FEATURES OF AN ORDER IN INFRARED ABSORPTION SPECTRA OF WATER SOLUTION SUBJECTED TO WEAK ELECTROMAGNETIC FIELD

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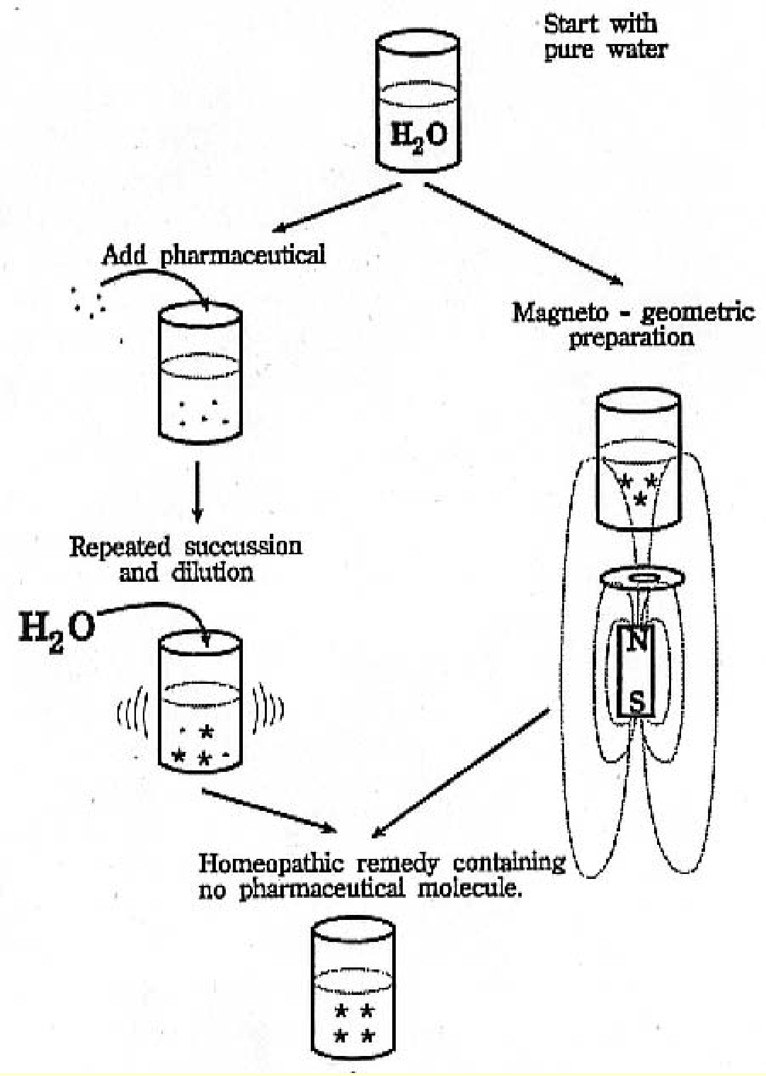
Introduction

- An ability of water to respond to external influences during long period or so named “water memory” phenomenon was discussed widely especially in regard to homeopathy (Davenas et al., 1988; Lo et al., 1996; Roy et al., 2005; Thomas, 2007).
- Homeopathy is a branch of complimentary medicine in which highly diluted solutions of parent bio-active substances are used during approximately 200 years with empirical data on their efficiency in treatment of people and animals.
- Besides homoeopathic remedies prepared by the conventional dilution/succussion procedure, homeopathic preparations based on electronic copying parent bio-active substances received certain acceptance in complementary medicine.

Introduction



- There are 2 procedures of preparation of homeopathic remedies (Towsey M.W., Hasan M.Y. Homoeopathy - a biophysical point of view. Br Hom J 1995; 84: 218-228.):
- left branch – traditional dilution/succussion;
- right branch – electronic copying (“imprinting”) with M. Rae’s apparatus.

There are available some types of devices for such electronic copying

- The first of them was ‘radionic’ magneto-geometric copying apparatus, invented by M. Rae.
- Another electronic copying technique was invented by J. Benveniste’s team (2004) and L. Montagnier (2009).
- Physical basis of electronic copying phenomenon is unclear but there are few suppositions bonding it with interaction of external electromagnetic fields and electromagnetic field of human-operator.
- There are a few empirical observations on the similarity of biomedical action of electronic copies to their parent substances or to conventional homeopathic preparations of these parent substances.

Applications of Electronic Copies

Electronic copies (ECs) are used in modern homeopathy, in Voll & Schimmel’s electro-puncture diagnostics, in Applied Kinesiology. The latter diagnostic technique will be demonstrated by my co-author Tatiana Chernysheva, MD.

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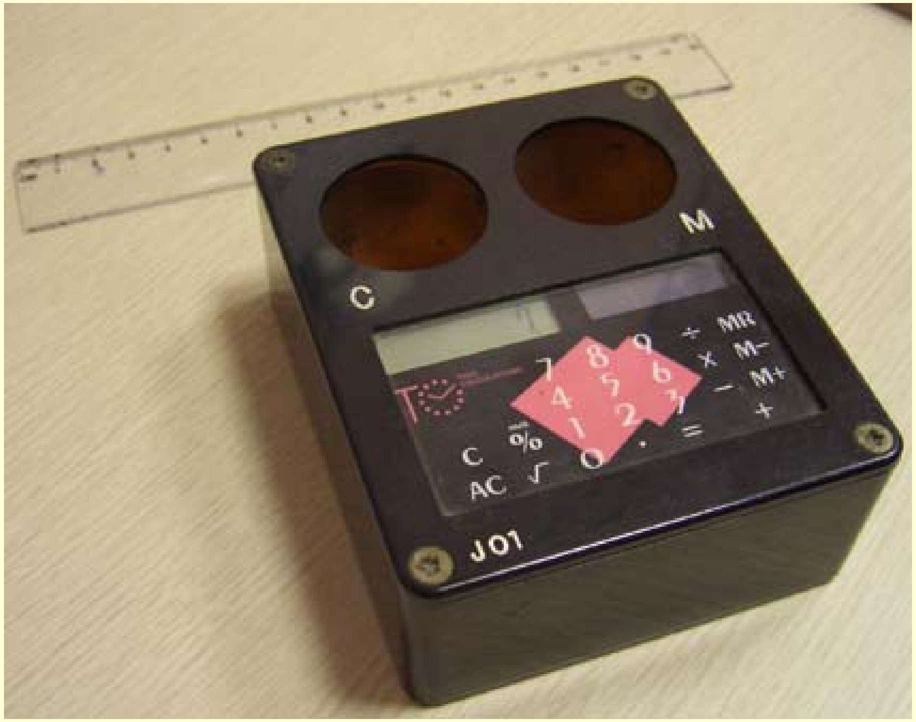
Subject of the study and its purpose

- It is evident that objective physical studies are necessary to approve or reject electronic copying phenomenon.
- One of such studies may be absorption spectroscopy of water-based electronic copies. However this procedure must be strictly double blind due to possible bias involved by human-experimenters.
- Authors made pilot study (Korenbaum et al., 2006, 2009) on this issue, developed double-blind experimental procedure and found statistically essential spectral differences for a part of saline-based electronic copies in the band of wavelengths 800 – 700 nm *re* blank saline solution carrier (centered spectra).
- The purpose of this study is independent double blind analysis of differences between water based electronic copies and blank water carrier in extended band of near-infrared absorption spectra 3000 – 600 nm.

We studied absorption spectra of ECs produced from 7 parent homeopathic remedies:

- DNA-tox (**DNA**) – indicator of DNA problems caused by exposure of organism to toxic agents (Manus, Russia);
- Bacteria (**B**) – superposition of 75 pathogenic bacteria (Meripharm GmbH, Germany);
- Manus (**MAN**) – harmonizing preparation (Manus, Russia);
- Fungus (**FUN**) - superposition of 17 pathogenic fungus (Metabolics Ltd, GB);
- Toxic metal (**TM**) - superposition of 27 salts of heavy metals and toxic metals (Metabolics Ltd, GB);
- Virus (**VIR**) – superposition of 41 pathogenic viruses (Meripharm GmbH, Germany);
- Degeneration (**DEG**) – superposition of 41 oncologic cultures (Meripharm GmbH, Germany).

Simulator (Metabolics Ltd, GB) - a version of M. Rae black box is widely used in Applied Kinesiology



- Apparatus contains two copper tubes, the right of which (M) is for the parent substance copied, whereas the left one (C) for the prepared EC.
- According to Towsey and Hasan (1995) there is a magnet under container C in the box.
- In accordance with “radionic” technique developed by M. Rae the effect of a substance copied is to ‘modulate’ magnetic field, which in turn “restructures” water crystallization.

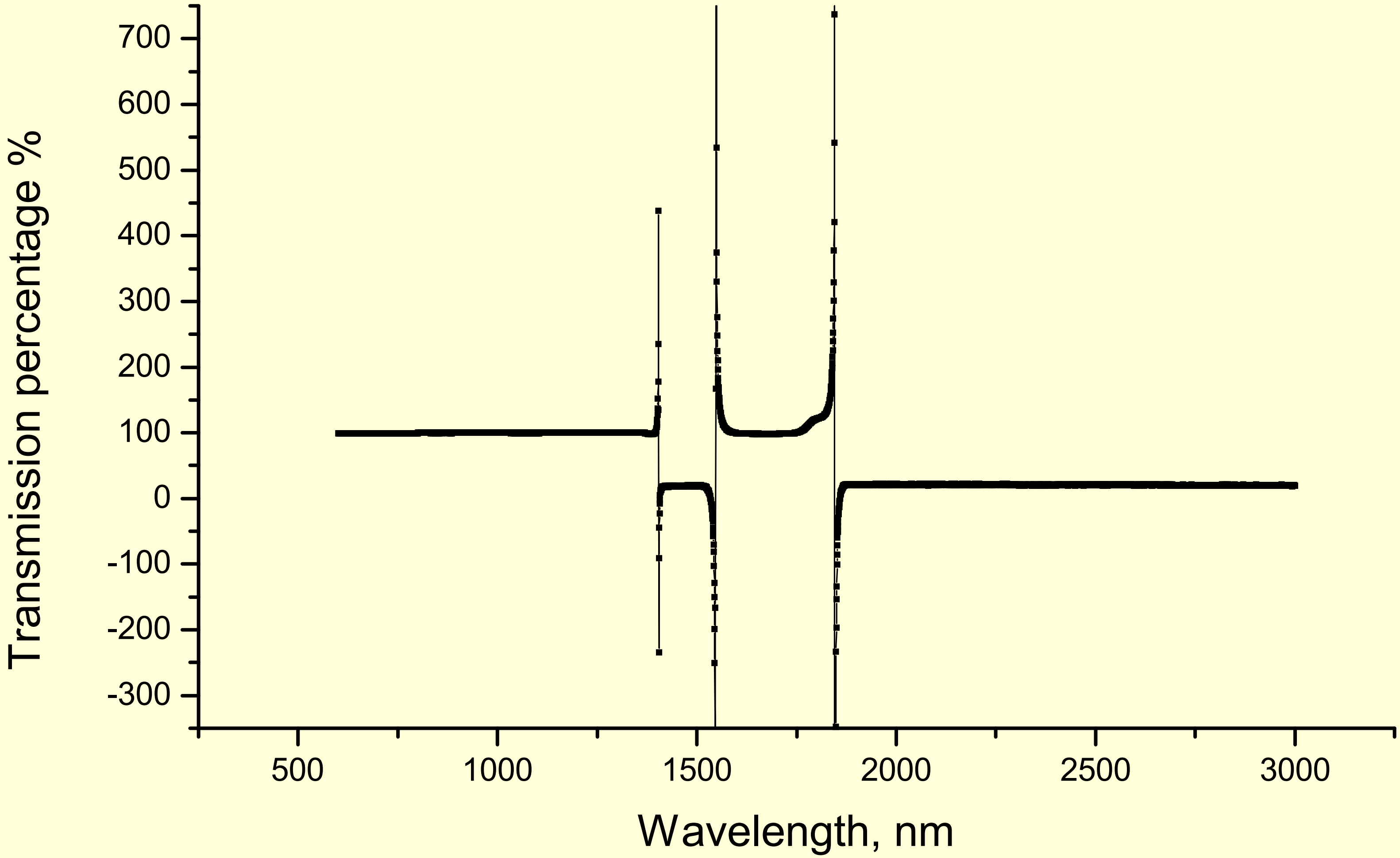
Preparations

- 3 experiments with the same parent substances were made.
- In the 1-st and 2-nd experiments the carrier was a sterile saline solution (NaCl 9%), while in the 3-rd experiment it was medical distilled water. Both were in 5-ml factory sealed ampoules.
- In each experiment 200 sealed ampoules from one factory lot were used. 190 of them were arbitrarily numbered.
- It was prepared by 19 EC ampoules of each parent substance (a total of 133 ampoules) and 57 ampoules of hidden control (placebo) for every experiment. Copying in all 3 experiments was made by the same person (V.G.), which did not participate in spectral measurements and statistical processing.
- The rest 10 ampoules were used as working control.
- The correspondence of the ampoule numbers with the ECs or hidden controls (HCs) was recorded in the protocol that was not been opened until the completion of spectral analysis and the recording all spectral files of every experiment.

Spectral measurements

- Absorption spectra in all 3 experiments were measured using modern Varian Cary 5000i (Agilent Technologies, USA) double-beam spectrophotometer of analytical class in the wave band 3000 – 600 nm with intervals of 0.5 nm.
- For each studied specimen the values of transmission in percents *re* working control were written to the hard disk as a file of spectral readings, the number of which was appropriate to that of an ampoule.
- Every ampoule of sample was opened just before measurement, and the specimen was poured in 3 ml quartz glass cuvette (rectangular parallelepiped 4.5 cm in height, 1 mm wall thickness) with expendable syringe.
- After recording the difference absorption spectrum the cuvette was flushed out with pure carrier solution, dried, and wiped with an optical blanket.
- The control cuvette was filled once for every series (each day) with a species from arbitrarily taken ampoule of working control.

Typical difference spectrum of an EC re working control, obtained from the spectrophotometer



Procedure of statistical analysis of spectra (being the same in all 3 experiments)

- For each spectral reading (wavelength) every EC, represented by the ensemble of 19 samples, was compared with every group of hidden control (HC), represented by the ensemble of 19 samples, using Mann-Whitney non-parametric U-test (Statistica, StatSoft).
- The wavelengths with the differences being significant ($p < 0.05$) were registered.
- To enhance a significance we selected those wavelengths in which the significant differences of the same sign were observed for an EC *re* all 3 groups of hidden control (HC1, HC2, HC3).

WL	R1	R2	U	Z_{adj}	p	R1	R2	U	Z_{adj}	p	R1	R2	U	Z_{adj}	p
nm	B	HC1				B	HC2				B	HC3			
2821.5	438	303	113	2.0	0.049	485	256	66	3.3	0.001	474	267	77	3.0	0.002
2108.5	444	297	107	2.1	0.032	451	290	100	2.4	0.018	451	290	100	2.4	0.018
2044	288	453	98	-2.4	0.015	300	441	110	-2.1	0.040	263	478	73	-3.1	0.001

The wavelengths (nm) with significant differences *re* 3 hidden control groups (HC1, HC2, HC3) – Exp.#1

EC i	DNA	DEG	B	VIR	FUN	TM	MAN	HC *re* HC
1	2697.5	2805.5	2635.5	2843	2963.5	2974	2786.5	HC1 *re* HC2, HC1 *re* HC3, HC2 *re* HC3 **There were no one such wave-length in all range 3000 – 600 nm**
2	2446.5	2764	2558	2786.5	2822.5	2898.5	2402	
3	2359	2647	2463	2772	2804	2520.5	2342.5	
4	**2274.5**	2550	2396.5	2675	2786.5	2387	2238.5	
5	**2274**	2334.5	1931.5	2520.5	2732.5	2219.5	1987	
6	1697.5	1906	1855.5	2312.5	**2662**	2139	1984.5	
7	1456	1898.5	1635.5	2221	**2661**	2052	1906	
8		1647		2047.5	2597		1461.5	
9		1453		1931.5	2539			
10				1675	2513			
11					2277.5			
12					2205.5			
13					2135			
14					1982			
15					**1662**			
16					**1661**			
17					1404.5			

The wavelengths (nm) with significant differences *re* 3 hidden control groups (HC1, HC2, HC3) – Exp.#2

EC	DNA	DEG	B	VIR	FUN	TM	MAN	HC *re* HC
i								
1	2020.5	**2506**	2821.5	2093	2989.5	2825	2539	HC1 *re* HC2, HC1 *re* HC3, HC2 *re* HC3 **There were no one such wavelength in all range 3000 – 600 nm**
2	1939	2057.5	2108.5	2059.5	2868	2527.5	2116	
3	1542	1445.5	**2044**	1576	1812.5	**2506**	1916.5	
4	1414		2013.5	1573.5	1526.5	2441.5	1551	
5			1558.5	1571		2317	1530	
6			1542	1568.5		**2045.5**		
7			1530.5	1568		1967.5		
8			1496	1567.5				
9				1567				
10				1566.5				
11				1566				
12				1565				
13				1564				
14				1563				
15				1562.5				
16				1561.5				
17				1561				
18				1560.5				
19				1560				
20				1559.5				
21				1559				
22				1558.5				
23				1558				
24				1557.5				
25				1556.5				
26				1556				
27				1555				
28				1553.5				
29				1540.5				
30				1539.5				

The wavelengths (nm) with significant differences *re* 3 hidden control groups (HC1, HC2, HC3) – Exp.#3

EC	DNA	DEG	B	VIR	FUN	TM	MAN	HC *re* HC
i								
1	2503.5	2569	2445.5	**2325**	1918	2984	2371	**There were no one**
2	2024.5	2536.5	2424	1485.5	1539.5	2915		
3	1977.5	2074	**2325**		**1413**	**1413**		
4		1945.5						
5								
6								

Discussion of results

- The first interesting result of the study is that there are some such wavelengths for each EC type in all 3 experiments.
- The second interesting result is that revealed wavelengths are located in the band from 3000 nm to 1400 nm. There are no such wavelengths below 1400 nm.
- There are adjacent wavelengths (bolded). There are identical wavelengths (underlined) which are met in various EC spectra. Additionally there are some wavelengths closely located in limits of 5 nm (colored).
- Are wavelengths' rows specific for each EC type? It is very doubtful because there are much more similar wavelengths (in 5 nm limits) between various ECs in the same experiment than between the same EC type in different experiments (both saline *re* saline and saline *re* distilled water).
- However additional investigations are necessary to look for reproducibility of all these wavelengths for every EC name.

Reliability: Statistical significance

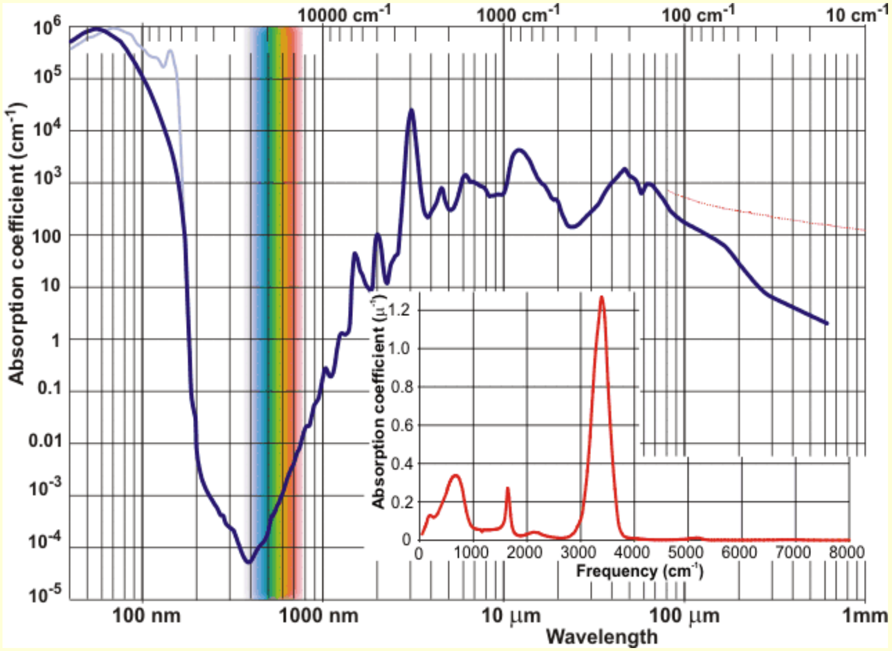
- As for Bonferoni's multiple comparison problem we made 24 paired comparisons for every wavelength, therefore significance level must be $p < 0.05/24 = 2.1*10^{-3}$. However our wavelengths are found under condition $p < 0.05^3 = 1.25*10^{-4}$ (differences *re* all 3 HC). This is at least one order better than demanded.
- Furthermore statistical significance of wavelengths is approved by comparison of differences in 3 pairs of hidden control. There were no wavelengths where significant differences were observed under comparison of all three pairs of hidden control (HC1 *re* HC2, HC1 *re* HC3 and HC2 *re* HC3).
- Identical direction of differences of investigated ECs from all 3 HC groups amplifies the significance of these distinctions.
- Thus the chance of accidental revealing the wavelengths seems to be non significant.

Reliability: Isn’t it an apparatus error?

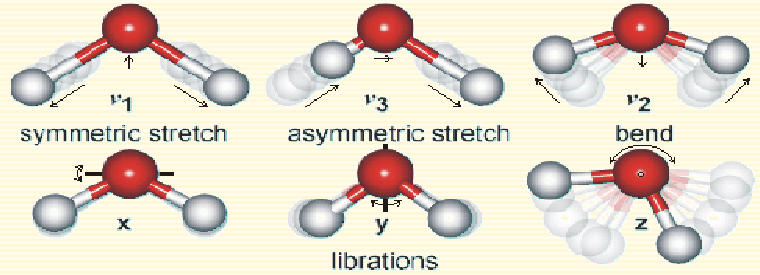
- From one hand there are no revealed wavelengths corresponding to the wavelengths of changing detector (800 nm) or filters (1200, 2000 nm) of the spectrophotometer.
- From the other hand it is obvious that a bias is possible between two beams of spectrophotometer or between metering cuvette with investigated preparation and working control cuvette.
- However in accordance with the procedure developed all investigated preparations (ECs and HCs) were measured in the same metering cuvette and consequently in one beam of spectrophotometer. Therefore ECs and HCs being poured into the same metering cuvette were compared in the same chamber of spectrophotometer but in random order.
- Thus wavelengths revealed may not be attributed to any apparatus bias or drift.

A system in the wavelengths positions

In accordance with [Martin Chaplin. Water structure and science. www.lsbu.ac.uk/water] there are typical water molecular vibrational resonances in the band.

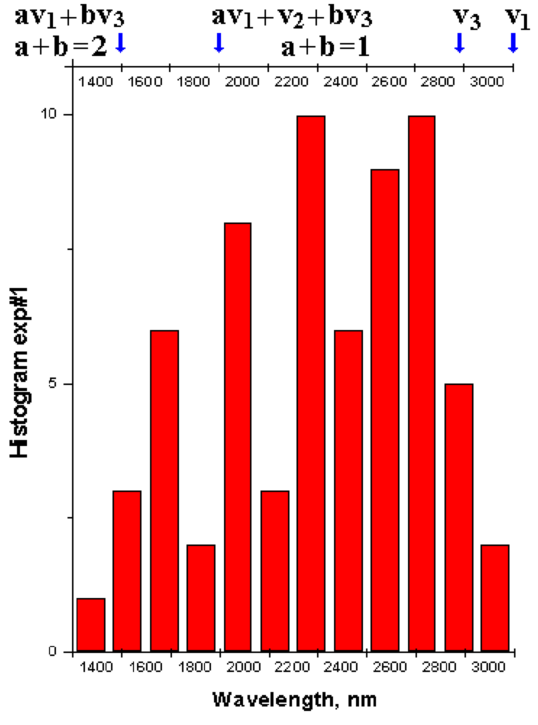


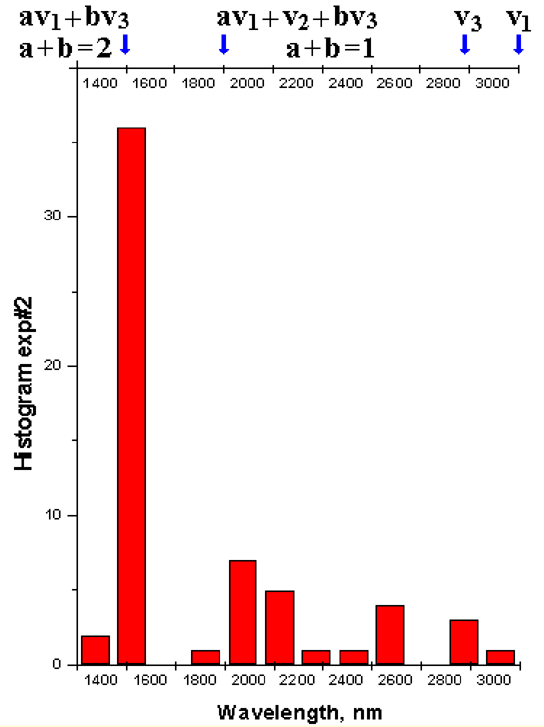
Spectrum of absorption of liquid water

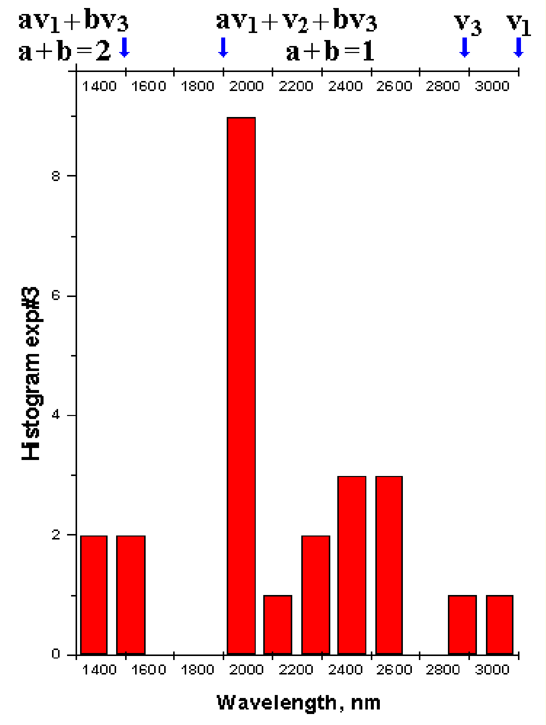


Wavelength		Vibrations
nm	cm^{-1}	
3050	3277	v_1, symmetric stretch
2870	3490	v_3, asymmetric stretch
1900	5260	$av_1 + v_2 + bv_3$; a+b=1
1470	6800	$av_1 + bv_3$; a+b=2
1200	8330	$av_1 + v_2 + bv_3$; a+b=2
970	10310	$av_1 + bv_3$; a+b=3
836	11960	$av_1 + v_2 + bv_3$; a+b=3
739	13530	$av_1 + bv_3$; a+b=4
660	15150	$av_1 + v_2 + bv_3$; a+b=4
606	16500	$av_1 + bv_3$; a+b=5

Histograms of the wavelengths







- There are maxima located near 1525-1675, 1975-2125, 2275-2425, 2725-2875 nm. However peaks' location varies in the experiments.
- A coordination between some wavelengths and classical water molecule resonances underlines the non-accidental character of identified wavelengths.

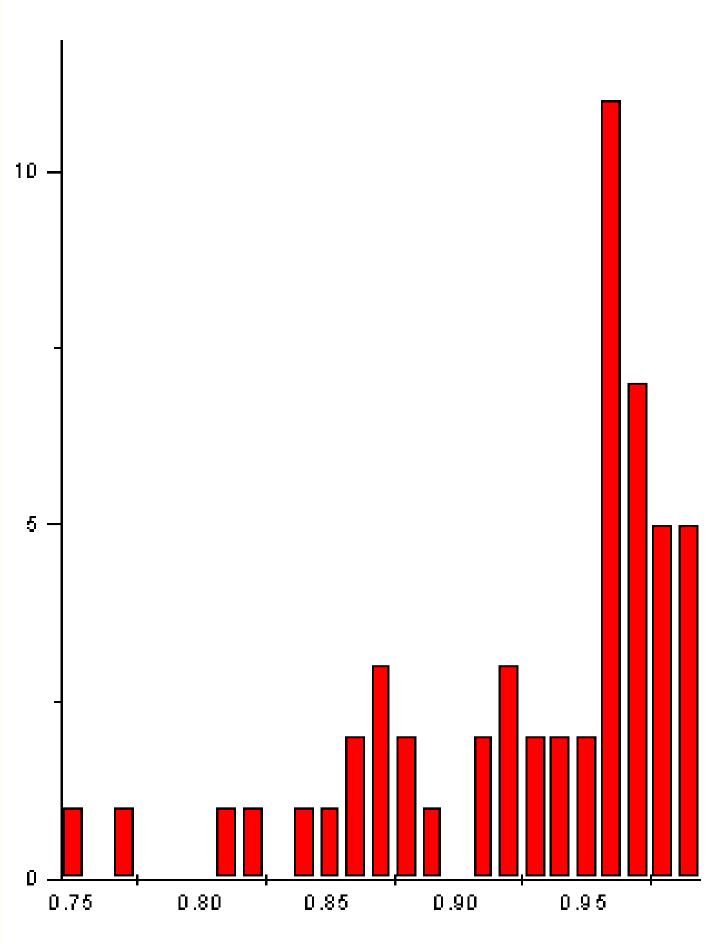
A system in the wavelengths arrangements

- Calculated ratios between adjacent wavelengths λ_{i+1}/λ_i for each EC, represented in the Table, point out to a frequent occurance of ratio about 0.96-0.97 (underlined) – Exp.#1 (saline1)

DNA	DEG	B	VIR	FUN	TM	MAN
0.907	0.985	0.971	0.980	0.952	0.975	0.862
0.964	0.958	0.963	0.995	0.993	0.870	0.975
0.964	0.963	0.973	0.965	0.994	0.947	0.956
1.0	0.915	0.806	0.942	0.981	0.930	0.888
0.746	0.816	0.961	0.917	0.974	0.964	0.999
0.858	0.996	0.881	0.960	1.0	0.960	0.960
	0.868		0.922	0.976		0.767
	0.882		0.943	0.978		
			0.867	0.990		
				0.907		
				0.968		
				0.968		
				0.928		
				0.839		
				0.999		
				0.846		

If influence of electronic copying on water is unspecific we may analyze all ratios irrespectively to EC name

- The histogram of all λ_{i+1}/λ_i ratios - Exp.#1 (saline)



- Count of this histogram

Ratio λ_{i-1}/λ_i	Count	n	$(0.965)^n$	%
0.75	1			
0.76	0			
0.77	1			
0.78	0			
0.79	0			
0.8	0			
0.81	1			
0.82	1			
0.83	0			
0.84	1			
0.85	1			
0.86	2	4	0.867	9.4
0.87	3	4	0.867	
0.88	2	3	0.899	5.7
0.89	1	3	0.899	
0.9	0			
0.91	2			
0.92	3	2	0.931	9.4
0.93	2	2	0.931	
0.94	2			
0.95	2			
0.96	11	1	0.965	34
0.97	7	1	0.965	
0.98	5			
0.99	5			

An order in λ_{i+1}/λ_i ratios

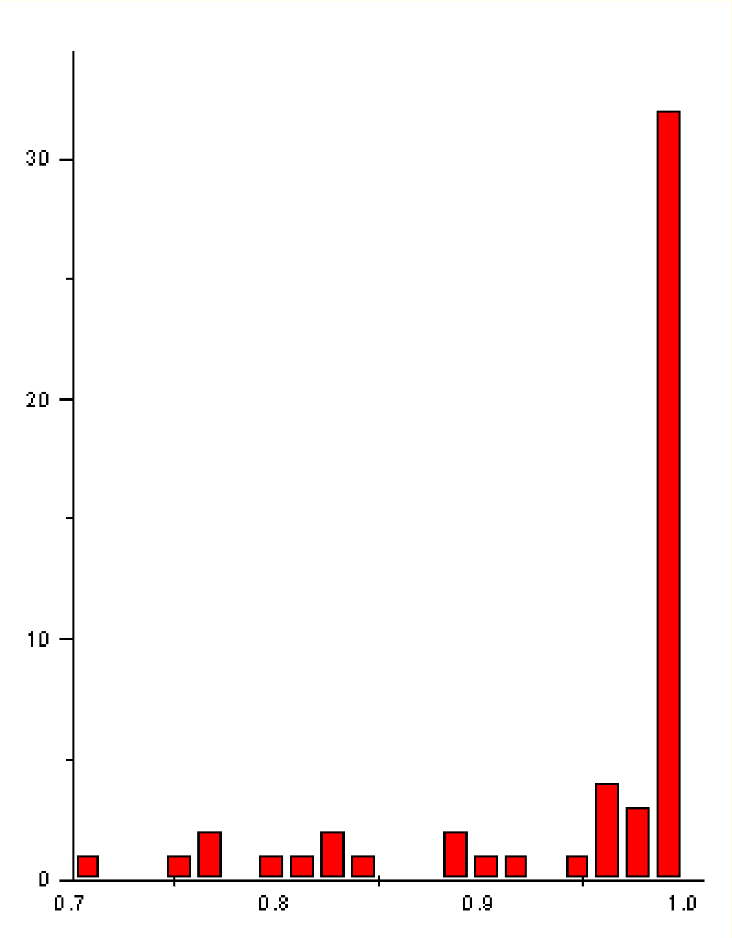
- One can see that ratio $\lambda_{i+1}/\lambda_i \sim 0.965$ is seen as evident maximum of the histogram. Furthermore the equation

  $\lambda_{i+1} \approx (0.965)^n \lambda_i$

  may be constructed for maxima of histogram, where n = 1,2,3,4…
- These periodic maxima cover approximately 58.5% of cases counted. It looks like an order is guessed in random noise. Furthermore such behavior of non random part of ratios looks like a spectral series (quantum effect).

The dependence is also seen in the 2-nd experiment. However it is smoothed by the first peak and covers only about 30% of counts.

- The histogram of all λ_{i+1}/λ_i ratios - Exp.#2 (saline)

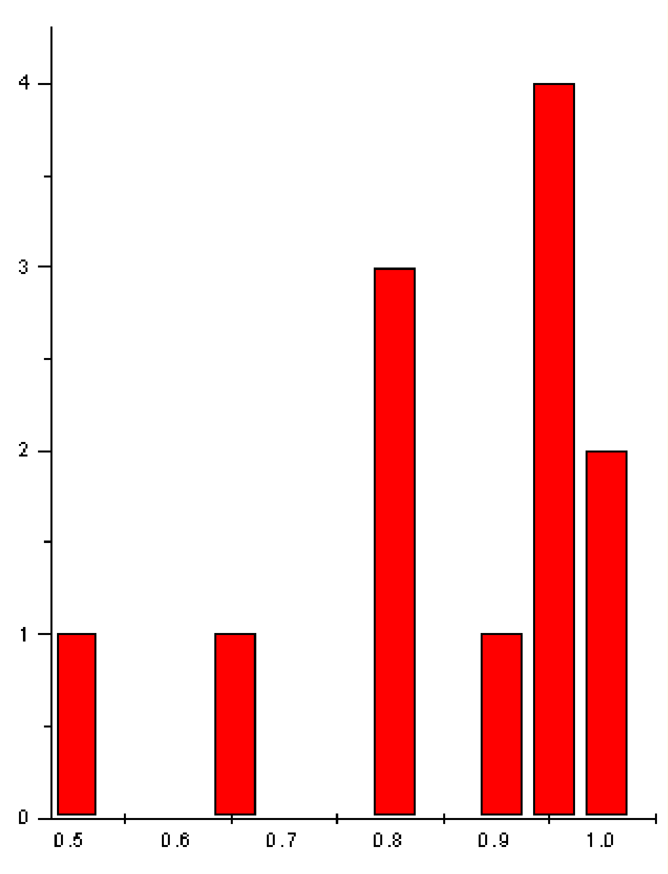


- Count of this histogram

Ratio λ_{i-1}/λ_i	Count	n	$(0.965)^n$	%
0.7525	1			
0.7675	2	7	0.779	4
0.7825	0		0.779	
0.7975	1			
0.8125	1	6	0.808	6
0.8275	2	6	0.808	
0.8425	1			
0.8575	0			
0.8725	0			
0.8875	2	3	0.899	6
0.9025	1	3	0.899	
0.9175	1			
0.9325	0			
0.9475	1			
0.9625	4	1	0.965	14
0.9775	3	1	0.965	
0.9925	32			
1.0075	0			

The dependence is also seen in the 3-rd experiment with coverage of more than 50% of counts

- The histogram of all λ_{i+1}/λ_i ratios - Exp.#3 (dist. water)



- Count of this histogram

Ratio λ_{i-1}/ λ_i	Count	n	$(0.965)^n$	%
0.505	1			
0.555	0			
0.605	0			
0.655	1			
0.705	0			
0.755	0			
0.805	3	6	0.808	25
0.855	0			
0.905				
0.955	4	1	0.965	33
1.005	2			
1.055	0			

Let's evaluate increments of Planck's energy

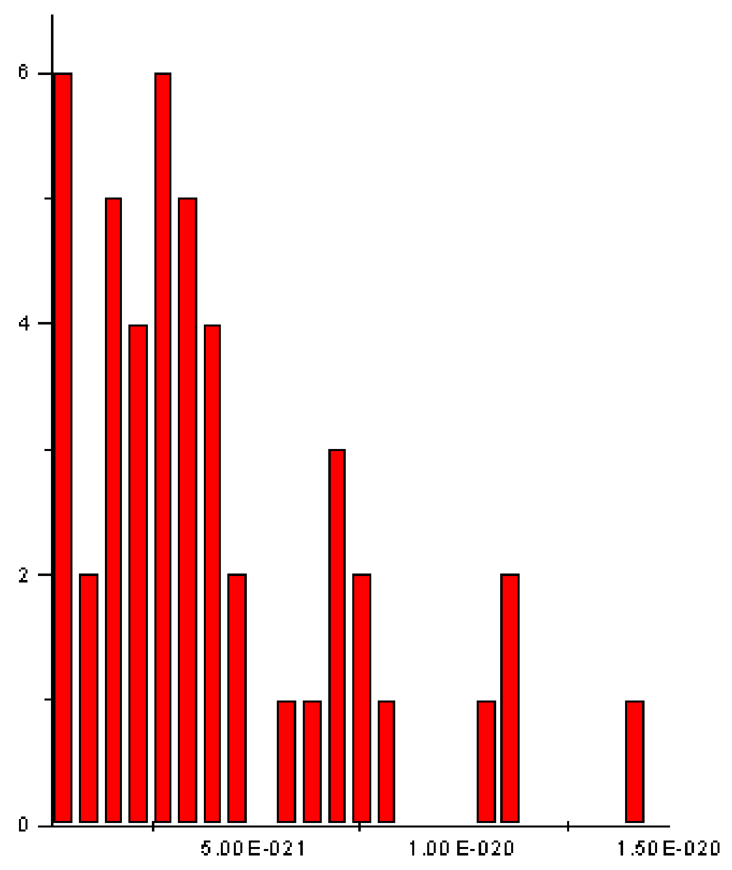
- Under transition from λ_{i+1} to λ_i (between adjacent wavelengths) increments of Planck's energy were calculated

$$\Delta E = hc(1/\lambda_{i+1} - 1/\lambda_i)$$

(where h – Planck's constant, c – electromagnetic wave speed in vacuum).

If influence of electronic copying on water is unspecific we may analyze all ΔE irrespectively to EC name

- The histogram of all ΔE - Exp.#1 (saline)



- Count of this histogram

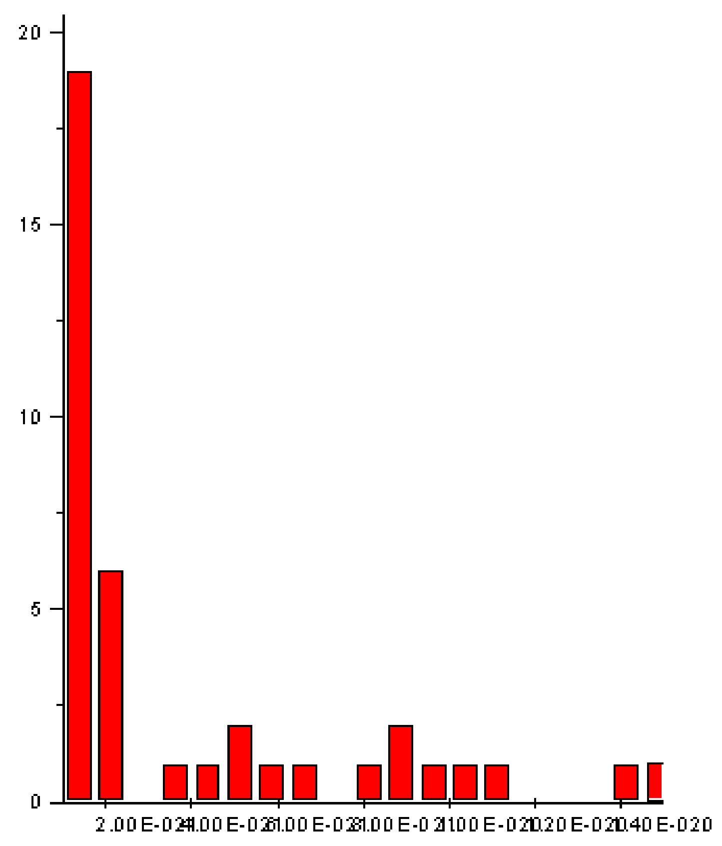
ΔE, Joules	count	Steps, Joules
3.50E-22	6	
9.50E-22	2	
1.55E-21	5	
2.15E-21	4	
2.75E-21	6	base
3.35E-21	5	
3.95E-21	4	
4.55E-21	2	
5.15E-21	0	
5.75E-21	1	
6.35E-21	1	
6.95E-21	3	4.2E-21
7.55E-21	2	
8.15E-21	1	
8.75E-21	0	
9.35E-21	0	
9.95E-21	0	
1.06E-20	1	
1.12E-20	2	2*4.2E-21
1.18E-20	0	
1.24E-20	0	
1.30E-20	0	
1.36E-20	0	
1.42E-20	1	
1.48E-20	0	

Discussion

- The histogram of increments of Planck’s energy summarizes results for all EC types.
- It has the main peak (near 2.75E-21 Joules) and evident side lobes with steady periodicity (approximately 4.2E-21 Joules).

Similar behavior is also seen in the 2-nd experiment

- The histogram of all ΔE - Exp.#2 (saline)

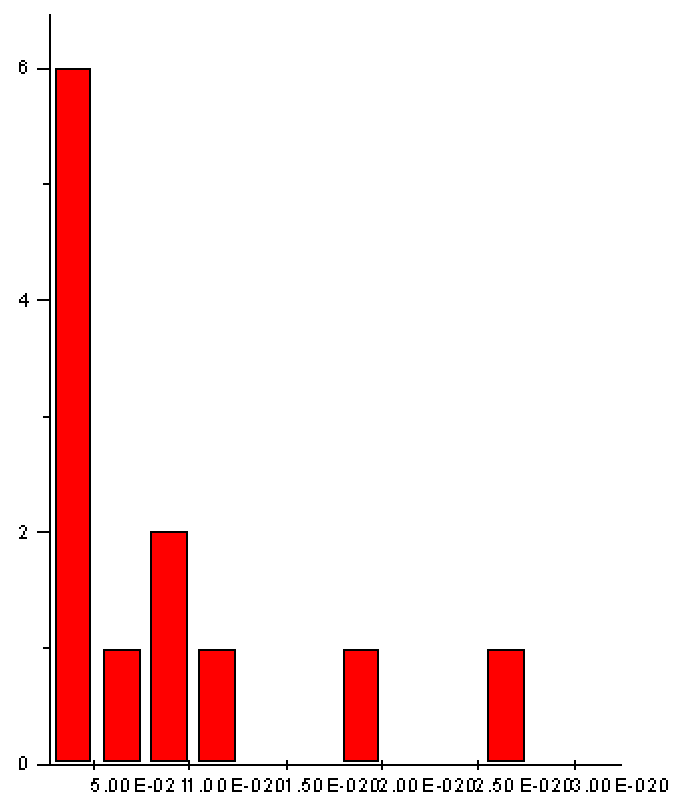


- Count of this histogram

ΔE, Joules	count	Steps, Joules
3.89E-22	19	base
1.14E-21	6	
1.89E-21	0	
2.64E-21	1	
3.39E-21	1	
4.14E-21	2	3.75E-21
4.89E-21	1	
5.64E-21	1	
6.39E-21	0	
7.14E-21	1	
7.89E-21	2	2*3.75E-21
8.64E-21	1	
9.39E-21	1	
1.01E-20	1	
1.09E-20	0	
1.16E-20	0	
1.24E-20	0	
1.31E-20	1	

Similar behavior is also guessed in the 3-rd experiment

- The histogram of all ΔE - Exp.#3 (dist. water)



- Count of this histogram

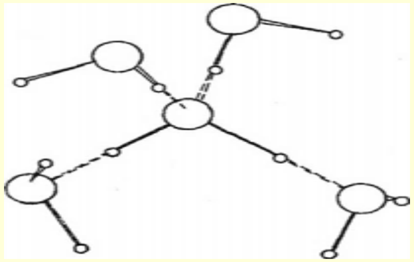
ΔE, Joules	count	Steps, Joules
1.45E-21	6	base
3.95E-21	1	
6.45E-21	2	5E-21
8.95E-21	1	
1.15E-20	0	
1.40E-20	0	
1.65E-20	1	3*5E-21
1.90E-20	0	
2.15E-20	0	
2.40E-20	1	
2.65E-20	0	
2.90E-20	0	
3.15E-20		

Steps of ΔE

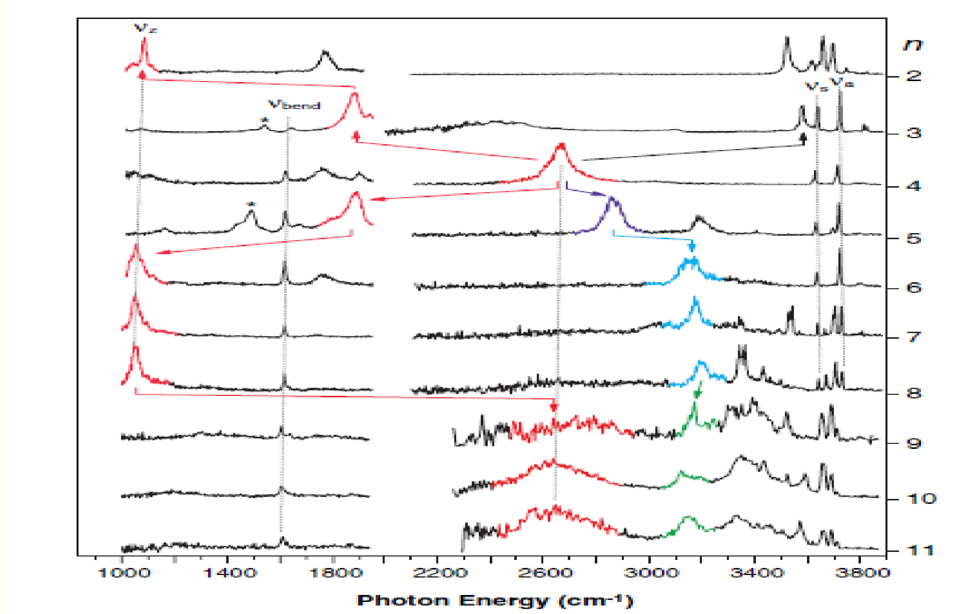
- Exp#1: the main peak is near 2.75E-21 Joules and the step is approximately 4.2E-21 Joules.
- Exp#2: the main peak is near 3.9E-22 Joules and the step is approximately 3.75E-21 Joules.
- Exp#3: the main peak is near 1.45E-21 Joules and periodical lobes with the step of approximately 5E-21 Joules.
- Although base levels are various in all experiments the steps of energy increment are close to each other 3.75E-21 – 5E-21 Joules.
- Periodic steps of energy increment are well known to be characteristic of quantum effects. However, what is the effect? May be found increments of Planck’s energy will be useful to explain it?

Discussion of increments of Planck’s energy

- Water molecules in liquid are connected by intermolecular hydrogen bonds. There is an estimate [*Chumaevskii, Rodnikova, 2003*] of energies accumulated in these bonds as 20 – 3.6 kJ/mol.
- Dividing these values by Avogadro number, we can obtain energies of about 3.3E-20 – 6E-21 J for one water molecule or single hydrogen bond.
- The lover border of this interval seems to be very close to the above steps of Plank’s energy.



5 – element water cluster full connected hydrogen bonds



- Alternative explanation may be found in the fine splitting of energetic levels of water molecular resonances observed in clusters of water molecules [*Headrick et al., 2005*].
- This splitting is even more subtle than the observed steps of Plank’s energy increments.
- **Both possible explanations involves supramolecular behavior.**

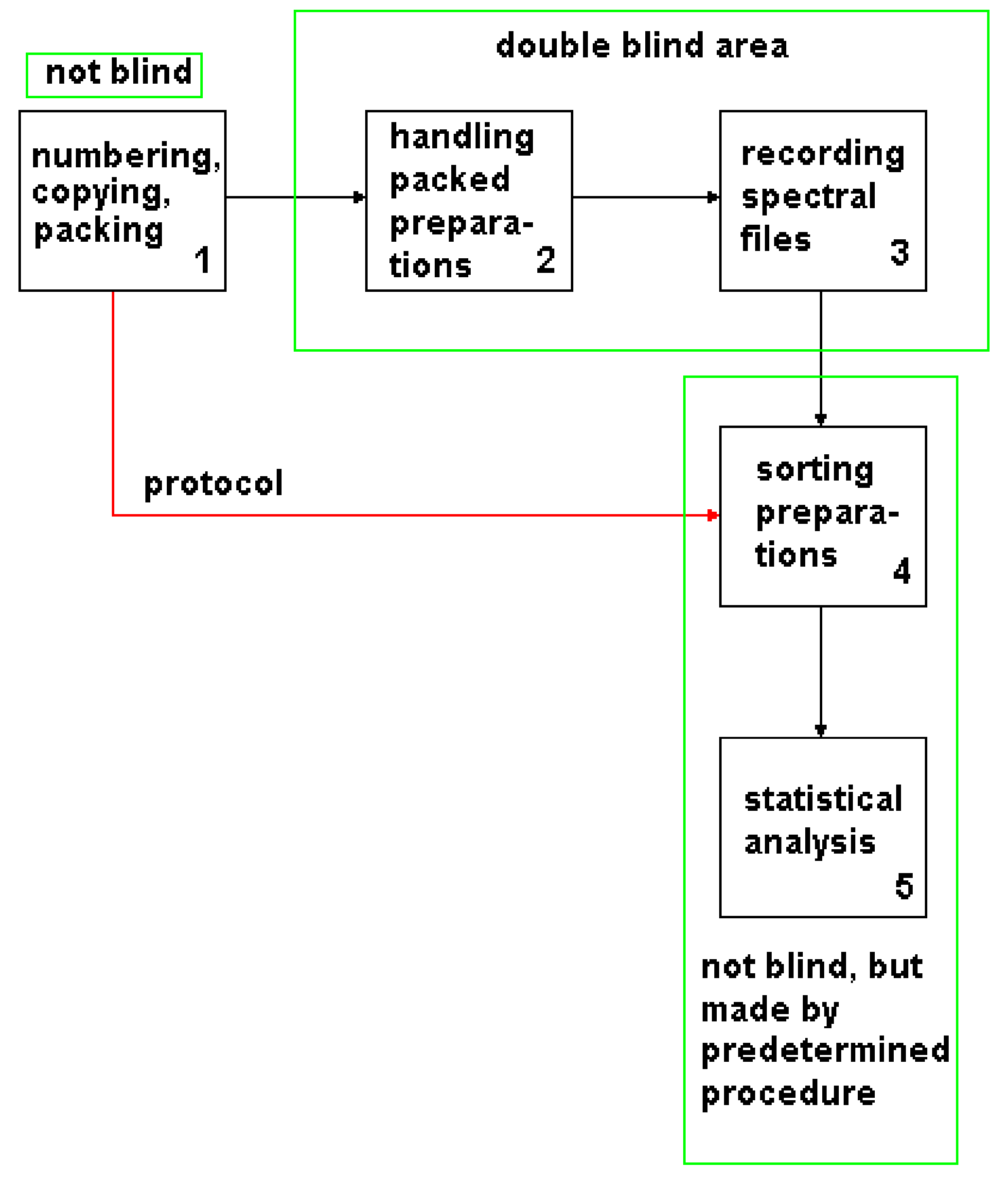
A supramolecular effect!?

- In fact, according to (Lo et al., 1996), extremely dilute solutions contain ice-like crystals (groups of water molecules). Called “IE crystals”, they are stable even at higher temperatures.
- According to (Del Guidice et al., 1988) there are long living, coherent in quantum electrodynamics sense, zones in water.
- According to (Ponomarev, Fesenko, 2000) the dynamic state of liquid water may be determined by the presence of a quasi-particle field (excitations, dislocations) or so named solitons caused by relaxation of excited singlet oxygen molecules.
- All such cooperative structures may be sensitive to influence of weak electromagnetic fields and therefore may be involved in long term response of water to electronic copying procedure.

A hypothetic explanation of electronic copying
(Assuming actions of weak electromagnetic fields)

- Human body is a source of wide-band electromagnetic disturbances associated with the vital activity of cells and organs (electrical charge motions). Moreover, all this takes place against the background of a weakly-varying magnetotelluric field, and with a field of permanent magnet set in M. Rae’s apparatus placed beside the operator’s body (or coils in other apparatus).
- The preparation being copied, interpreted as a kind of passive resonator (Shaub, 1998), probably might modify the field of wide-band electromagnetic emission of the operator’s organism or interaction between this field and external magnetic fields.
- In its turn this modified field is superimposed on EC. **Thus EC “commits to memory” not the self-field of the parent substance but an operator’s organism physical response to it.**
- This concept seems to be in accordance with previously known operator’s personality influence on therapeutic effectiveness of prepared ECs or experimenter’s effect of J. Benveniste’s electronic preparations (Ives, et al., 2006), as well as with great variety of copying methods and copying apparatus types.

Flow chart of the experiment



- Only copying procedure (1) is dependent on voluntary experimenter's influence.
- Meanwhile other steps are double blind (2,3) or strictly predetermined (4,5) thus being independent on any voluntary experimenter's influence.

Conclusions

- Statistically significant distinctions in some wavelengths of near-infrared absorption spectra of water, subjected to weak electromagnetic influence (electronic copying), and blank water carrier were revealed in 3 double blind studies.
- A part of revealed wavelengths having statistically significant distinctions *re* blank carrier demonstrated an order in their position and arrangement.
- Both conclusions stated above are independent on a carrier: saline solution or distilled water.
- Statistically significant distinctions as well as signs of an order in the wavelengths structure may be interpreted in favor of reality of electronic copying phenomenon.