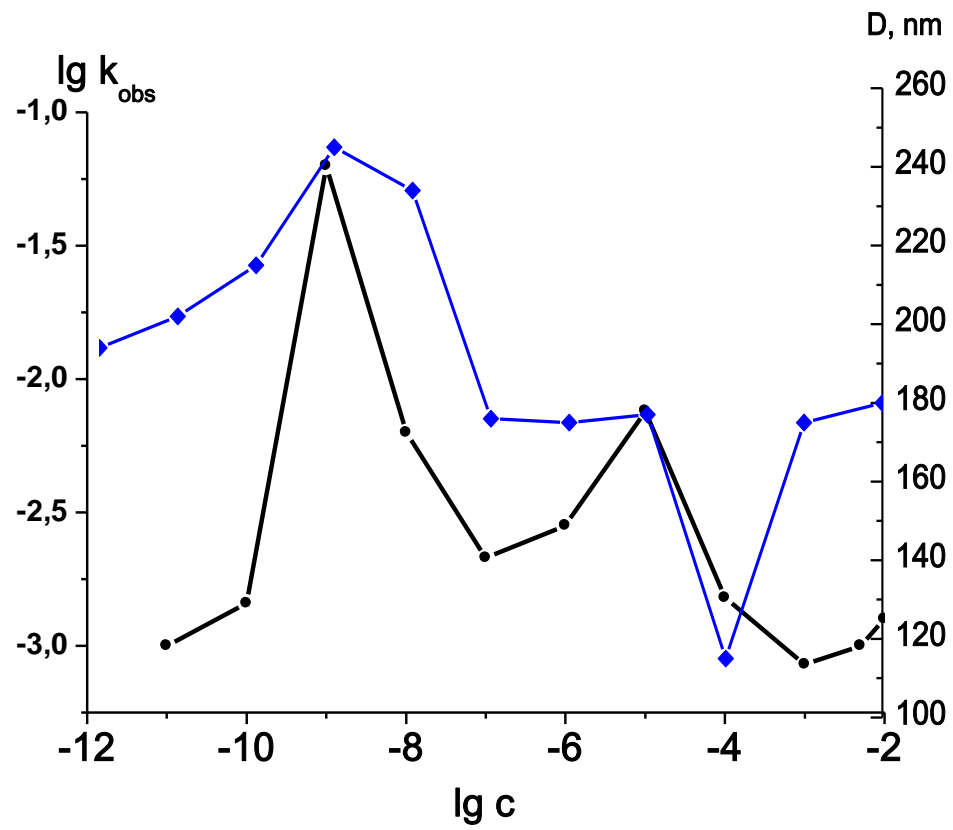
IN

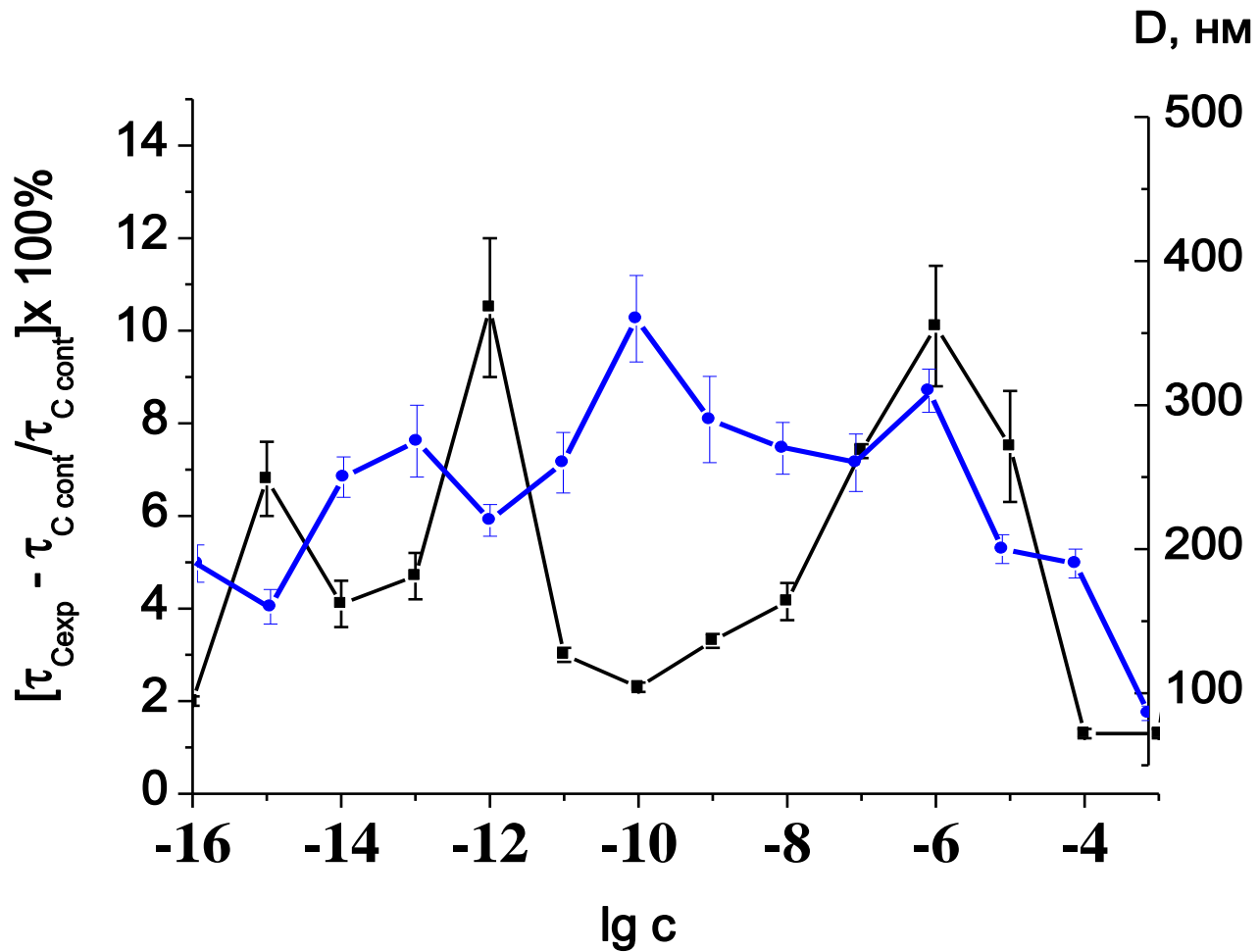
classic biomimetic reaction



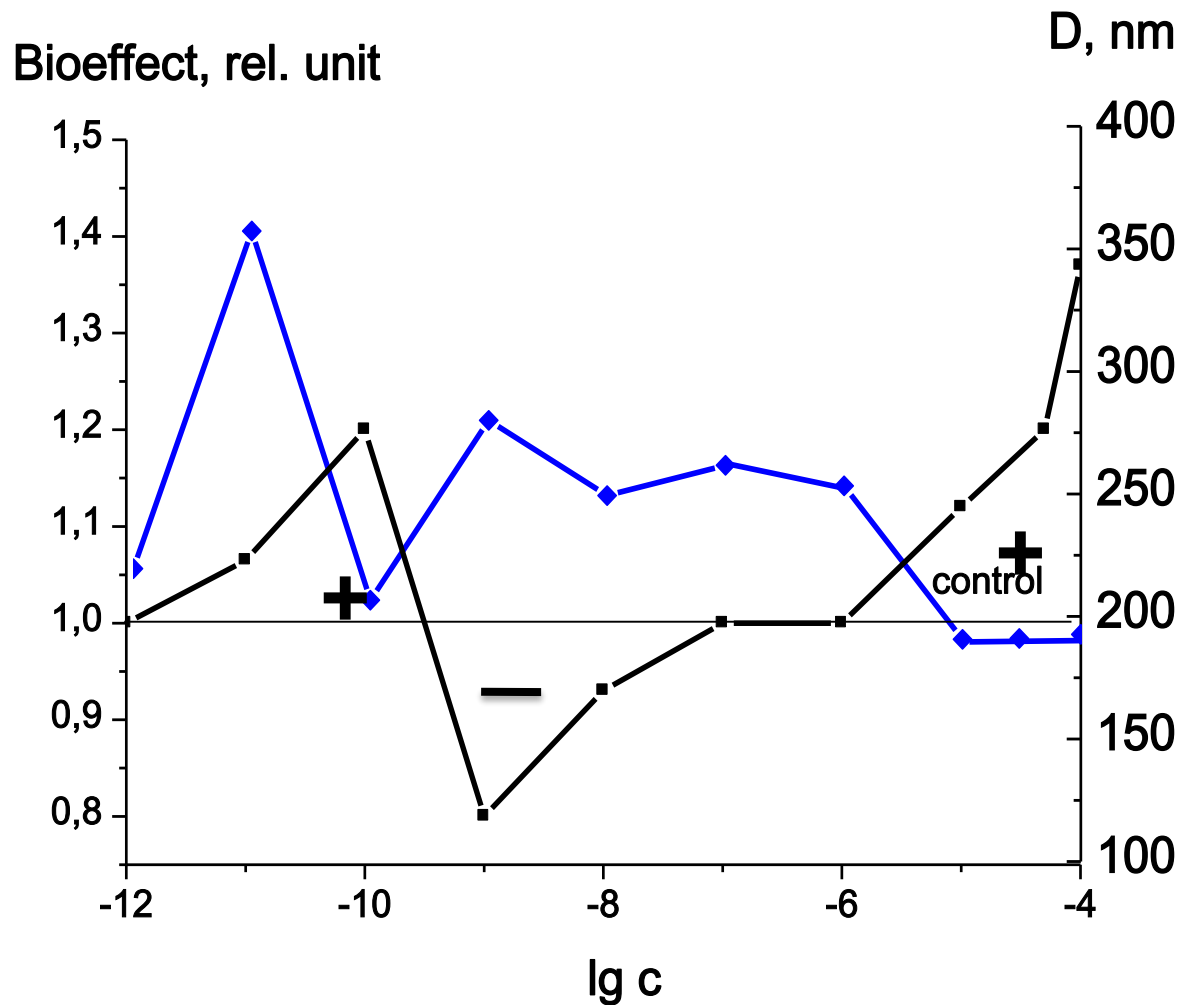
**4-nitrophenyldiphosphat**  
**pH=8, 25 ° C**







The concentration dependence in the membrane lipid microviscosity of synaptosome using HDWS of PhK



**DERIVATIVE OF CALIX[4]RESORCINE: INFLUENCE ON THE CONSUMPTION OF OXYGEN BY CUTTED OFF ROOTS OF WHEAT**

**Electromagnetic fields are necessary**  
**for the formation of nanoobjects and development of**  
**the «abnormal» properties**  
**by highly diluted aqueous solutions**

The initial solutions of each concentration were divided into two series, which were kept for 18 hours before measurement:

1. **The first one** on a laboratory table (**usual conditions**)
2. **The second one** in a **permalloy container** (**hypoelectromagnetic conditions**).

laboratory bench



**permalloy container**



magnetic induction (B) of geomagnetic field of Earth  
in Kazan is  $53 \cdot 10^3$  nTl, in container - 10-20 nTl

**Parameters and properties**

**D - size**

**particles**

**$\zeta$  - potential**

\_\_\_\_\_

**X – electro-conductivity**

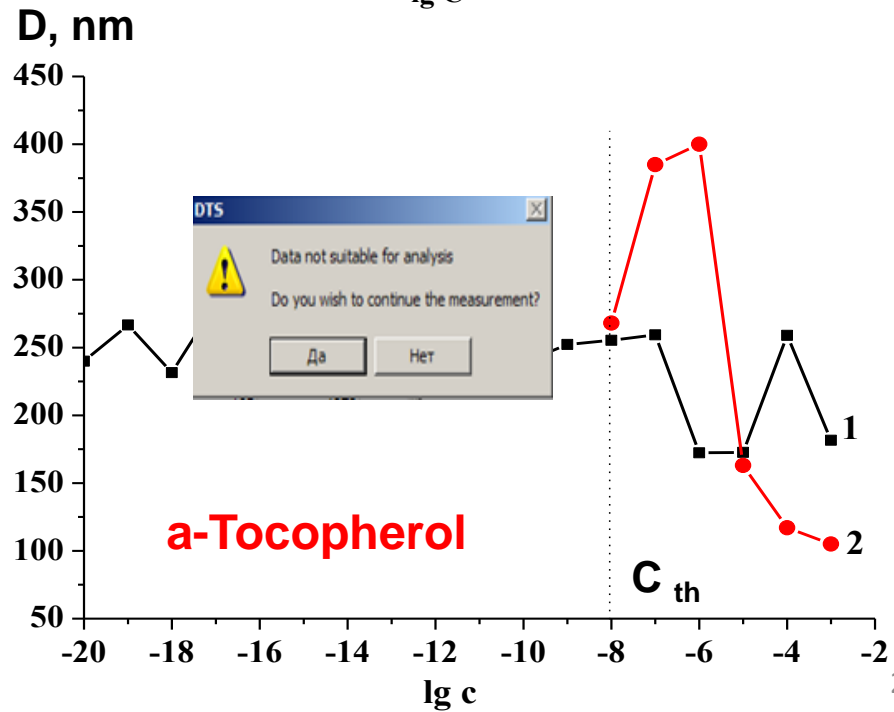
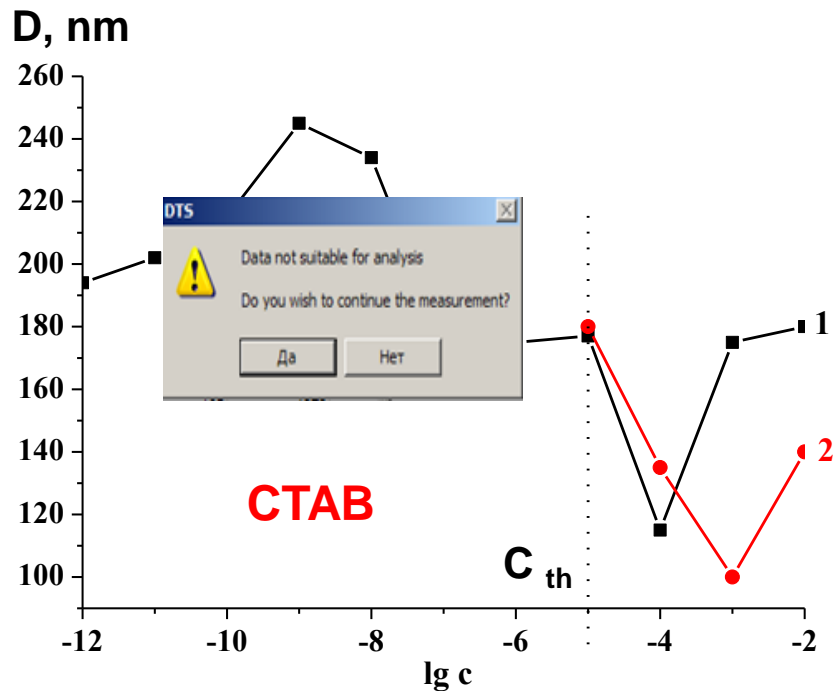
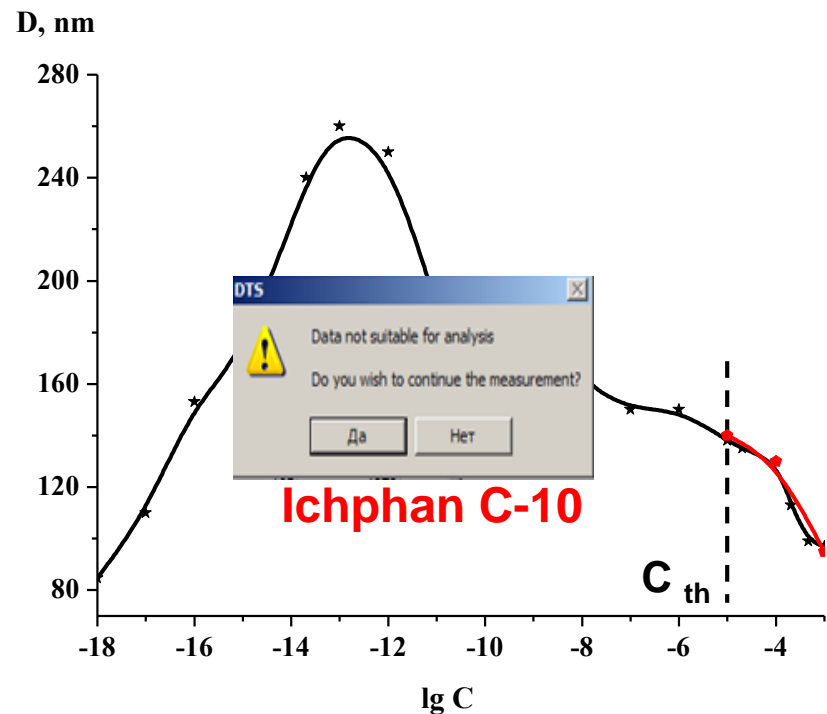
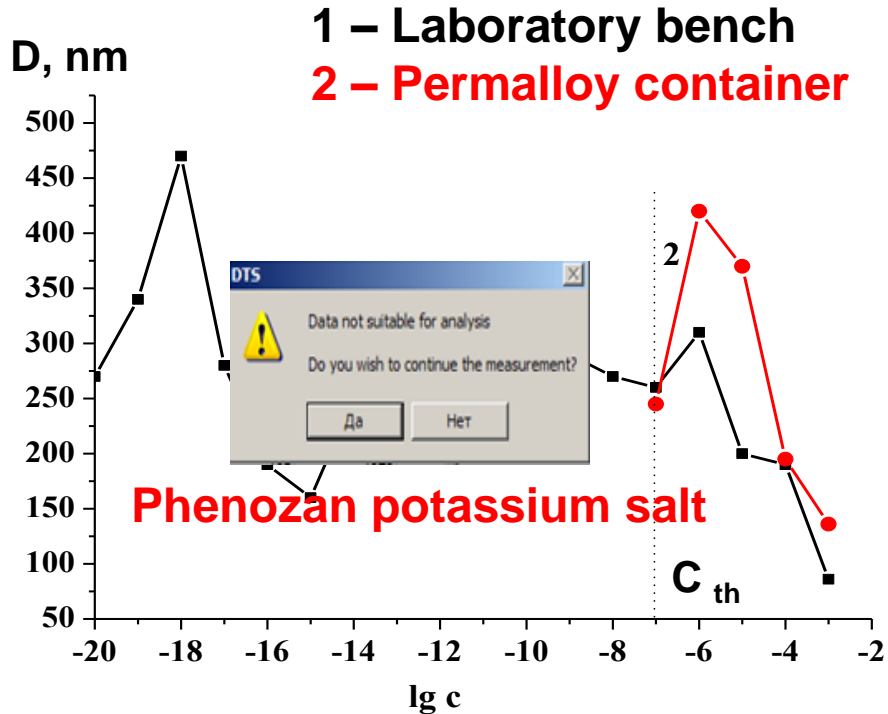
**solutions**

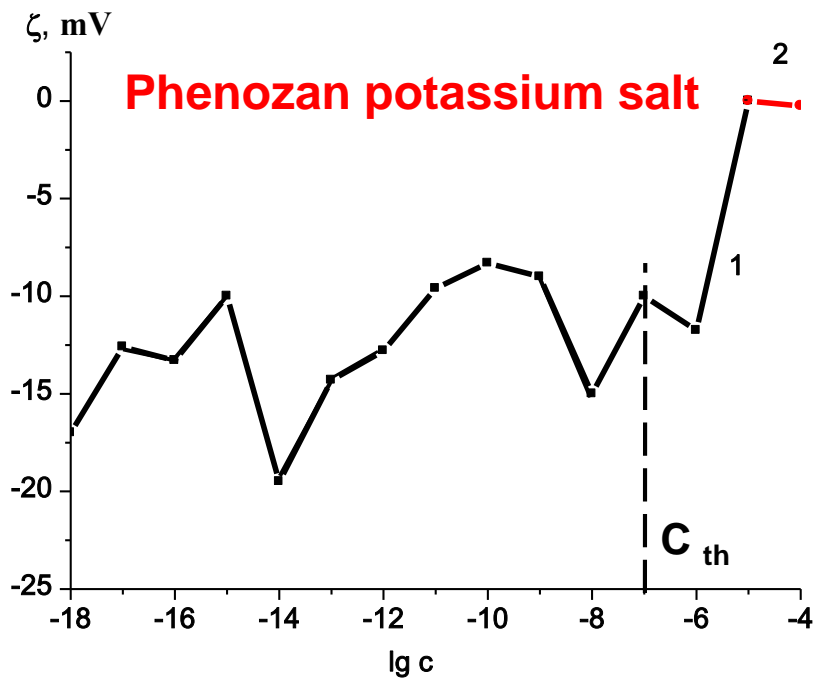
**$\alpha$  - optical activity**

**catalytic activity**

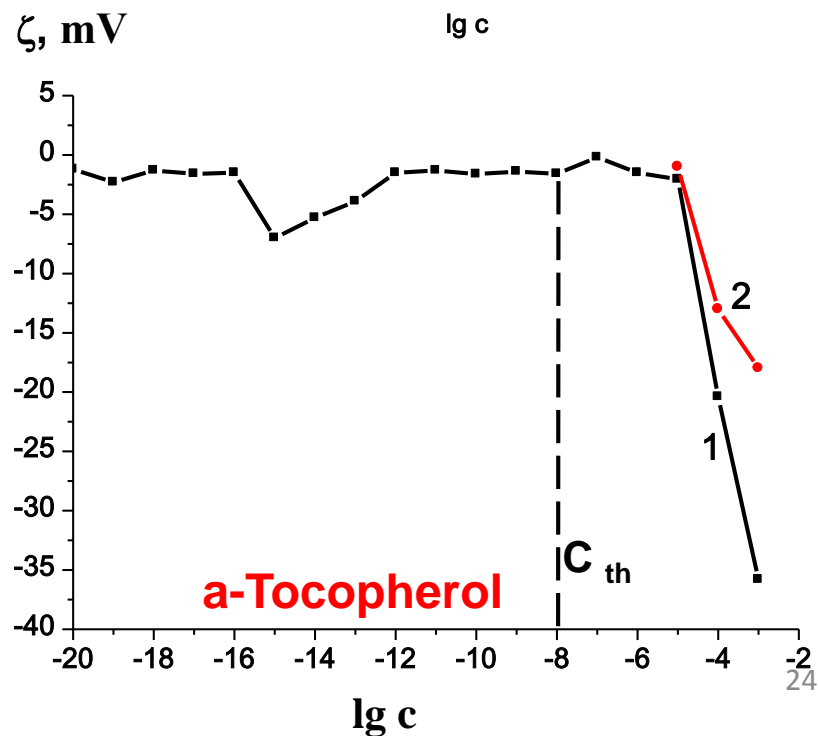
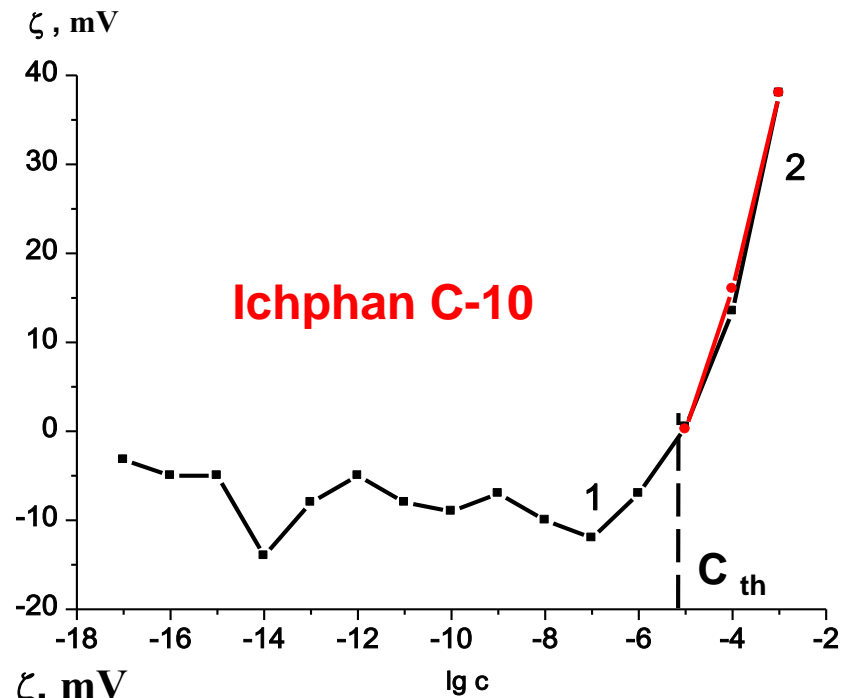
**biological activity**

**change of sign of influence of biological activity**



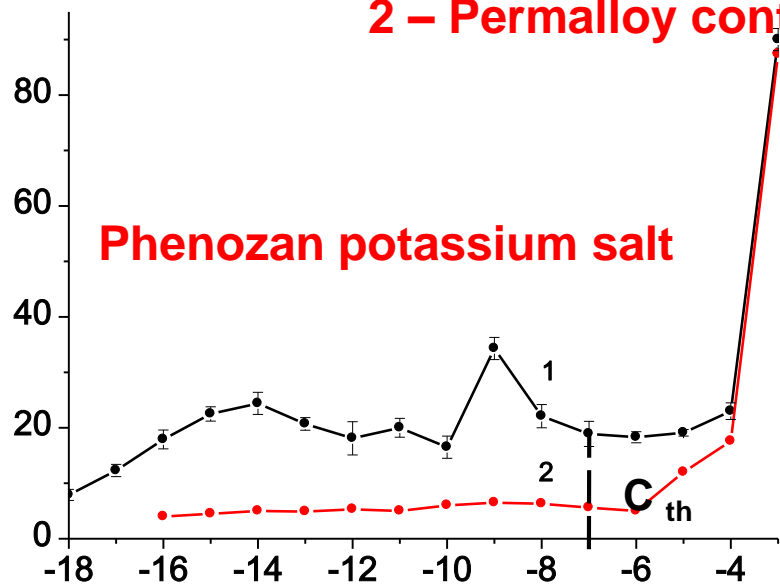


**1 – Laboratory bench**  
**2 – Permalloy container**



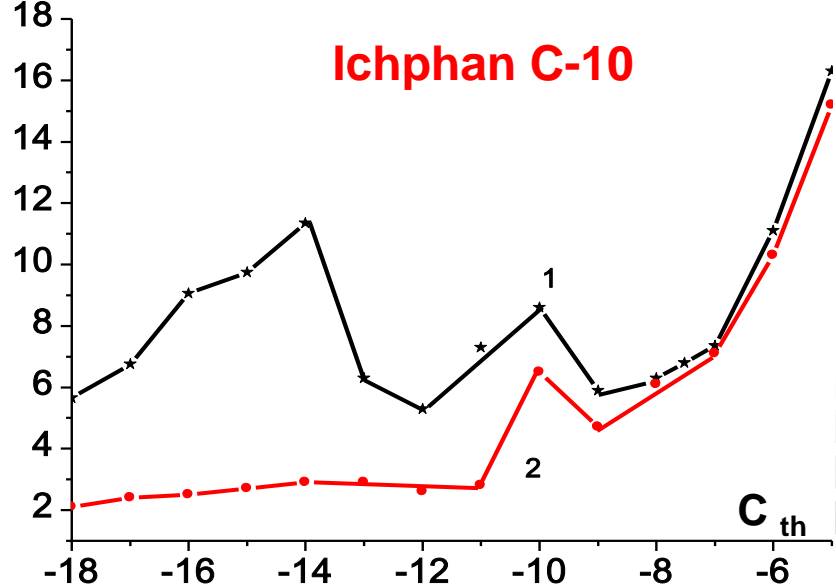
$\chi$ ,  $\mu\text{S}/\text{cm}$

1 – Laboratory bench  
2 – Permalloy container



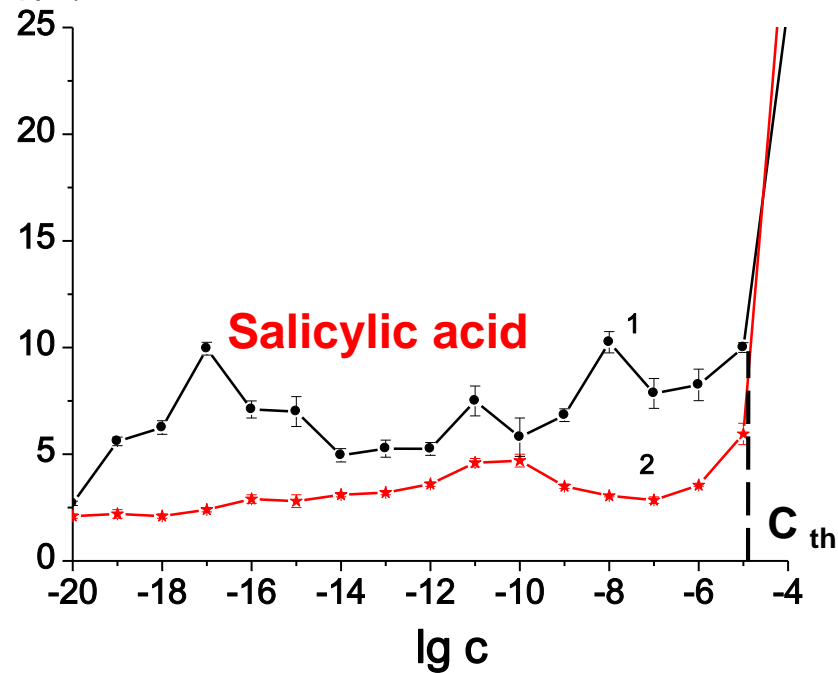
$\chi$ ,  $\mu\text{S}/\text{cm}$

Ichphan C-10



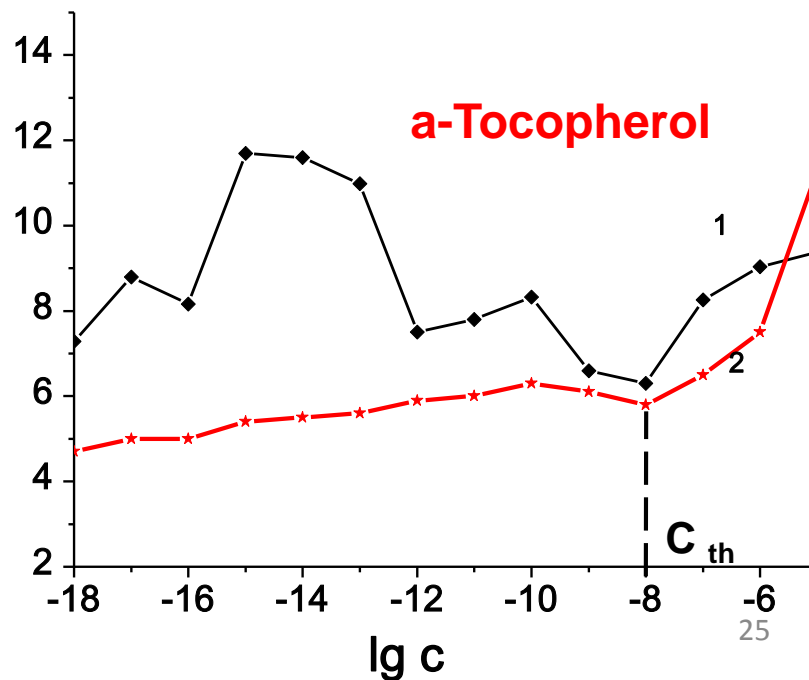
$\chi$ ,  $\mu\text{S}/\text{cm}$

$\lg c$



$\chi$ ,  $\mu\text{S}/\text{cm}$

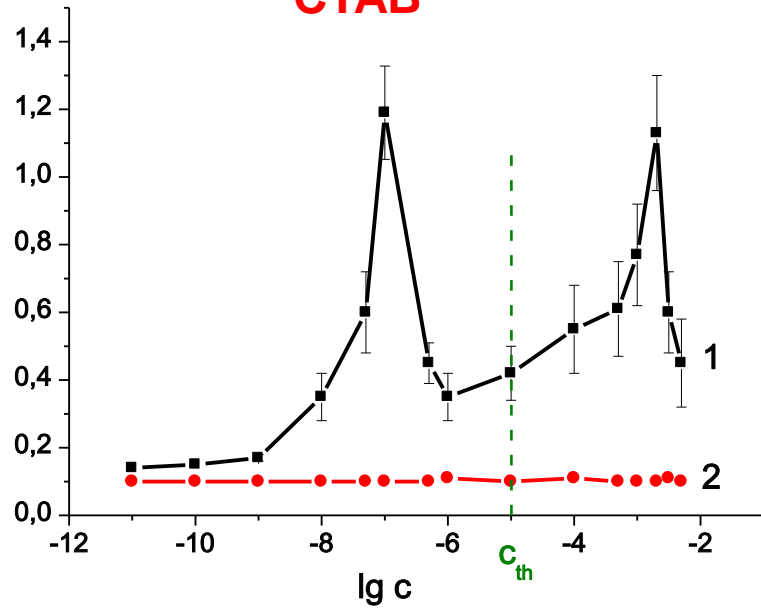
$\lg C$





$10^2 \alpha$ , град

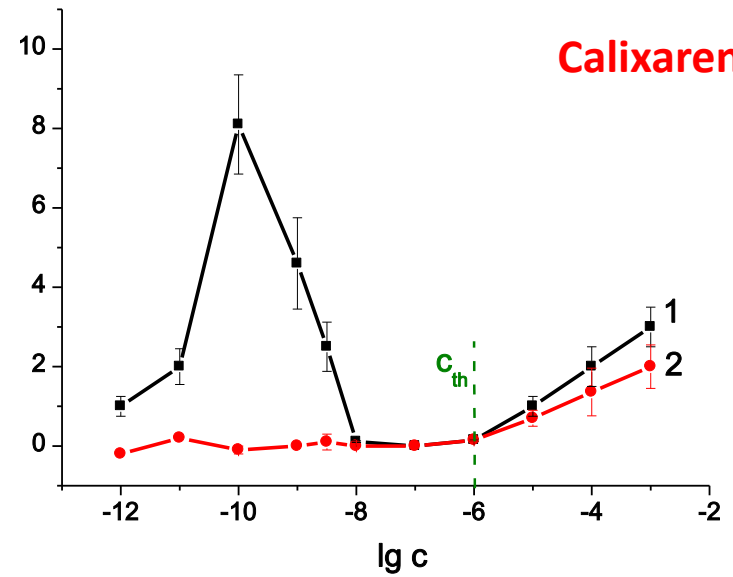
**CTAB**

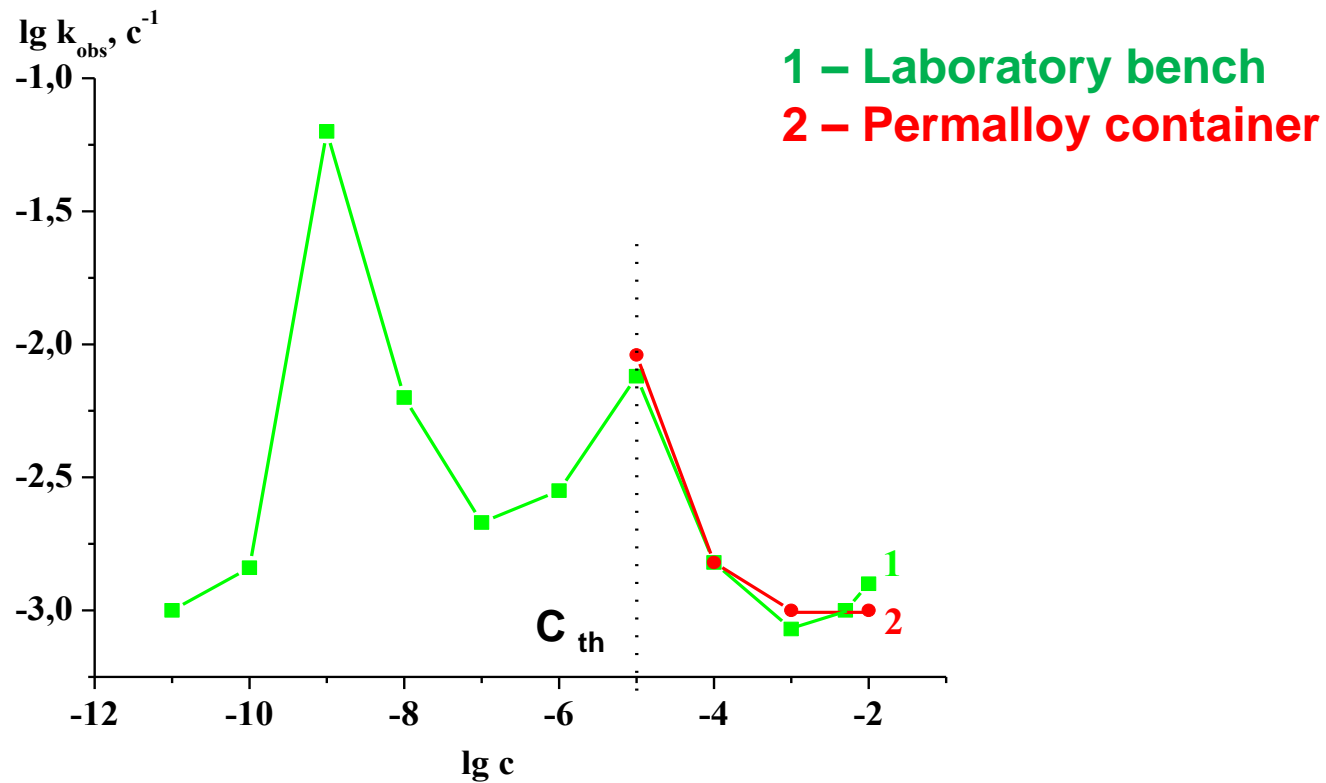


1 – Laboratory bench  
2 – Permalloy container

$10^3 \alpha$ , град

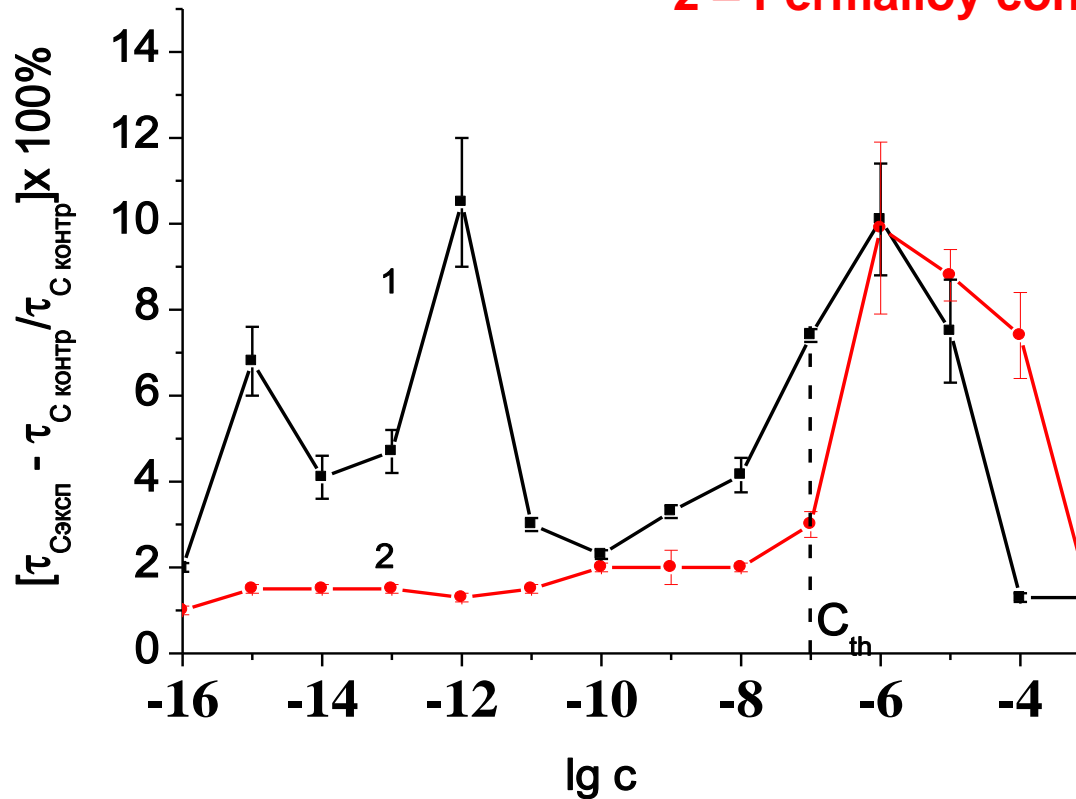
**Calixarene**





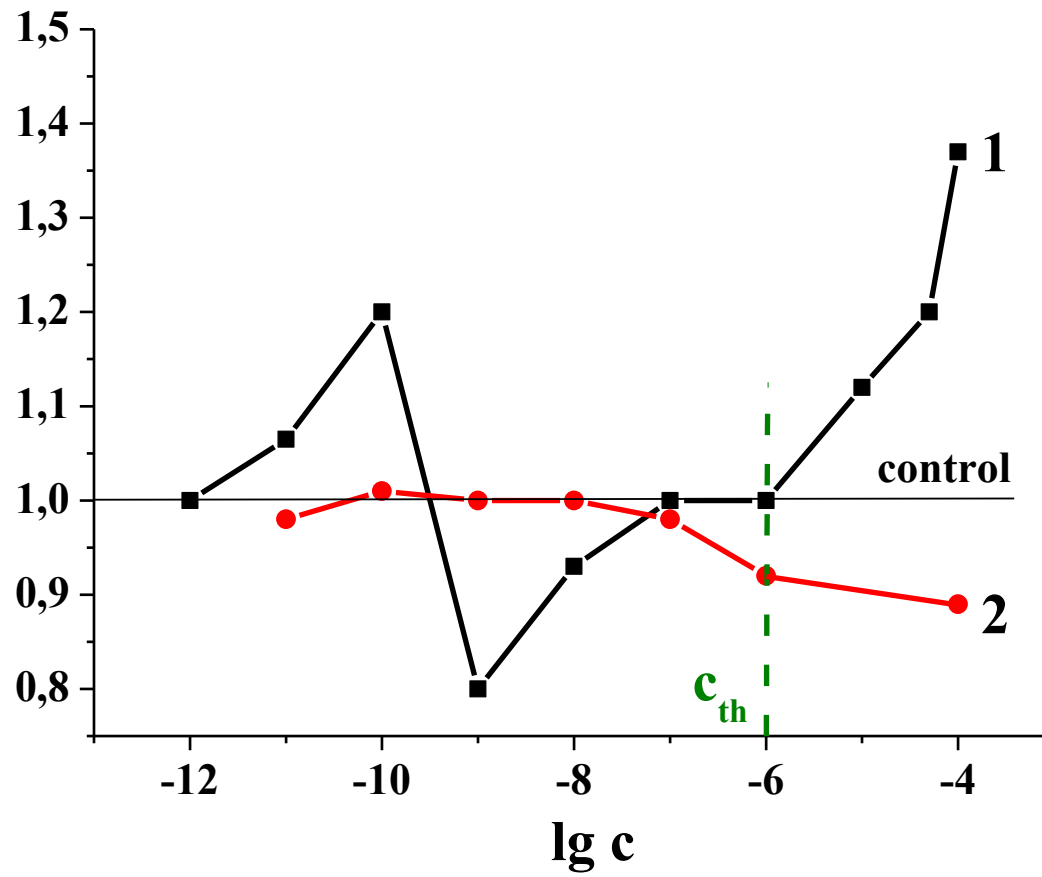
## CATALYTIC EFFECT OF CTAB DILUTED SOLUTIONS

1 – Laboratory bench  
2 – Permalloy container



The concentration dependence in the membrane lipid microviscosity of synaptosome using HDWS of PhK

# Bioeffect, rel. unit



**AFTER C<sub>th</sub>**

Laboratory bench

Formation of nanoobjects

properties of diluted solutions

are realized  
all properties of nanoobjects.

But formation **ONLY** of nanoobjects  
are possible **EMF** **EMF**.

**BEFORE C<sub>th</sub>**

Laboratory bench

Permalloy container  
**EMF**

**NANOOBJECTS**

**PROPERTIES**

C<sub>th</sub>

Limit of Avogadro  
range

10<sup>-22</sup>

10<sup>-8</sup> - 10<sup>-5</sup>

10<sup>-4</sup>

10<sup>-3</sup>

10<sup>-2</sup>

(*c*, *M*)

# AFTER C<sub>th</sub>

What is the nature of nanoobjects which are formed after C<sub>th</sub> in customary conditions?

Are they supramolecular in classical sense?

C<sub>th</sub>

Limit of Avogadro range

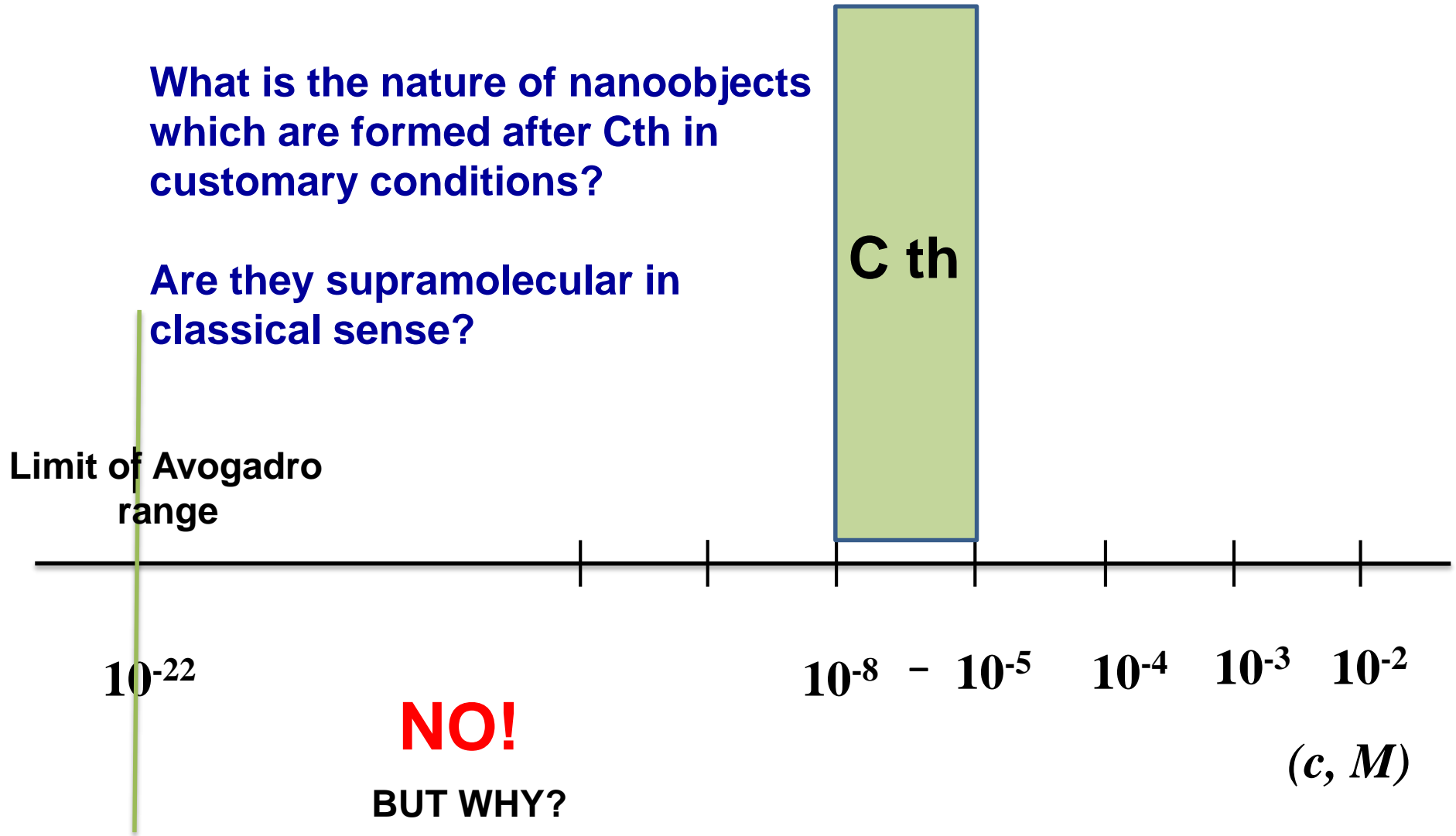
10<sup>-22</sup>

10<sup>-8</sup> - 10<sup>-5</sup>    10<sup>-4</sup>    10<sup>-3</sup>    10<sup>-2</sup>

**NO!**

BUT WHY?

(*c*, *M*)



**Supramolecular systems are complex entities, which are self-organized from two or more individual molecules under action of intermolecular forces.**

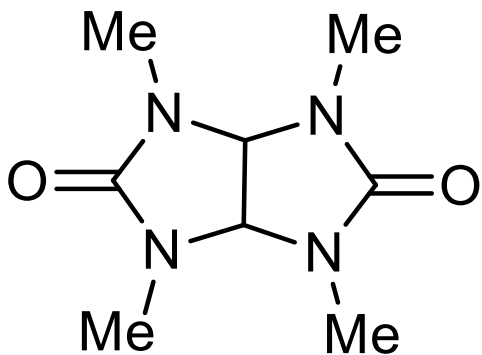
**Supramolecular systems can be organized by interaction of several (two) molecules and do not demand for their formation EMF**



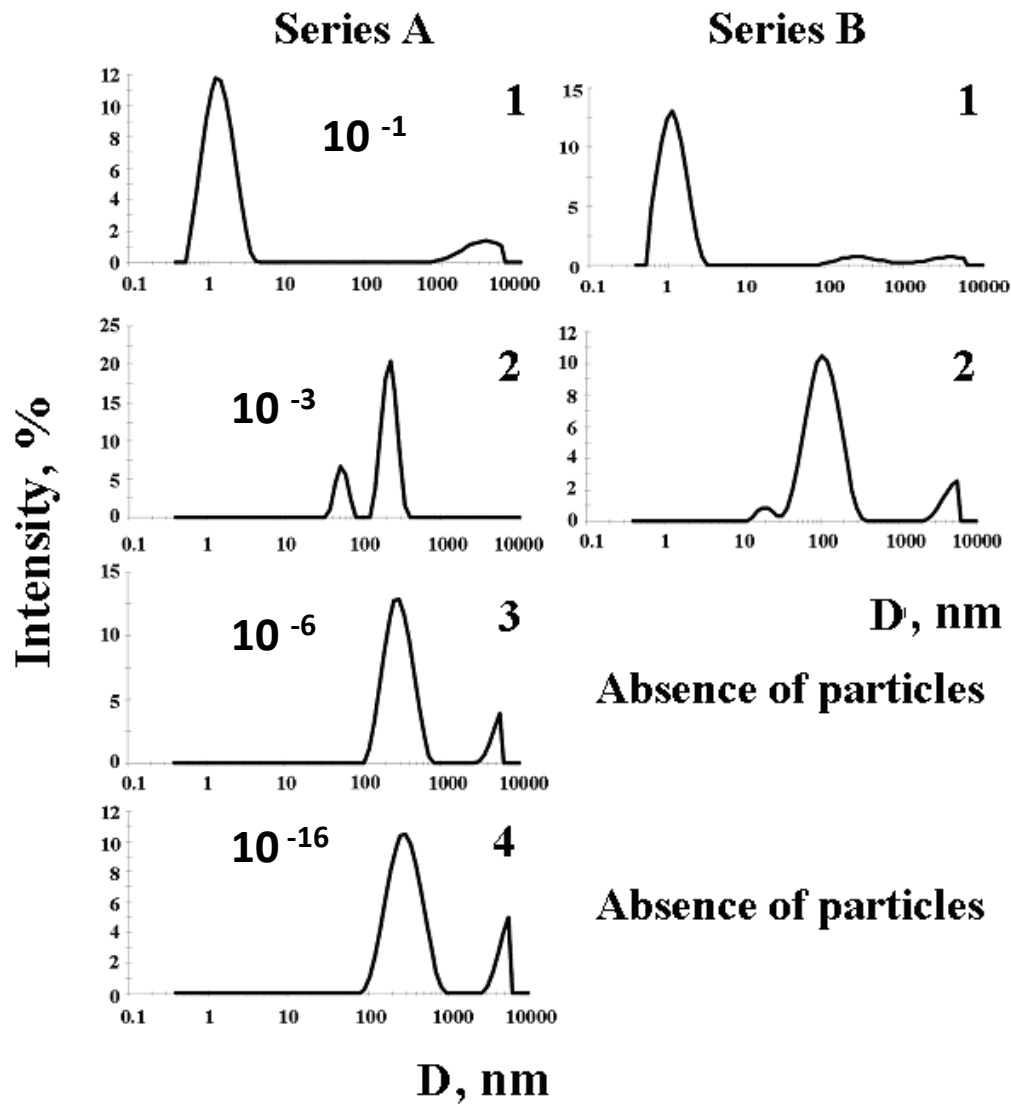
**Customary models:**

**Short (nm) range electro-static (ES) (Coulomb) interactions among solvent and solute molecules affect liquid structure; only can account for selforganization of ~1-10nm supramolecular architectures.**

# MEBICAR SOLUTIONS



A – Laboratory bench  
 B – **Permalloy container**

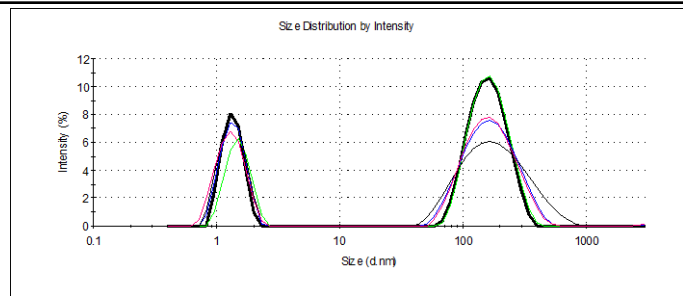




# Laboratory table

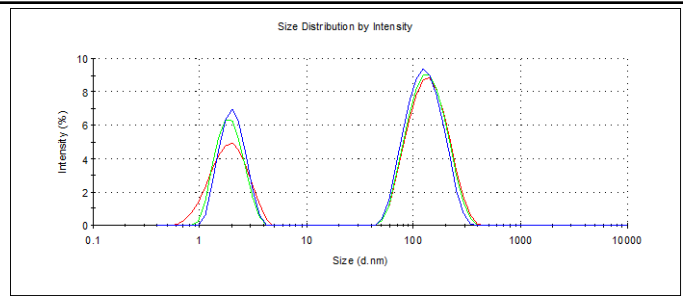
**CTAB**

# Permalloy container

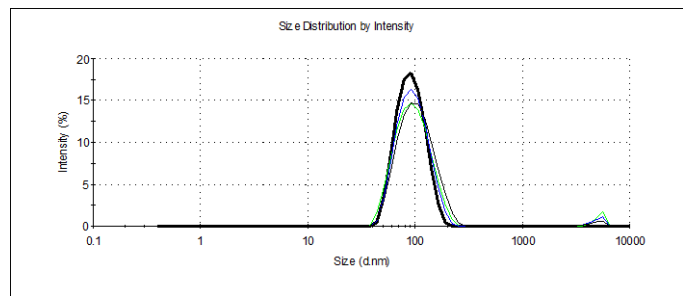


**+65  
mV**

**10<sup>-2</sup>**

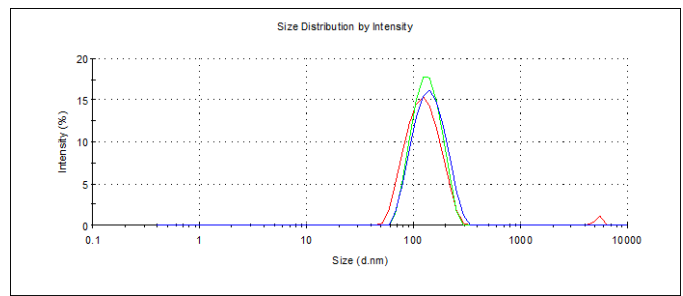


**+15  
mV**

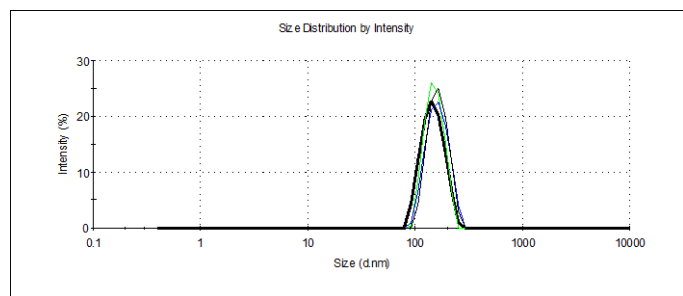


**+20  
mV**

**10<sup>-4</sup>**

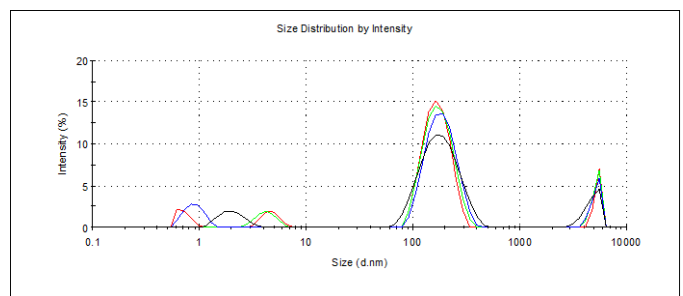


**+4  
mV**

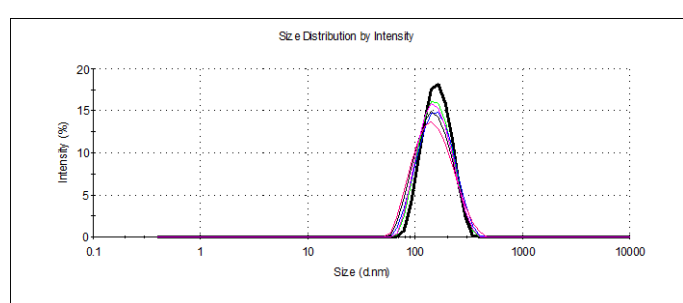


**0  
mV**

**10<sup>-5</sup>**

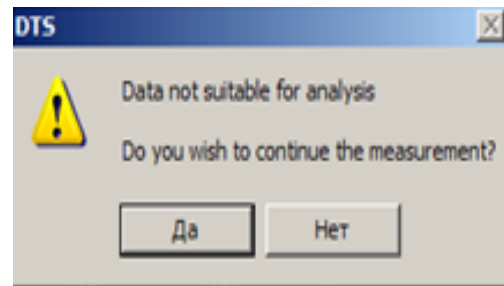


**+4.2  
mV**



**-8  
mV**

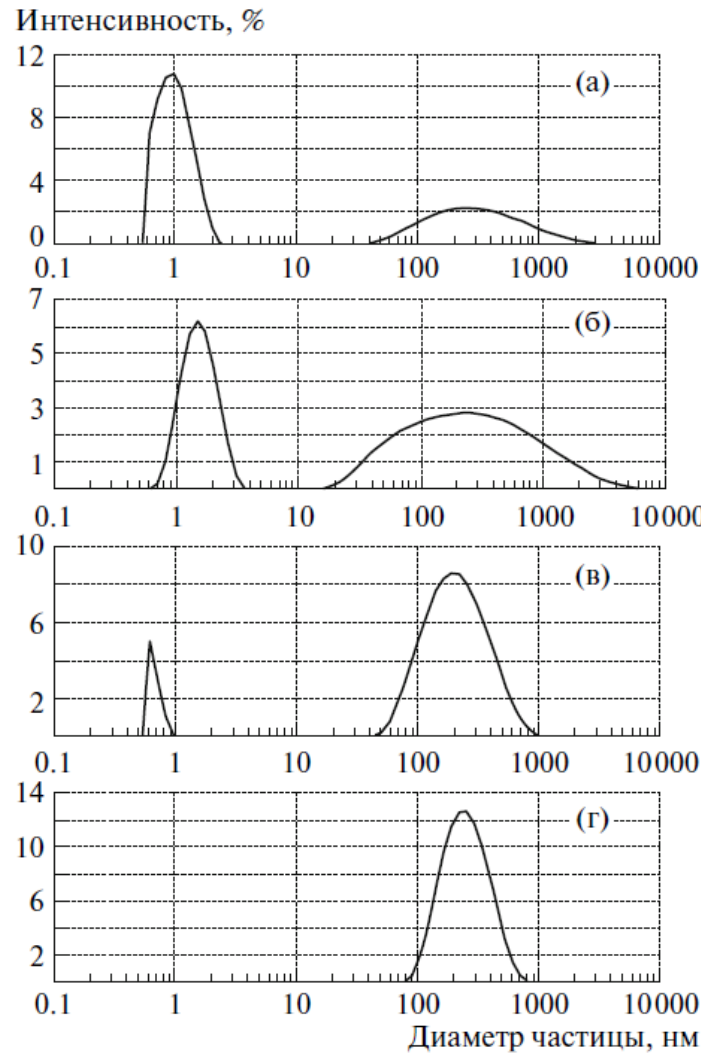
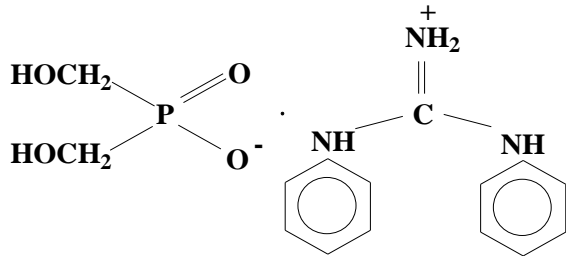
**10<sup>-6</sup>**



**0**

# SIZE DISTRIBUTION OF NANOOBJECTS BY DILUTION

## GUANIBIPHOS



M %

$10^{-2}$  72

$10^{-3}$  27

$10^{-4}$  9

$10^{-5}$  0



## Customary models:

**Short (nm) range** electro-static (ES) (Coulomb) interactions among solvent and solute molecules affect liquid structure; only can account for selforganization of **~1-10nm supramolecular architectures.**

➤ **Customary models:**

**Short (nm) range** electro-static (ES) (Coulomb) interactions among solvent and solute molecules affect liquid structure; only can account for selforganization of **~1-10nm supramolecular architectures**.

➤ **Quantum Electro-dynamic (QED) model:**

In 1988-1993 G. Preparata, **E.Del Giudice** and G. Vitiello solved a quantum physics controversy;

**$10^2$ - $10^5$ nm span** ED interactions among solvent and solute molecules, **mediated by EMF**, may lead to  **$10^2$ - $10^5$ nm domains**.

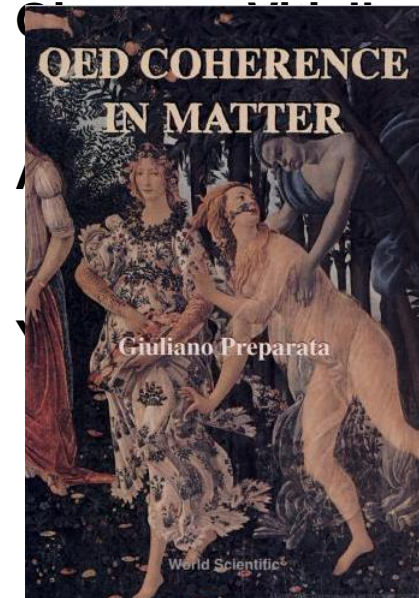
**Domains formation realizes with participation of millions molecules.**

# QFT

# QED



**G.Preparata, E.Del Giudice**



**Tamar Yinnon**

**G.Preparata, 1995, QED Coherence  
In Matter, World Scientific Publishing  
, Singapore**

**Tamar Yinnon, summarizing all results on the application of QED model to highly diluted water solutions or more wider to Serial Diluted Vigorous Shaken Polar Liquids (SDVSPL) containing different type of solutes, concluded that in such solutions (liquids) SERIES OF DOMAINS MEDIATED BY EMF CAN BE FORMED:**

$$\mathbf{CD}_{\text{elec}} = \sim 10^2 \text{ nm}$$

$$\mathbf{CD}_{\text{plasma}} = \sim 10^3 \text{ nm}$$

$$\mathbf{IPD}_{\text{plasma}} = \sim 10^3 \text{ nm}$$

$$\mathbf{CD}_{\text{rot}} = \sim 10^4 - 10^5 \text{ nm}$$

**Electric Dipole Aggregate (EDA)**

**It was shown by Tamar Yinnon that our experimental results correspond to those predicted by QED theory.**

**But it can be said vice versa predicted by QED theory results correspond to those obtained by experiments.**

# Domains formation mediated by electromagnetic fields in dilute solutions

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### Abstract

► **EM-field** mediated issues related to our experimental work  
► **Diluted** and **partially** characterized (PC) thermal stable polymeric micellar gels of  $\alpha$ -cyclodextrin (CD) in water  
► **EM-field** mediated issues related to our experimental work  
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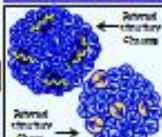
### Introduction & study goal

► **EM-field** mediated issues related to our experimental work  
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### EM FIELD FALSIFICATION OF ORDER FORMATION

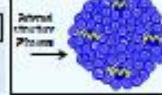
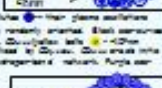
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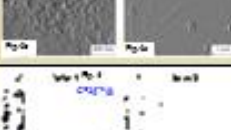
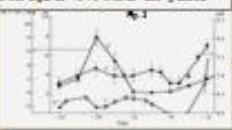
### EXPERIMENTAL RESULTS

► **EM-field** mediated issues related to our experimental work  
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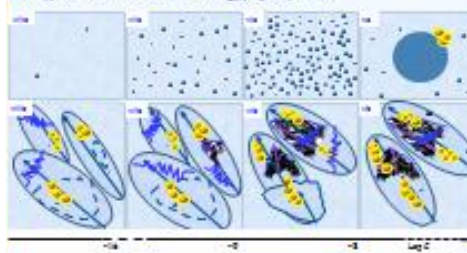


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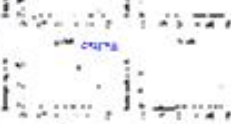


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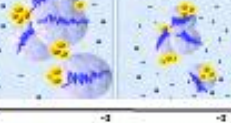
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# Aqueous solutions containing domains

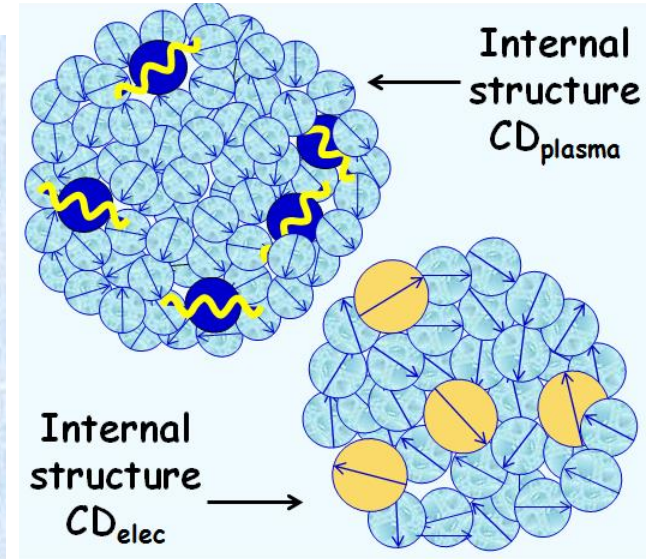
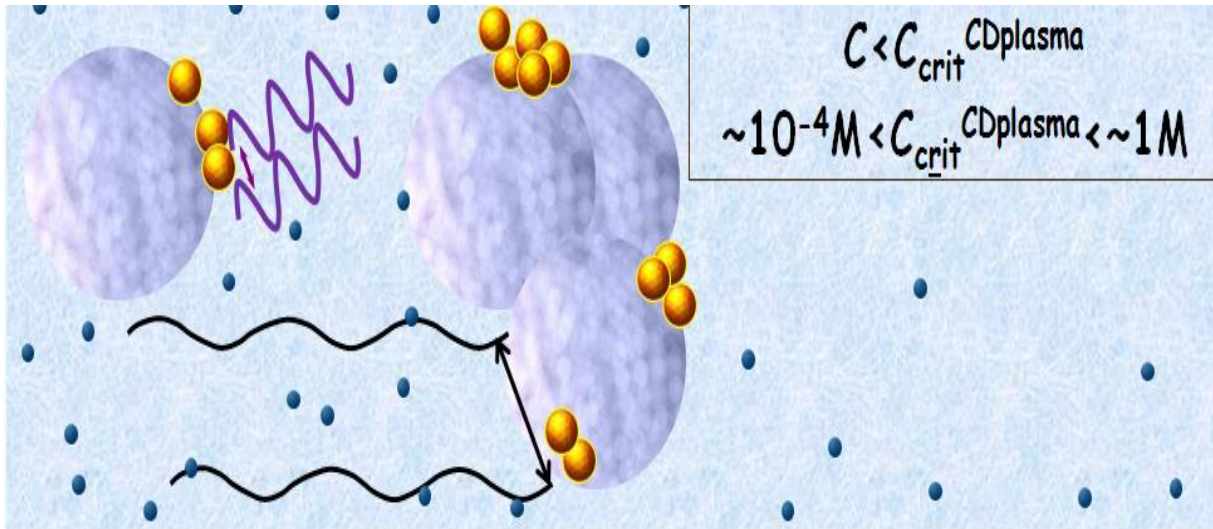


Fig.1  $CD_{plasma}$  (purple balls) =  $\sim 10^3 \text{ nm}$  domains composed of: (a) Solutes  $\bullet$  - their plasma oscillations are coherent; (b)  $H_2O$  with their dipole moments (DM) randomly oriented. Black cos-curves represent GHz-MHz EMF mediating interactions between solutes.  $CD_{elec}$  (yellow balls ) =  $\sim 10^2 \text{ nm}$  domains. 13% of their  $H_2O$  are electronic excited.  $CD_{elec}$  get stabilized by  $CD_{plasma}$ .  $CD_{elec}$  are ab initio derived by QED theory and underlie empirically-identified hydrogen-bond network. Purple cos-curves represent UV EMF mediating between  $H_2O$  of  $CD_{elec}$ .

Tiny blue balls = solvated solutes.



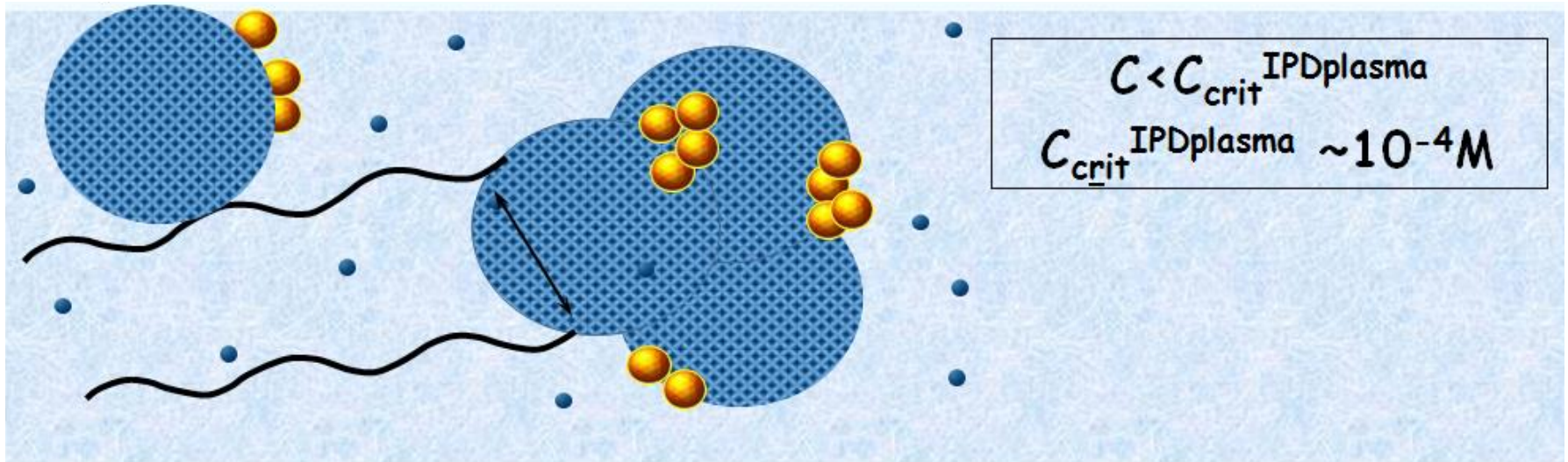
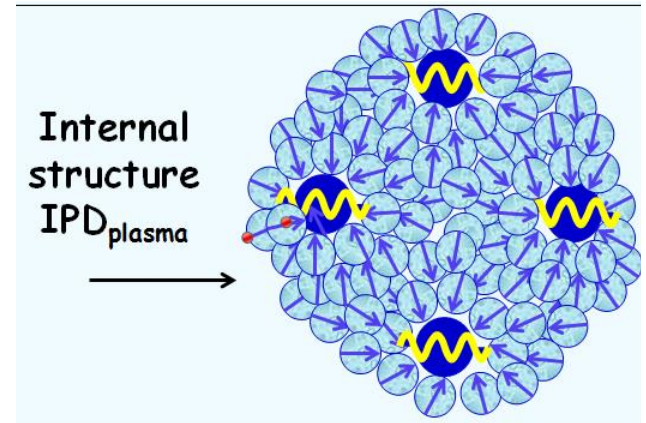
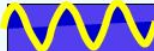



Fig.2 IPD<sub>plasma</sub> (large blue balls) =  $\sim 10^3 \text{ nm}$  domains composed of:

- (a) Crystalline ordered solutes ● -- their plasma oscillations  are in-phase;
- (b) numerous  $\text{H}_2\text{O}$   -- their DM are spherical symmetric oriented around nearest solute molecules. Black cos-curves, yellow and tiny blue balls are as in Fig.1.

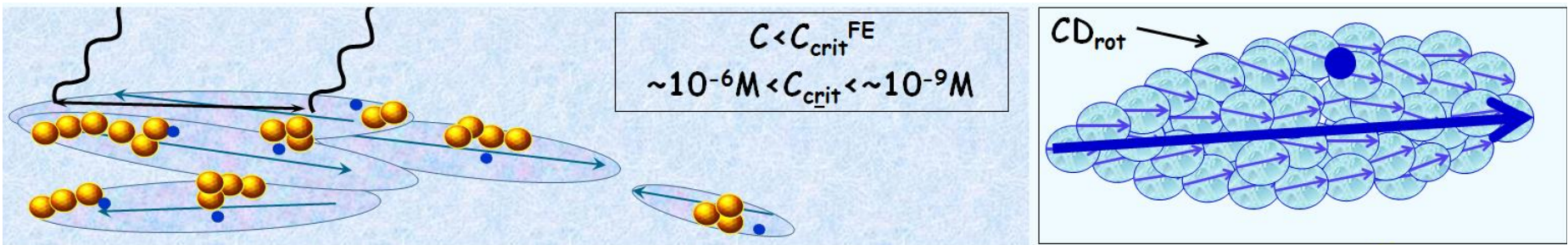


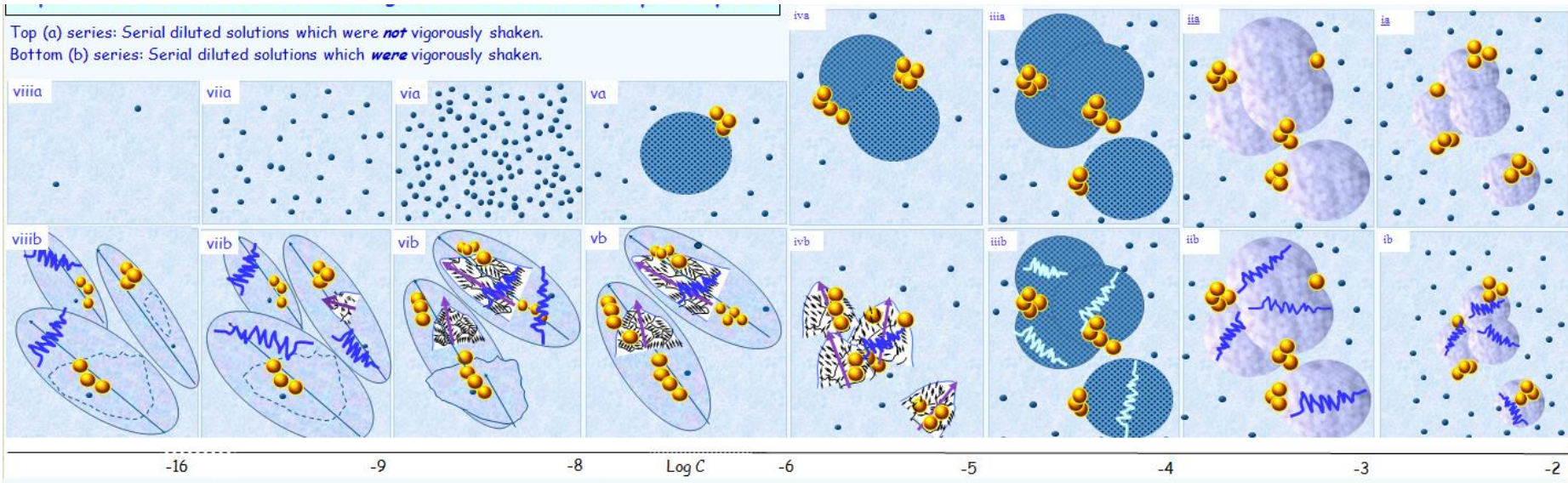


Fig. 3  $CD_{rot} = 10^4-10^5$ nm elongated domains composed of ferro-electric (FE) ordered  $H_2O$   and may contain few solutes .  $CD_{rot}$  have a DM.  $CD_{rot}$  only form (are stabilized) in presence of particles (large molecules or clusters) which have a significant DM. Black cos-curves represent FIR EMF mediating interactions between  $H_2O$ . Yellow and tiny blue balls are as in Fig.1.  $CD_{rot}$  stabilize  $CD_{elec}$ .

## Note:

- Domains are not pictured according to real scale ratios.
- Ratios of  $CD_{rot}$ ,  $CD_{plasma}$  and  $CD_{elec}$  radi resemble that of the sun, earth and moon.  
 $IPD_{plasma}$  size  $\approx$   $CD_{plasma}$  size.

# Impact of serial dilutions and shaking after each dilution on polar liquids



# CONCLUSIONS

IT IS SHOWN THAT IN «USUAL CONDITIONS» IN HIGHLY DILUTED SOLUTIONS NANOOBJECTS ARE FORMED WHICH ARE ABSENT IN «PERMALLOY CONDITIONS» AFTER (BY DILUTIONS) «THRESHOLD CONCENTRATIONS»

THIS FACT INDICATES ON SPECIAL ROLE OF EXTERNAL EMF BY FORMATION OF NANOOBJECTS OBSERVED AND CLUE ROLE OF «THRESHOLD CONCENTRATIONS» IN BEHAVIOUR HIGHLY DILUTED SOLUTIONS

APPLICATION OF QED THEORY TO HIGHLY DILUTED SOLUTIONS INDICATES ON CORRESPONDANCE EACH OTHER OF EXPERIMENTAL AND PREDICTED BY THEORY DATA

ACCORDINGLY NANOOBJECTS OBSERVED SHOULD BE CONSIDERED AS QED DOMAINS OR DOMAINS MEDIATED BY EMF WITH PARTICIPATION OF SOLUTE AND MILLIONS (AT LEAST) SOLVENT MOLECULES

# Acknowledgments

Ph.D. Murtazina L.I.  
Ph.D. Kiseleva Ju.V.

*A.E. Arbuzov Institute of Organic and  
Physical Chemistry of Kazan Scientific  
Centre of Russian Academy of Sciences*

Fattakhov S. G.  
Solov'yeva S. E.  
Mironov V.F.  
Timosheva A.P.  
Kadirov M.K.  
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Litvinov A.I.

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Zhigacheva I.V

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Physics of RAS*

Valitova Ju.N.

*Kazan Institute of Biochemistry and  
Biophysics of RAS*

Fridland S. V.

*Kazan National Technological University*

Evtushenko E

*Moscow State University*

**FINANCIAL SUPPORT**

**PRESIDIUM OF RUSSIAN ACADEMY OF SCIENCES  
AND  
RUSSIAN FOUNDATION OF BASIC RESEARCH**

**Thank you very much  
for your kind attention!**