Invited Article

Experimental Study of Macroscopic Nonlocality of Large-scale Natural Dissipative Processes

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Abstract
Phenomenon of quantum nonlocality may play an important role in some macroscopic brain processes. But as a matter of mechanism of persisting of entanglement on macro-level is very difficult, it is reasonable at the beginning to study macroscopic nonlocality on simple non-living systems. Nonlocal dependence of dissipative processes is described as relation of the entropy productions in a probe process (detector) and environment and probably has in its foundation quantum nonlocality. Its peculiarity is availability of unusual advanced correlation for noncontrolled by an observer processes. The natural process of geomagnetic variations gives a convenient possibility for study of this effect. The long-term experiment allowed to estimate the cross-section of nonlocal transaction and to detect advanced correlation. The possibility of employment of the latter for geomagnetic activity forecast has been demonstrated. Similar advanced transaction might take place in the dissipative processes in some brain structures.

Key Words: nonlocality, entanglement, time, entropy, forecast, geomagnetism

NeuroQuantology 2005;4: 275-294

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1. Introduction

The object of common interest is possible manifestation of quantum nonlocality in the macroscopic brain processes. Indeed, nonlocality might explain number of mysterious psychophysical phenomena, including extrasensorial perception and proscopy. But the fact is, if macroscopic nonlocality really exists, it could be studied at the beginning better in much simpler nonliving systems. Our article is devoted to results of experimental study of this phenomenon in the case of nonliving large-scale physical processes.

Phenomenon of quantum nonlocality attracts increasing attention due to number of its unusual properties. In particular, transactional interpretation of quantum nonlocality in the framework of Wheeler-Feynman action-at-a-distance electrodynamics (Cramer, 1986) suggests existence of signals in reverse time. According to principle of weak causality (Cramer, 1980) it leads to observable advanced correlation of unknown states (Elitzur and Dolev, 2003) or, in other terms, noncontrolled by an observer processes. Further there is reason to believe that nonlocality asymptotically persists in the strong macro-limit and it has been proved in the numerical (Home and Majumdar, 1995) and real (Ghosh et al., 2003) experiments. Moreover a new way of entanglement formation via a common thermostat (which can be served the electromagnetic field) has been suggested (Basharov, 2002) and this way needs dissipativity of the quantum-correlated processes (namely radiation ones). It means that dissipativity may not only lead to decoherence, but on the contrary, it may play a constructive role. Our idea was to include dissipation in the framework of modern action-at-a-distance electrodynamics (Hoyle and Narlikar, 1995) and to verify existence of advanced nonlocal correlation of macroscopic dissipative noncontrolled by an observer (random) processes experimentally (Korotaev et al., 1999, 2000a, 2002, 2003a, 2003b, 2004, 2005). Probably the effect of macroscopic nonlocality had been revealed before appearance of these ideas in the causal mechanics experiments and correspondingly, interpreted in other terms (Kozyrev, 1971; Kozyrev and Nasonov, 1978, 1980) but their level of rigor was not enough for responsible conclusions.

We aimed to perform the experiments on the modern level of rigor with large-scale dissipative source-processes. As a result existence of nonlocal correlation (violating Bell-type inequality) between the source-processes and the probe-processes in the detectors of various types had been proved and availability of advanced correlation for the noncontrolled (natural random) source-processes had been revealed (Korotaev et al., 1999, 2000a, 2002, 2003a, 2003b, 2004, 2005). The latter involved the possibility of forecast applications. Among different natural source-processes the most convenient proved to be the geomagnetic activity.

Recently a new long-term natural experiment of such kind has been completed and in this article we consider its results concerning the geomagnetic activity. Previously in Sec.2 we very shortly describe theoretical ideas and in Sec.3 experimental ones. In Sec.4 summarize the results of preceding experiments Sec.5-7 devoted some results of the most recent experiment.

2. Heuristic model of macroscopic nonlocality

As development of strict theory of macroscopic nonlocality is very difficult problem, we consider the simplest heuristic model.

Action-at-a-distance electrodynamics justifies unobservability of the advanced field and in fact the only observable result of its existence reduces to the phenomenon of radiation damping. But the latter presents a typical dissipative process. Moreover, any dissipative processes is ultimately related with radiation, and therefore with the radiation damping. The third time derivative of position *x* appearing in the formulae of radiation damping can be directly related with the entropy production. Indeed, for oscillating charge *q* the advanced field E^{adv} is related to the retarded field E^{ret} and the radiation damping (Hoyle and Narlikar, 1995) :

$$E^{adv} = E^{ret} - \frac{4e^2}{3qc^3}\dddot{x}. \tag{1}$$

On the other hand, radiation power is:

$$P = \frac{3}{3}\frac{e^2}{c^3} < \ddot{x}^2 > = -\frac{2}{3}\frac{e^2}{c^3} < \dot{x}\dddot{x} > . \tag{2}$$

The entropy (dimensionless) production per a particle at temperature q is $\dot{S} = P/kq$, and therefore

$$< \dot{x}\dddot{x} > = -\frac{3c^3}{2e^2} kq\dot{S}. \tag{3}$$

From Eqs. (1)-(3) it can be asserted that advanced fields carry out the relationship between the dissipative processes.

From above and other (Korotaev et al.. 2003a, 2003b) operational considerations it is possible to formulate the following heuristic equation of macroscopic nonlocality:

$$\dot{S} = s \int \frac{\dot{S}}{x^2} d\,(t^2 - \frac{x^2}{v^2})dV \tag{4}$$

with

$$s \approx \frac{\mathbf{h}^4}{m^2 e^4}, \tag{5}$$

where $\dot{S}$ is the rate of entropy production density in the absorber (probe-process in the detector), S& is entropy production in the sources, s is transaction cross-section, m is electron mass, velocity v is bounded by $v^2 \le c^2$, and integral extends over infinite volume V. The d -function shows that transaction progresses with a finite retardation and advancement.

Note, we expect that if the transaction occurs through a medium with the participation of diffusion processes, reducing any events on the micro-level to electromagnetic interaction of the particles of a medium (and correspondingly propagation of entanglement), then values of resulting retardation and advancement are large.

The role of medium manifests itself in one more way. In Ref. (Hoyle and Narlikar, 1995) it has been shown that known Wheeler-Feynman requirement on perfect absorption of the field by the matter concerns only the retarded part, while absorption of the advanced one must be imperfect. Therefore screening properties the matter relative to the advanced field must be attenuated. As a result, level of advanced correlation may exceed the retarded one.

3. Experimental Problem

The task of the experiment is to detect the entropy change of the environment according to Eq. (4) under condition that all known kinds of classical local interaction are suppressed. Although any dissipative process may be used as the probe one, its choice is dictated by relative value of effect and theoretical distinctness, allowing to relate the measured macro-parameter (signal) with the left-hand side of Eq. (4) and consciously to take steps on screening and/or control of all possible local noise-factors (temperature, pressure, electromagnetic field, etc).

Two experimental setups for study of macroscopic nonlocality had been constructed (Korotaev et al., 2002). In the Geoelectromagnetic Research Institute (GERI) setup two types of detectors based on spontaneous potential variations of weakly polarized electrodes in an electrolyte and on spontaneous variations of the dark current of the photomultiplier had been used. In the Center of Applied Physics (CAP) setup ion mobility detector based on spontaneous variations of conductivity fluctuation dispersion in a small electrolyte volume had been used.

Consider e.g., theory of the electrode detector. The self-consistent solution for the potential u in the liquid phase is (Korotaev, 1979):

$$u = \frac{2kq}{q} \ln\cos(z \arccos\exp\frac{qz}{2kq}), \tag{6}$$

where q is ion charge, z is dimensionless length (z = 1 corresponds to, half of the distance between the electrodes) and z is full (electrokinetic) potential. The entropy can be expressed in terms of the normalized potential Φ as:

$$\Phi = \frac{u}{\int_0^1 u\,dz}, \tag{7}$$

$$S = -\int_0^1 \Phi \ln\Phi\, dz. \tag{8}$$

After substituting Eq. (6) into Eqs. (7) and (8) one may express the entropy in the elementary functions:

$$S \approx \ln 6 - 2\ln(\arccos\exp w) + \frac{6(\ln|w|\, w \arcsin\exp w - \exp w \ln w - \exp w + \ln|w| + w + \frac{w^2}{4} + 1}{(\arccos\exp w)^3} \tag{9}$$

where

$$w = \frac{qz}{2kq} \tag{10}$$

and as signs of q and z are always opposite, w < 0. For weakly polarized electrodes it is easily attainable $|w| << 1$. Then Eq. (9) is simplified:

$$S \approx \ln 6 - 2\ln(\arccos\exp w). \tag{11}$$

Note if $w \to -0$, then $S \to +\infty$, that corresponds to expectative (space distribution aspires to uniform one). From Eq. (11) the entropy production is

$$\dot{S} \approx \frac{\exp w}{\arccos\exp w\sqrt{1-\exp 2w}}\dot{w}. \tag{12}$$

The prefactor before $\dot{w}$ is always positive, therefore from Eqs. (10) and (12) it follows that correlation of S and z is negative. If $|\Delta z / z| << 1$, we can linearize Eq. (12) and obtain simple practical formula:

$$\Delta S \approx -\frac{1}{\sqrt{6}}\frac{|q|}{kq}U\,, \tag{13}$$

where $U = \Delta z$ is measurable variable potential difference.

For the photocathode detector make use the well-known formula for entropy per electron:

$$S = \frac{qj}{kq} + \frac{5}{2}\;, \tag{14}$$

where qj is the work function of the cathode. From Richardson-Dushman equation we have:

$$\frac{qj}{kq} = \ln[A(1-R)] + 2\ln q - \ln j \tag{15}$$

where $A = mk^2e/p^{\,2}\mathbf{h}$, *R* is reflection coefficient, *j* is emission current density. Substituting Eq.(15) into Eq.(14) we obtain:

$$\dot{S} = -\frac{\dot{j}}{j} = -\frac{\dot{I}}{I}\;, \tag{16}$$

where *I* is in our case the dark current of the photomultiplier. Therefore,

$$\Delta S = -\frac{\Delta I}{<I>}. \tag{17}$$

The theory of the ion mobility detector is rather complicated (Morozov, 1997), but the final practical formula is similar to Eq. (17):

$$\Delta S = -\frac{\Delta d}{<d>}, \tag{18}$$

where *d* is measured voltage dispersion on the electrolyte cell, which is proportional to dispersion of ion mobility (Morozov, 1997; Korotaev et al, 2002).

All technical details of the detectors and their parameters are presented in Ref. (Korotaev et al., 1999, 2000a, 2000b, 2002, 2003a).

Turn to the right-hand side of Eq. (4). Among various large-scale natural dissipative processes with big random component the most convenient are geomagnetic variations because, firstly, the all three types of detectors are not sensitive the local magnetic field (Korotaev et al., 1999, 2000a, 2002, 2003a) and, secondly, these variations can be easily related with electric current dissipation in their source (magnetosphere).

The density of entropy production is:

$$\dot{s} = \frac{< E^2(f) >}{rkq} = \frac{| Z(f) |^2 < F^2(f) >}{rkq}, \tag{19}$$

where *E* is electric field, *f* is frequency, r is medium resistivity, q is medium temperature, *Z* is impedance, *F* is magnetic field. *Z* and r we may consider for simplicity as scalars. By substituting Eq. (19) into Eq. (4) further simplification is possible, using the known properties of the electromagnetic field of the magnetospheric source (Rokityansky, 1982). First, the field *F* is well approximated by plane wave, therefore it is possible to factor out the $\dot{s}$ from the integral, and, restricting our consideration to the spectral amplitudes, we reduces this integral simply to thickness of dynamo-layer. Second, use quasi-steady-state approximation of the plane wave impedance of homogenous medium: $| Z(f) |^2 = 2pfm_0 r$. Dependence on r disappears, and for spectral amplitudes it is easily to show (Korotaev et al., 1999, 2000a, 2002, 2003a) that following ratio is frequency-independent:

$$\frac{U(f)}{F^2(f)} = const \tag{20}$$

and analogously for *I (f)* and *d (f).* Of course, Eqs. type of (20) are approximated, because above simplest expression for |*Z* (*f*)|^2 is rather rough approximation.

4. Summary of previous experiments

The experiments with controlled lab source-processes had shown existence only retarded nonlocal correlation (Morozov, 1997; Korotaev et al., 2000b) and they are out of scope of this article.

The long-term experiments with natural source-processes had been conducted in 1993-96 with the electrode detector and 1996-97 with four detectors: the electrode and photocathode detectors of GEMRI setup, spaced at 300 *m* one more electrode detector and spaced at 40 *km* CAP setup (ion mobility detector). The most important results follow (Korotaev et al., 1999, 2000a, 2002, 2003a, 2003b, 2004, 2005):

1. The signals of all detectors are correlated. A correlation between the electrode detectors, electrode-photocathode detectors and electrode-ion mobility detectors was widely illustrated in Ref. (Korotaev et al., 1999, 2000a, 2002, 2003a), here we show for completeness only correlation between the signals of photocathode and ion mobility detectors (Fig. 1 and 2).

Analysis had shown that signals were formed by some common causes, but their influence could not be local.

2. Such common causes proved to be mainly solar, synoptic and geomagnetic activity. Rather strong advanced correlation of the detector signals in relation to these processes has been revealed. Retarded correlation is always less. The order of value of advancement is large: from 10 hours to 100 days and it increases along with the space scale.

3. Nonlocal character of correlation was proved by Bell-type inequality violation by two ways: analyzing of external - internal temperature – detector signal causal chain (Korotaev et al, 1999, 2002, 2003a) and solar-geomagnetic activity-detector signal causal chain (Korotaev et al., 2004).

4. Equation (4) was verified on example of the process of geomagnetic activity by confirmation of order of value s (Eq. (5) and validity of Eq. (20) (both by data of the electrode detector).

5. The level of advanced correlation allowed demonstrating the possibility of solar, geomagnetic and synoptic forecast.

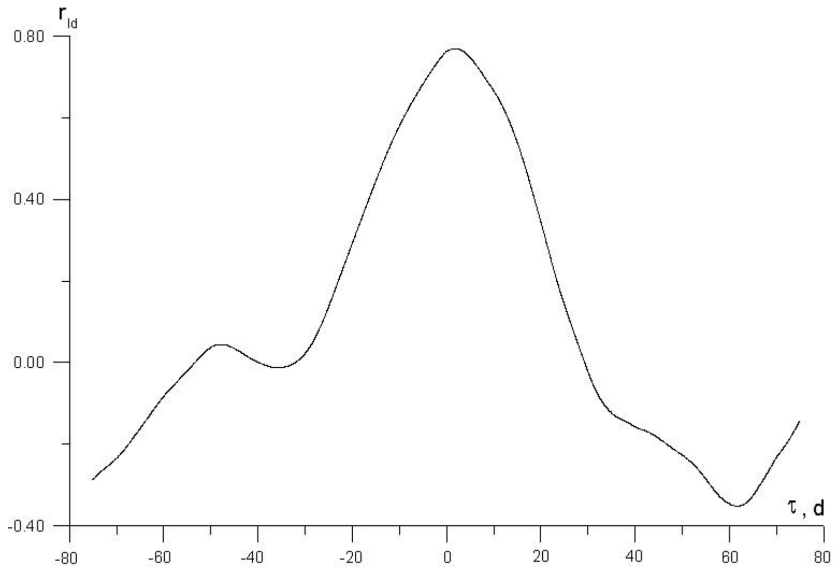

Fig. 1. Correlation function of photocathode detector signal *I* and ion mobility one *d.* Maximum of correlation corresponds exactly zero time shift t . Data are low-pass filtered (T > 20^d).

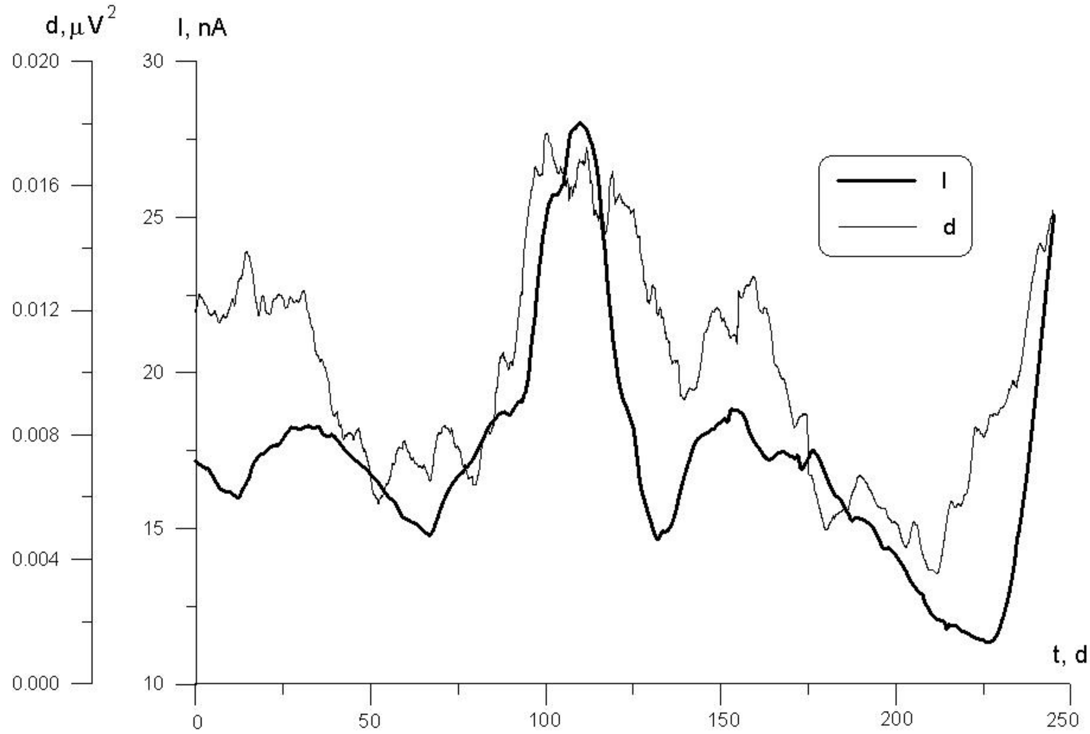

Fig. 2. Synchronous time variations of photocathode detector signal *I* and ion mobility one *d* . Data are low-pass filtered (T > 20^d).

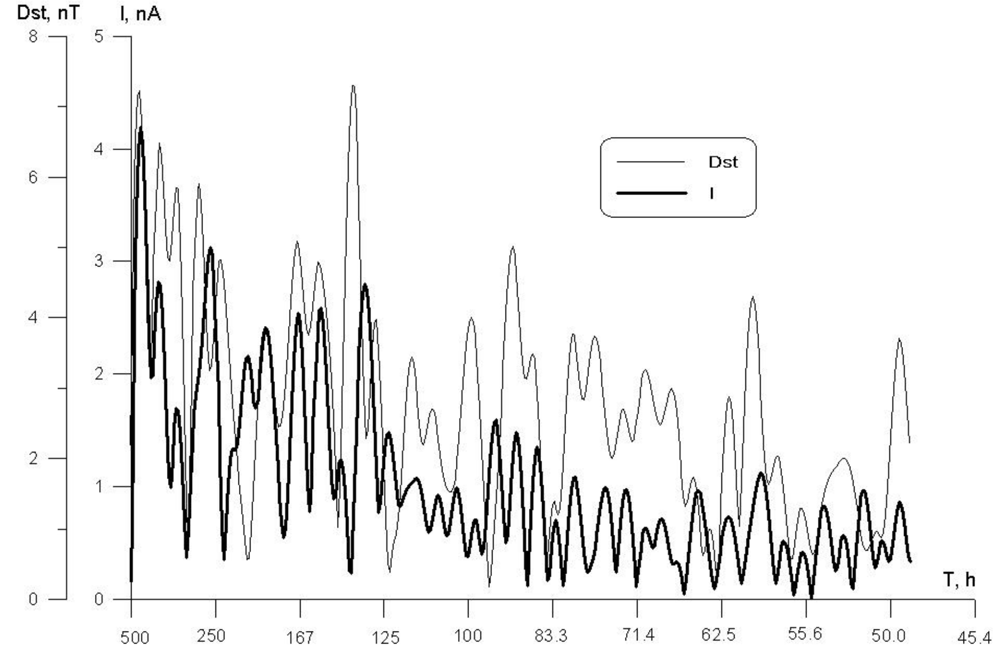

Fig. 3. Amplitude spectra of photocathode detector signal *I* and geomagnetic activity *Dst*.

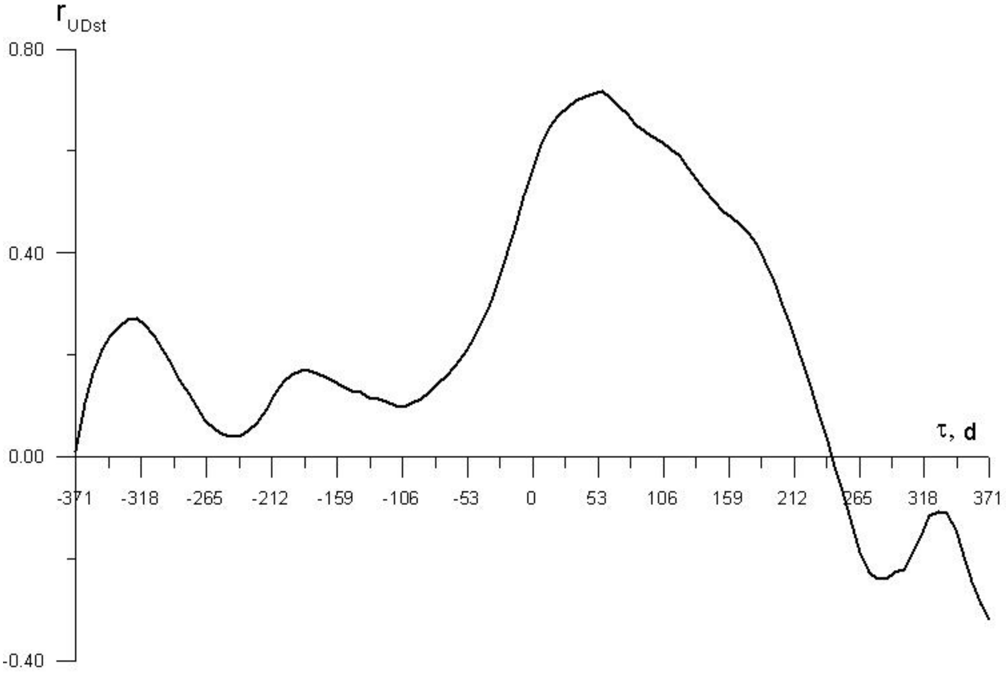

Fig. 4. Correlation function of electrode detector signal *U* and geomagnetic activity *Dst* at periods *T* > 31.8^d. $t < 0$ corresponds to retardation *U* relative to *Dst*, $t > 0$ - to advancement

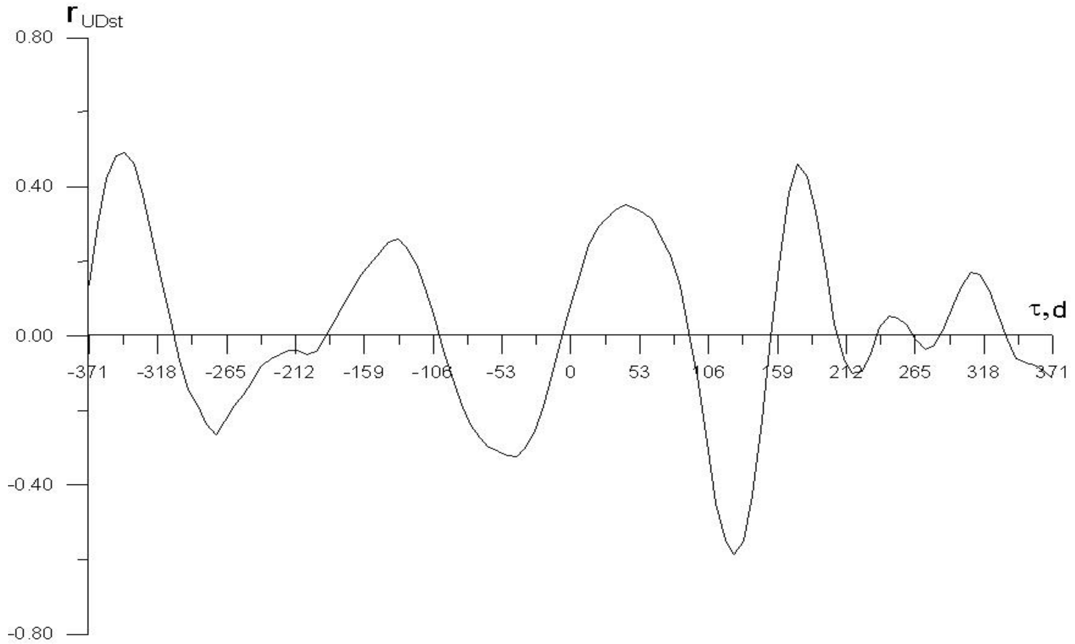

Fig. 5. Correlation function of electrode detector signal *U* and geomagnetic activity *Dst* at periods $136^d > T > 31.8^d$. $t < 0$ corresponds to retardation *U* relative to *Dst*, $t > 0$ - to advancement.

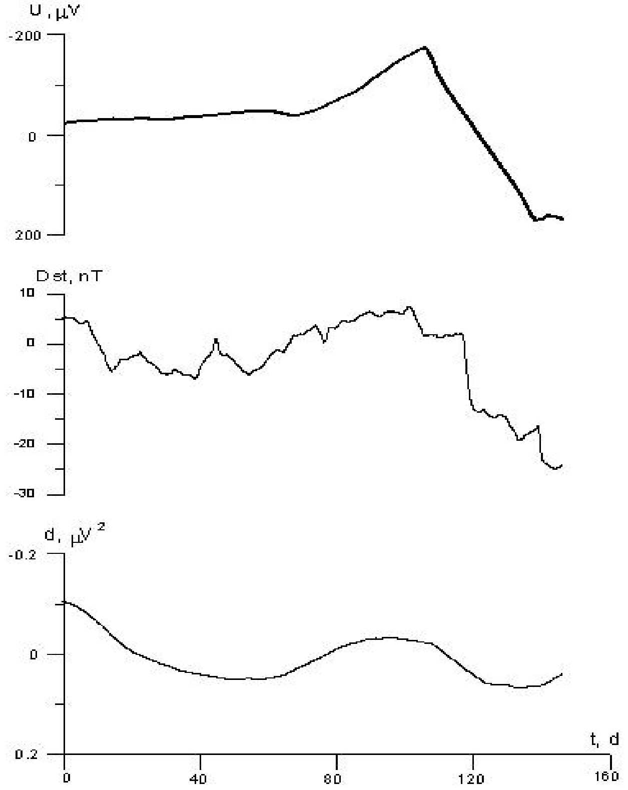

Fig.6. Electrode detector signal *U* and ion mobility one *d* forecast the geomagnetic activity *Dst* with advancement 130^d.

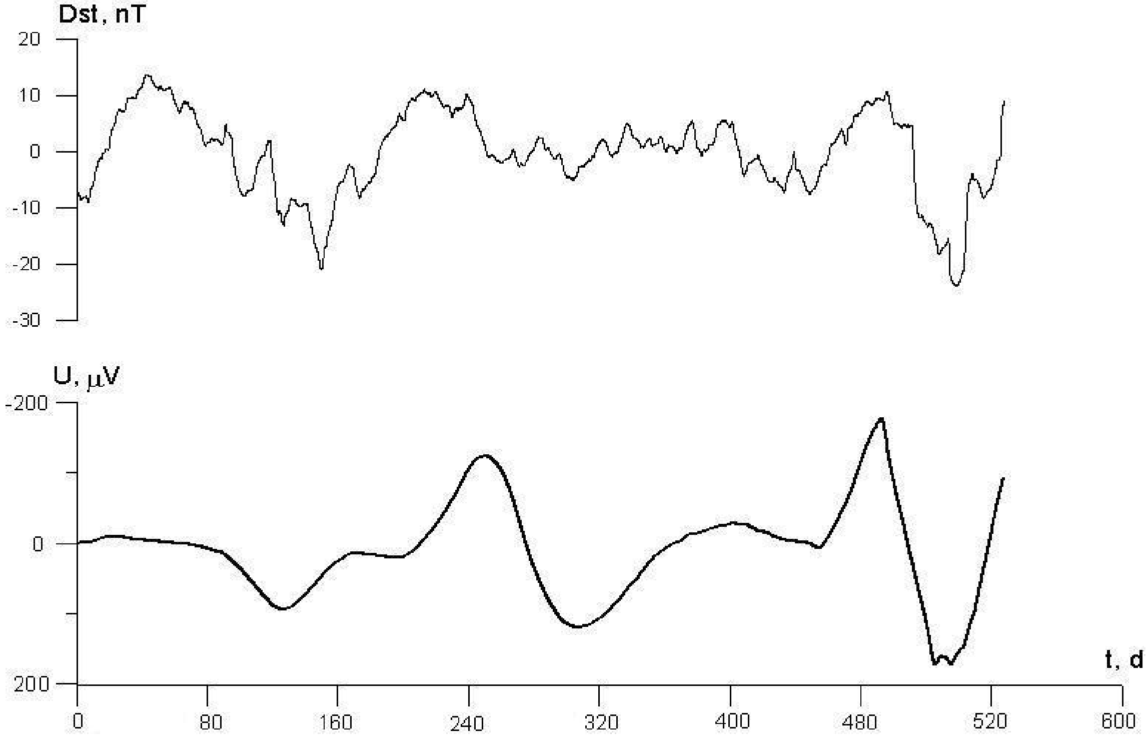

Fig. 7. Electrode detector signal *U* forecasts the geomagnetic activity *Dst* with advancement 130^d.

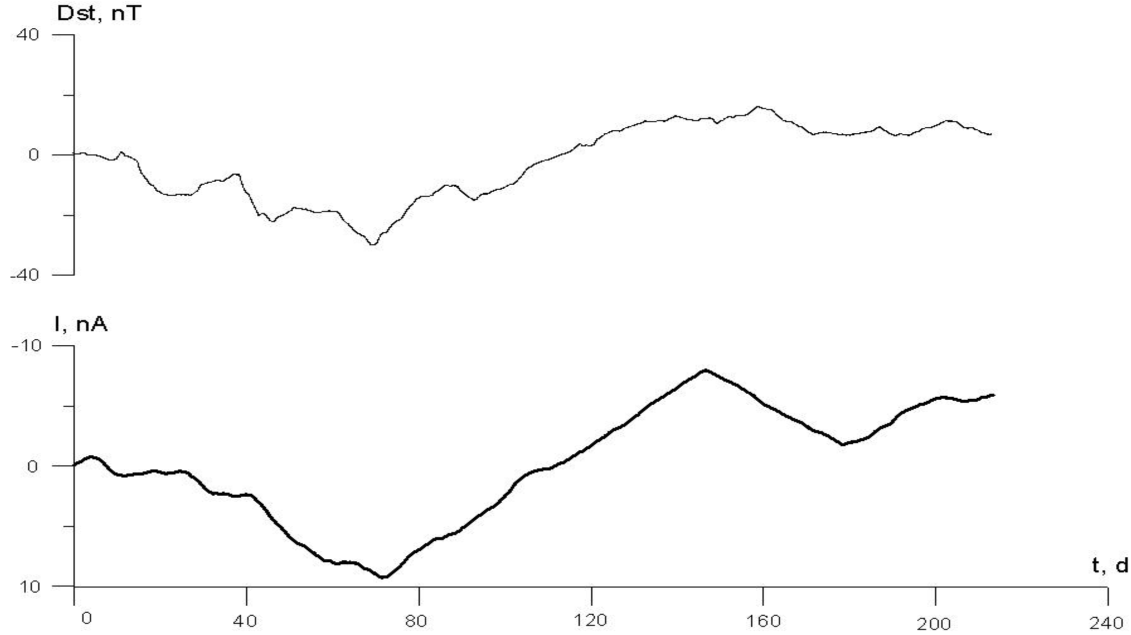

Fig. 8. Photocathode detector signal *I* (realization I_I) forecasts the geomagnetic activity *Dst* with advancement 90^d.

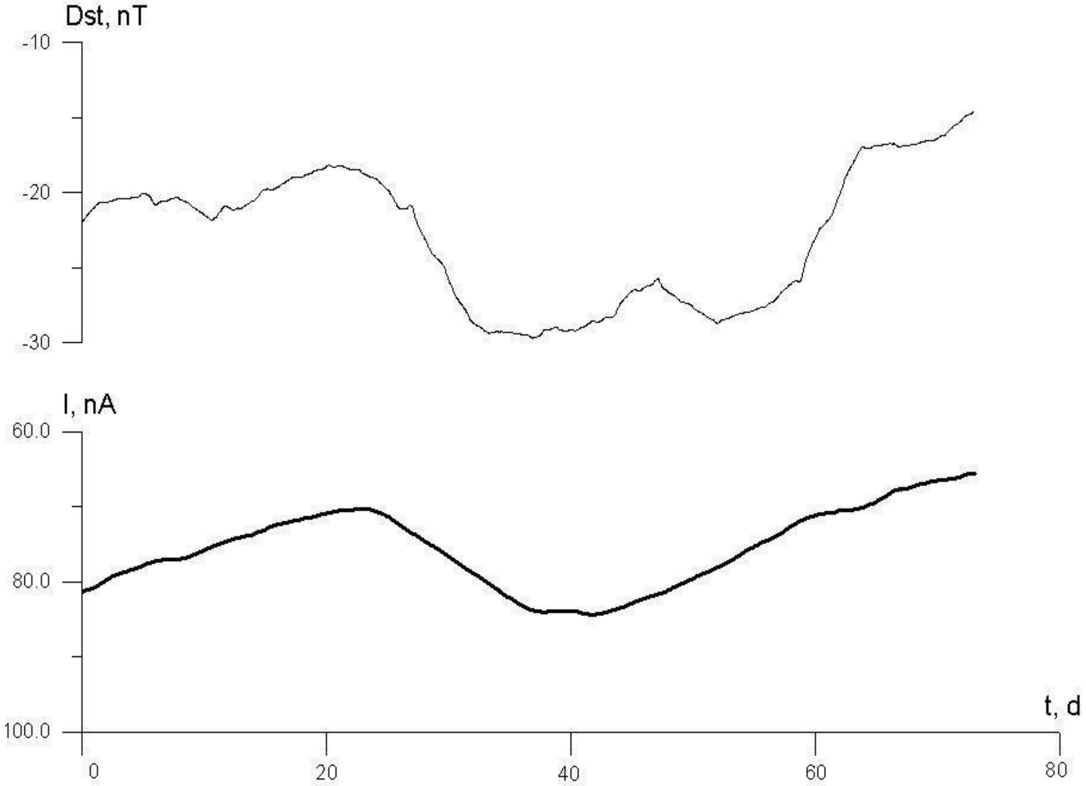

Fig. 9. Photocathode detector signal *I* (realization I_2) forecasts the geomagnetic activity *Dst* with advancement 130^d.

5. New experiment

The new experiment (2001-2003) aimed long-term synchronous observations of signals of three different type detectors (GEMRI and CAP setups). As compared with previous experiment the system of the electrode detector temperature stabilization was improved and duration of continuous measurements with each detector was increased more that twice. The latter is particularly important, because advanced correlation represents itself mainly at extremely low frequencies. Because of some technical reasons full-unbroken two-years record was obtain only with the electrode detector. Two segments had broken series of measurement with the photocathode detector. CAP setup worked during the second year of the experiment with GEMRI one. As a result we had the following time serieses.

1. Electrode detector: U, 10/22/2001 - 10/27/2003.
2. Photocathode detector: I_1, 10/22/2001 - 06/24/2003; I_2, 07/14/2003 - 10/27/2003.
3. Ion mobility detector: d, 10/19/2002 - 10/18/2003.

Sampling rate for the all series was 1 hour.

While in processing of previous experimental data (Korotaev et al., 1999, 2000a, 2002, 2003a, 2003b, 2005) we used, besides traditional statistical methods, the causal analysis as the most sophisticated informational-statistical method, the achieved level of knowledge allows for goals of given work to restrict processing by the usual methods of spectral and correlation analysis. In addition, so long as the problem of suppression of the interference had been investigated in details and solved in the cited works, below we do not concern it.

6. Estimation of cross-section of transaction

Taking into account complexity and, as a rule, poor knowledge of large-scale natural source-processes parameters it is hoped on only order estimation of s in Eq. (4) by the detector signal and standard geophysical data. Accordingly it has meaning use of a simplest model for the source-process entropy production like to Eq. (19). But the geomagnetic activity, as a separate source-process, has a flaw – it is close correlated with solar activity especially at long periods $T >$ 27 days. On the other hand, short periods (and correspondingly small space scales) $T <$ 1 day do not cause enough strong detector reaction (Korotaev et al., 1999, 2000a, 2002, 2003a). It holds significance also choice of an index of geomagnetic activity. As it had been shown in the previous studies the most effective was to correlate the detector signals not with the magnetic field measured at the setup site (although it was possible (Korotaev et al., 1999, 2000a, 2002, 2003a)), but with *Dst*-index of global geomagnetic activity, which corresponded to the most large scale electric current system in the magnetosphere (Korotaev et al., 2003a, 2003b, 2004, 2005). *Dst*-index due to procedure of its calculation is most representative at T > 2 days. For these reasons the spectral window $20^d > T > 2^d$ was selected for analysis.

However in that window nonlocal interference from the synoptic activity is just possible. Therefore it is a need to select for analysis enough long time segment with quiet weather condition. That is why in the all previous studies we succeeded in estimation of s only in one case (Korotaev et al., 1999). It was estimation by electrode detector and setup's quantum magnetometer data: $s \approx 2\times10^{-21} m^2$.

The last reference also indicates the desirability to estimate s by data of different detectors, because every of them may be noised in different manner.

Close examination of our data has shown that the most appropriate data segment turns out just I_2 series. In Fig. 3 amplitude spectra of I_2 and *Dst* are shown. The spectra are rather similar - many of individual pikes coincide (at periods 450, 371, 321, 135, 92.2, 79.9, 72.9, 61.8, 59.4, 55.8 and 49.5 hours). Pike-to-pike variation coefficient (ratio of the standard deviation to the mean) for I/Dst^2 equals 0.12, while for I/Dst it equals 0.31, that confirms approximate validity of equation type of Eq. (20).

For s estimation we combine Eqs. (4) in plane wave approximation, (17) and (19). In this approximation the source is characterized by two well known parameters - thickness of dynamo-layer h and temperature$q$: $h \approx 1.3\times10^6 m$ and$q \approx 1.3\times10^3 K$. Then for realization I_2 we obtain the average estimation $s \approx 5\times10^{-20} m^2$.

Realization of U synchronous to I_2 proved to be noisier, that probably shifts the estimation up. But using Eq. (13) instead of (17) we obtained in the same spectral window close average estimation $s \approx 8\times10^{-20} m^2$.

Realization segment of d synchronous to I_2 was shorter, might be because of that, using Eq.

(18) instead of (17) we obtained in the same spectral window bigger average estimation $s \approx 6\times10^{-19} m^2$.

In view of the fact that accepted model of the complex source of the variable geomagnetic field is extremely approximated and separation of the useful signal from interference is poor, coincidence of above estimations with theoretical one (about 10^{-20} m^2 by Eq. (5)) may be thought as satisfactory. Thus transaction cross-section is of order of an atom one.

7. Forecasting effect

Availability of advanced nonlocal correlation and moreover, exceeding advanced correlation over retarded one had been revealed in the all previous works (Korotaev et al., 1999, 2000a, 2002, 2003a, 2003b, 2004, 2005) for the all studied natural processes including the geomagnetic activity. It had also been demonstrated (Korotaev et al., 2003a, 2004) the possibility of geomagnetic forecast by shift time series on the value corresponding to the main advanced maximum of module of correlation function. Here we are going to demonstrate it not simply once more, having more rich experimental data, but in the more distilled performance. The matter of fact is advanced correlation is the property only of random processes. If deterministic, i.e. in the given case, periodic component of variation is not suppressed, then forecasting effect might be amplified by autocorrelation. It would be useful in practice, but here we are going to study namely advanced cross correlation and therefore we have to suppress that component. The main periodicity in the geomagnetic activity related with solar rotation synodic period (about 27 days) and its harmonics, and corresponding maxima are pronounced in the detector signals (Korotaev et al., 2003b, 2005). We have to suppress periods equal and less than solar synodic period. Indeed due to nonlinearity, related *Dst* spectral lines have periods some more the synodic one. Investigation of *Dst*, *U*, *d* and *I* spectra by our experimental data allowed to select optimal low-pass filtration as $T > 31.8^d$. In Fig. 4 correlation function for the longest of all *U* low-pass filtered series is shown. Correlation maximum correspond advancement about 60 days and equals 0.72 ± 0.01. Correlation time asymmetry (defined as ratio $max\,|r^{adv}|\ /\ max\,|r^{ret}|$) in the shift τ range $\pm 371^d$ equals 2.64 ±0.01. It is essentially more than it was calculated in the previous similar experiments with suppression of periodic component.

But in the long period domain there is correlated nonlocal interference from the solar activity. Moreover, direct influence of solar activity is prevailed over geomagnetic one (Korotaev et al., 2003b, 2004, 2005). Although for possible future practical application of nonlocality effect for direct forecast of geomagnetic activity such interference is even useful (because geomagnetic activity is caused by solar one and all existing methods of long-term forecast of the former are indirect, based on forecast of the latter), we tried as far as possible to attenuate it. The matter of fact, due to nonlinear effects of generation of the geomagnetic activity in response to the solar one there are (random) long period spectral maxima of *Dst*, while amplitudes of any index of solar activity increase to long periods, at least to year, almost monotonously (there are not definite spectral lines in the mentioned range). Therefore we can attenuate influence of solar activity by wide-band filtration $T_m > T > 31.8^d$, where T_m is selected individually for each time serieses as period shorter than which Dst spectrum has own (random) maxima. This procedure was possible for all our realization except l_2 (because it was too short). The optimal T_m proved to be 136^d for *U*, 365^d for l_1 and 187^d for d. After such filtration correlation functions became more complicated and their asymmetry decreases, but remain significant: 1.20 ± 0.01 for *U*, 1.10 ± 0.01 for l_1 (compare: 1.23 ± 0.02 for l_2) and 1.58 ± 0.02 for *d.* As example such correlation function is shown in Fig. 5. Corresponding values of correlation (and advancement t) are: $r = -0.59 \pm 0.01$ at $t = 130^d$ for *U*, $r = -0.952 \pm 0.004$ at $t = 90^d$ for l_1, (compare: $r = -0.82 \pm 0.01$ at $t = 130^d$ for l_2) and $r = -0.875 \pm 0.008$ at $t = 220^d$ for *d.*

Discrepancy between values $r(t)$ is explained, first of all, by non-stationarity of the source entropy generation and propagation, and in addition, by different noise properties of the detectors. Perhaps there are several typical time shifts, corresponding different modes of the process (for *Dst* generation those are: transversal electric current in the magnetosphere tail, the equatorial ring electrojet, and so on). For instance, the correlation extremum at $t = 130^d$ is everywhere, but e.g. for *U* realization it is the main one, while for *d* it is the second $(r = -0.70 \pm 0.01)$. We can compare shifted forward on that $t = 130^d$ *Dst* series relative to synchronous segment of realizations *U* and *d* and see the forecasting effect (Fig. 6). Note *U* and *d* are less similar to each other either of both to *Dst.*

Optimal time shift for full realization of U, I_1 and I_2 demonstrates the forecasting effect quite clearly (Fig. 7 – 9).

One can see a common peculiarity of the all forecasting pictures: the detector signal curves are smoother than *Dst* ones. High-frequency (small-scale) details are absent in the signals. Therefore we obtain the background forecast that should be forthcoming.

Of course we have demonstrated only principal possibility of the forecast. The processes are far from d -correlated, therefore for real forecast the procedure of plural, perhaps nonlinear, regression is to be need.

8. Conclusion

We have described the results of processing and interpretation of the natural experiment on observation of macroscopic nonlocality effect. Via the entropy production of the source and probe processes we have estimated the cross-section of transaction which proved to be of order of an atom one. The most prominent property of macroscopic nonlocality is availability of advanced correlation of high level and with large time shift. The possibility of application this property to long-term forecast of random component of the geomagnetic activity has been demonstrated.

Although we had considered a nonliving system, the results have direct relation to living ones. In particular, the double electric layers and membrane structures in the brain cells are, in essence, the natural models of our electrode and ion mobility detectors respectively. Transaction in reverse time gives the possibility of the future noncontrolled by an observer. Thus observer's consciousness somehow suppresses the advanced transaction. It is a consequence of John Cramer weak causality principle, but deeper understanding of this phenomenon is burning.

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