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Interactive Comment

Interactive comment on "Reversal in the nonlocal large-scale $\alpha\Omega$-dynamo" *by* L. K. Feschenko and G. M. Vodinchar

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Dear Referee,

We appreciate your interest to our article and your remarks. We replay on them step by step.

1. REFEREE. The title of the paper is misleading. "Non-local" implies rather some spatial non- locality (space correlation, non-local interactions, etc.), than time effects. In fact, authors intend to introduce a dynamo model with memory. Different titles can be suggested (Reversals in an $\alpha\Omega$-dynamo model with memory, Reversals in an $\alpha\Omega$-dynamo with retarded quenching, etc.).

AUTHORS. Non-local properties may be considered both in time and space. In our

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paper we describe just the time non-locality (of memory or hereditarity). However, we agree, that we should specify it in the title more accurately. It is important since we unsuccessfully put together the spatial (large-scale) and time (non-locality) characteristics. So, we decided to change the title of the manuscript to “Reversals in an large-scale $\alpha\Omega$-dynamo with memory”. We'll also note it in the annotation and in the text of the paper, that “non-locality” implies just time non-localness.

2. REFEREE. The introduction is redundant large. People, who can be attracted by the title (or the abstract) are familiar for sure with the induction equation (in the general form and in mean-field approximation). The idea of Parkers dynamo model is also well known in the dynamo community.

AUTHORS. The main equations to dynamo theory and the $\alpha\Omega$-dynamo mechanism are well known by the specialists in this area. However, NPG is not a dedicated journal of dynamo community. The readers are the specialists in different areas of Geophysics. Thus, we find it appropriate to describe the main notions of dynamo in the introduction.

3. REFEREE. On the contrary, the main part of the paper could be extended. In my opinion, the model (6) is more attractive, because it is really a model with memory. Authors found that this model cannot give reversals without the change of the sign of R_{alpha} and stopped by this. It's a pity that they have not tried to overcome this problem. A simple suggestion is to consider $B^P B^T$ instead of B^2. There are many other possibilities of course.

AUTHORS. We determined that the model (6) has two asymptotically stable stationary points. We think that this does not give the possibility to reversal the system between these points.

If we use the products $B^T B^P$ in (5) and (6) instead of B^2, we'll obtain not so much the quenching as the control of magnetic helicity.

Generally speaking, it follows from the expression for Lorenz force, that the quench-

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ing mechanism must be quadratic in magnetic field. In the considered model it means that R_α must be a quadratic function (functional) from B^T and B^P. The product $B^T B^P$, which you suggested, is also quadratic. However, if we want to realize quenching, the relations $R_\alpha R_\Omega > 1$ for $B < 1$ and $R_\alpha R_\Omega < 1$ for $B > 1 mustbesatisfied.Anyquadraticfunctionfrom \mathrm{B}^T$ and B^P, satisfying these relations has the form (5). If it is necessary, we can prove it mathematically.

4. REFEREE. The random model (7-9) is interesting, but uses an independent random process, which has nothing to do with the memory of the dynamo process. Why not include in some way the “dynamo memory” in this random process? Also a variety of possibility to realize it exists.

Summarizing, it is a pity that authors have not considered a real dynamo model with memory (implicitly promised in the introduction). In my mind it requires few additional efforts only.

AUTHORS. The random process considered in the model (7-9) is independent from the functions B^T and B^P. We suppose that two large-scale modes, toroidal and poloidal ones, are distinguished in the average field, and present them by the amplitudes B^T and B^P. But besides them there are smaller modes in the average field, the equations of which we neglect. We assume that a random process describes the effect of these neglected modes (lines 16-19, p. 1721). That is why the process is independent only from two large-scale modes. Non-Markov character of the process ξ result in non-Markov solutions of the stochastic system (4, 7-9). These solutions have the memory, the memory in stochastic sense, just like any non-Markov process does. Thus, we think that there is memory in the model (4, 7-9).

As you write, it is possible to try to include dynamo memory into a random process. It is possible, for example, to join the expressions (6) and (7-9). We mentioned such a possibility (lines 20-22, p. 1721) and plan to make such generalization in the future.

However, to our opinion, the described model is the result of a separate stage of work

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and may be the subject of an article.

5. REFEREE. The English should be checked (What is “ differential nature of the middle course”, “real space dynamo systems” , “ the authors of Frick et al. (2006) found that” , etc.).

AUTHORS. The authors are not English native speakers, that is why they appreciate any remarks on the language. All the phrases you’ve mentioned will be changed.

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1715, 2014.