

# Alexander Shapoval



## Personal

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birthday: October, 1972

## Fields of interest

Self-organized systems, solar dynamo, prediction of extremes, economic development

## Academic career

- 1994           Diplom cum laude in Mathematics and Applied Mathematics, Moscow State University, Department of Mechanics and Mathematics, Russia, Grade Point Average is 5.0 of 5.0
- 1998           Ph.D in Mathematics, Moscow State University, Department of Mechanics and Mathematics, Russia
- 1998 – 1998   Teaching of Topology and Calculus, Independent University of Moscow, Russia
- 1998 – 1999   Post-Doc, International Center of Theoretical Physics, Trieste, Italy
- 1999 –         Research Fellow, Senior Research Fellow, Institute of Earthquake Prediction Theory and Mathematical Geophysics, Russian Academy of Science, Moscow, Russia, part time job now
- 2000 –         Assistant Professor, Associate Professor, Professor of Applied Mathematics, Financial University under the Government of Russian Federation, Moscow, Russia
- 2003           Docent in Applied Mathematics, title of Associate Professor given in Russia
- 2011 –         Visiting Professor, The Institute of Earth Physics of Paris, France
- 2012           Doctor of Science in Applied Mathematics, Russian analogue of Habilitation, Keldysh Institute of Applied Mathematics, Russian Academy of Sciences, Moscow, Russia
- 2013 –         Senior Research Fellow, New Economic School, Center for the Study of Diversity and Social Interactions, Moscow, Russia, part time job
- 2014 –         Professor of Applied Mathematics, National Research University Higher School of Economics, Moscow Russia, part time job

## Awards

- 1994, 1995     Soros graduate student award

## Additional education

- 2010–2012     3-year summer school program in Spatial Economics, New Economic School, Moscow, Russia

## Research area

Applying mathematical modelling I have studied evolution of self-organized systems that reflect physical and economical phenomena. My mathematical background was linked to limit sets of non-linear equations of mathematical physics [S01]. Later I investigated the phenomenon of self-organized criticality in seismicity and searched for origins of predictability of extremes exhibited by self-organized critical systems [SS05, SS10, SS12]. Prediction algorithms based on inter-event distribution were evaluated in [S10]. Recently I turned to analysis of solar dynamo by using dynamical system tools. With Vincent Courtillot, Jean-Louis Le Mouél, and Mikhail Shnirman I revealed a regime change of solar dynamo occurred at approximately 1915 and found evidence for current reverse changes of solar dynamo to pre-1915-year level [SCLMS13, SCLMS14].

Professor Shlomo Weber brought me a year ago into applications of game theory to problems of economics and political economy. This work is under progress now at the New Economic School Center for the Study of Diversity.

## Publications

A handbook, 2 tutorials, 2 books, and approximately 25 papers in peer-refereed journals

### Principal papers:

- [S01] A. Shapoval, Attractors of non-linear elliptic equations with small parameter, *Differ. Equations* 37, 1303 (2001)
- [SS05] A. Shapoval, M. Shnirman, Crossover Phenomenon and Universality: from Random Walk to Deterministic Sand-Piles, *Int. J. Mod. Phys. C* 16, 1893 (2005)
- [SS10] M. G. Shnirman, A. B. Shapoval, Variable predictability in deterministic dissipative sandpile, *Nonlinear Processes in Geophysics* 17, 85 (2010)
- [S10] A. Shapoval, Prediction problem for target events based on the inter-event waiting time, *Physica A* 389, 5145 (2010)
- [SS12] A. Shapoval, M. Shnirman, The BTW mechanism on a self-similar image of a square: A path to unexpected exponents, *Physica A* 391, 15 (2012)
- [SCLMS13] A. Shapoval, V. Courtillot, J.-L. Le Mouél, M. G. Shnirman, Two Regimes in the Regularity of Sunspot Number, *Astrophysical Journal* 779, 108 (2013)
- [SCLMS14] A. Shapoval, J.-L. Le Mouél, V. Courtillot, M. G. Shnirman, Is a sudden increase of irregularity of sunspot numbers a precursor of a return to low solar activity?, *J. Geophysical Research*, accepted (2014), DOI: 10.1002/2013JA019584

## Research funding grants

- Grants of Russian Foundation for Basic Research
  - 99-01-00304: Trajectory attractors of equations of mathematical physics (1999–2001)
  - 02-01-00277: Global attractors for systems of equations of mathematical physics, theory of perturbation and averaging (2002–2004)
  - 05-01-00390: Attractors of dissipative infinite dimensional dynamical systems, effects of regularization, averaging, and memory (2005–2007)
  - 05-05-64384: Scaling laws and forecasting in a model and realistic seismicity (2005–2006)
  - 08-01-00784: Trajectory and global attractors for mathematical physics systems with strong degeneracy and singular oscillation (2008–2010)

- 08-05-00215: Earthquake prediction: the probability-theoretic aspect and models (2008–2009)
- 08-06-00283: Models of financial markets and prediction (2008–2010)
- 11-01-00339: Attractors for autonomous and non-autonomous equations of mathematical physics (2011–2013)
- 11-01-00887: Processes of self-organization in nonlinear spatially distributed systems with strong positive feedback (2011–2013)
- 11-06-00278: Prediction of crashes on financial markets: theoretical analysis and prediction algorithms (2011–2013)
- 14-01-00346 Regular and non-regular attractors of infinitely dimensional dynamical systems (2014–2016)
- 14-01-00773 Studies of complex ordering, structures, and chaos in non-linear media (2014–2016)
- Grant of the Economics Education and Research Consortium C 12-581 Monopolistic competition under uncertainty (2013)
- Research grants of Ministry of Education and Science of the Russian Federation (2002, 2011, 2012)

#### Research and development ordered by the Russian government and other organizations

- Influence of regional diversity on perspectives of a social-economical development of Russia, 2011–2013, executive (leader: professor Shlomo Weber, Southern Methodist University, USA), state contract 14.740.11.0883, employer: Ministry of education and science of the Russian Federation
- Identification of the intervals of a speculative growth on stock markets, 2012, leader, employer: Financial University, source of financing: federal budget,
- Decision making under uncertainty of financial assets executive, 2013, (leader: professor I. E. Denezhkina, Financial University), employer: Financial University, source of financing: federal budget,

#### Teaching experience

Probability and Statistics, Introduction to Theory of Complex Systems, Investment, Derivatives, and other courses

#### Supervised theses

Master theses: 2  
Diplom theses: 17  
PhD theses: 1

#### Principal conferences attended

European Geophysical Union General Assembly, Wien, Austria (2000, 2007), Petrovsky International Conference Differential Equations and Related Topics, Moscow, Russia (2001, 2007), International Conference of Applied Mathematics and Computing, Plovdiv, Bulgaria (2007), International Conference “Extreme Events: Causes and Consequences” Paris, France (2008). Second Russian Economic Congress, Suzdal, Russia (2013), Industrial Organization and Spatial Economics, Saint-Petersburg, Russia (2014)

#### Research management

As a deputy head of chair “Applied mathematics”, 2009–2014, I was responsible for initiation of

research projects, acquisition of necessary funding from national and international funding agencies (13 grants of Russian Foundation for Basic Research, 5 contracts with the Ministry of Education of the Russian Federation) and organization of conferences and other scientific events (f.e. the First Congress on Econophysics in Russia, yearly student conferences)

## Computer skills

- *C language* used for high-speed computer simulation
- *MatLab* used for simple scripts, management of C-programs, and presentation of numerical results
- Book preparation with  $\text{\TeX}$ .

## Full list of publications

### Papers in peer-reviewed journals

1. A. Shapoval, Behavior of solutions of quasilinear elliptic inequalities in an unbounded domain, *Mathematical Notes*, V. 60, 4, 1996, p. 415–424.
2. A. Shapoval, The Integral Manifold for Nonautonomous Nonlinear Parabolic Equations in an Unbounded Domain, *Russ. Math. Surveys*, 2, 1996, p. 929; translation from *Uspehi Mat. Nauk* 5, 1996.
3. A. Shapoval, Integral manifolds of nonautonomous evolution differential equations, *Mathematical Notes*, V. 61, 2, 1997, p. 258–261.
4. A. Shapoval, The Integral Manifold of a Nonlinear Elliptic Equation in a Cylinder, *Mathematical Notes* V. 61 3, 1997, p. 391 –395.
5. A. Shapoval, Liouville Theorem for Second Order Elliptic Equation with Degenerating Coefficients, *Moscow University Mathematics Bulletin*, V. 53, 2, 1998, p. 22–27.
6. A. Shapoval, Integral Manifolds of Nonlinear Elliptic Equations with a Small Parameter, *Russ. Math. Surveys*, V. 53, 4, 1998. p. 827; translation from *Uspehi Mat. Nauk* 5, 1996, p. 175.
7. A. Shapoval, On Boundness of one Class of Quasilinear Parabolic Inequalities Solutions, *Differential Equations*, V. 36, 6, 1998, p. 845 – 847.
8. A. Shapoval, Growth of Solutions of Nonlinear Degenerating Elliptic Inequalities in Unbounded Domains, *Moscow University Mathematics Bulletin*, V. 55, 2000, p. 1–5.
9. Attractors of Nonlinear Elliptic Equations with a Small Parameter, *Differential Equations*, V. 37, 2001, p. 1303–1314.
10. A. B. Shapoval, M. G. Shnirman, Strong Events in the Sand-Pile Model, *International J. Modern Physics C*, V. 15, 2, 2004, p. 279 – 288.
11. A. B. Shapoval, M. G. Shnirman, On Totality of the Strongest Events in the Sandpile (in Russian), *Computational Seismology*, V. 35, 2004, p. 258–267.
12. A. B. Shapoval, M. G. Shnirman, Scaling Properties of Strong Avalanches in Sand-Pile, *International J. Modern Physics C*, V. 16, 2, 2005, p. 341 – 348.
13. A. B. Shapoval, M. G. Shnirman, Crossover Phenomenon and Universality: from Random Walk to Deterministic Sand-Piles *International J. Modern Physics C*, V. 16, 12, 2005, p. 1893 –1907.
14. A. B. Shapoval, M. G. Shnirman, How Size of Target Avalanches Influences Prediction Efficiency *International J. Modern Physics C*, V. 17, 12, 2006, p. 1777–1790.
15. A. B. Shapoval, M. G. Shnirman, Prediction in a two-sign avalanche model, *Computational Seismology and Geodynamics*, Chowdhury D.K. (ed.) V. 7, American Geophysical Union, Washington D. C., 2005. p. 188–197.

16. A. B. Shapoval, M. G. Shnirman, Randomness and step-like distribution of pile heights in avalanche models, *European Physical J. B*, 2007, V. 59, P. 399–403.
17. A. B. Shapoval, M. G. Shnirman, Prediction Efficiency in an Avalanche Model for Different Target Events, *Izvestia, Physics of the Solid Earth*, V. 44, 2008, 495–500.
18. A. B. Shapoval, M. G. Shnirman, Sand density as sandpile descriptor, *International J. of Modern Physics C*, 2008, V. 19, p. 995–1006.
19. A. B. Shapoval, M. G. Shnirman, Scenarios of large events in the sandpile model, *Computational Seismology and Geodynamics*, Ismail-Zade A. (ed.) American Geophysical Union, Washington D. C., 2008. V. 8, p. 179–183.
20. V. B. Gisin, A. B. Shapoval, Two Agent Based Models and Market Stylized Facts, *International J. of Pure and Applied Mathematics*, 2008, V. 32, p. 521–527.
21. M. G. Shnirman, A. B. Shapoval, Prediction of the largest events in the sandpile model based on the earthquake precursors, *Izvestia, Physics of the Solid Earth*, V. 45, 2009, 406–413.
22. M. G. Shnirman, A. B. Shapoval, A dissipative deterministic BTW model with an activation scenario of strong events, *Izvestia, Physics of the Solid Earth*, V. 45, 2009, 414–423.
23. M. G. Shnirman, A. B. Shapoval, Variable predictability in deterministic dissipative sandpile, *Nonlinear Processes in Geophysics*, 2010, V. 17, 85–91.
24. A. B. Shapoval Prediction problem for target events based on the inter-event waiting time, *Physica A: Statistical Mechanics and its Applications*, 2010, V. 389, 5145–5154.
25. A. B. Shapoval, M. G. Shnirman, The BTW mechanism on a self-similar image of square: a path to unexpected exponents, *Physica A: Statistical Mechanics and its Applications*. 2012, V. 391, 8–14.
26. A. Shapoval, V. Courtillot, J.-L. Le Mouël, M. G. Shnirman, Two Regimes in the Regularity of Sunspot Number, *Astrophysical Journal*. 2013. V. 779, 108
27. A. Shapoval, J.-L. Le Mouël, M. G. Shnirman, V. Courtillot, Can irregularities of solar proxies help understand quasi-biennial solar variations?, *Nonlinear Processes in Geophysics*, 2014, V. 21. p. 797–813, doi:10.5194/npg-21-797-2014.
28. A. Shapoval, J.-L. Le Mouël, V. Courtillot, M. G. Shnirman, Is a sudden increase of irregularity of sunspot numbers a precursor of a return to low solar activity?, *J. Geophysical Research*, accepted (2014), DOI: 10.1002/2013JA019584

### Books and handbooks (all in Russian)

1. I. A. Alexandrova, V. M. Goncharenko, I. I. Denezhkina, V. V. Kiselev, D. S. Nabatova, V. Yu. Popov, I. G. Shandra, A. B. Shapoval, Methods of optimal solutions in economics and finance: Handbook, Ed. V. M. Goncharenko, V. Yu. Popov, Moscow, KNORUS, 2013, 400 pp.
2. A. B. Shapoval, Investments: mathematical methods, Moscow, FORUM, INFRA-M, 2007, 96 pp.
3. V. Yu. Popov, A. B. Shapoval, Investments: mathematical methods, 2-nd edition, Moscow, FORUM, INFRA-M, 2007, 144 pp.
4. N. I. Lahmetkina, S. V. Petropavlovsky, V. Yu. Popov, A. B. Shapoval, Quantitative methods of investment analysis: tutorial for undergraduate students, Moscow, Financial University, 2012, 168 pp.
5. I. E. Denezhkina, V. Yu. Popov, B. B. Rubtsov, N. A. Stanik, A. B. Shapoval, “Bubbles” as precursors of financial crashes, Moscow, Publishing house “Economiceskaya Gazeta”, 2012, 146 pp.
6. N. A. Stanik, V. A. Ivanyuk, E. V. Maevsky, V. Yu. Popov, A. B. Shapoval Identification of intervals of speculative growth on stock markets, Moscow, Publishing house “Granitsa”, 2012, 245 pp.