

## CURRICULUM VITAE

### **Alexei N. Fedorov, Ph.D.**

Associate Professor, Head of Bioinformatics Laboratory  
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#### ***PERSONAL***

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MARITAL STATUS: Married

#### ***EDUCATION***

1993 Ph.D., Institute of Molecular Genetics,  
Russian Academy of Sciences, Moscow  
Thesis Title: Investigation of beta-globin gene mutations  
in certain regions of the Caucasus and Central Asia

1982 M.Sc., Faculty of Physics,  
Moscow State University  
Thesis Title: Anomaly in lithium-magnesium alloys

#### ***PROFESSIONAL EXPERIENCE***

2008 Associate Professor, Department of Medicine  
University of Toledo, Health Science Campus  
3120 Glendale Ave, Toledo, OH 43614-5809

2003-2007 Assistant Professor, Department of Medicine  
University of Toledo, Health Science Campus  
3120 Glendale Ave, Toledo, OH 43614-5809

1998- 2003 Post-doctoral Research Fellow  
The Biological Laboratories (Walter Gilbert Lab)  
Harvard University, Cambridge, MA 02138, USA

1997-1998 Post-doctoral Research Fellow  
Department of Physiology, School of Medicine,  
University of Miami, Miami, FL 33136, USA

1994-1996 Post-doctoral Research Fellow  
Sussex Centre for Neuroscience (IRC),  
University of Sussex, Brighton, BN1 9QG, UK

1985-1994 Research Associate  
Department of Human Genetics, Institute of Molecular Genetics,  
Russian Academy of Sciences, Moscow 123182, Russia

1982-1985 Junior Research Associate  
Research Institute for Biological Tests of Chemical  
Compounds, Kupavna, Moscow region

#### ***SCIENTIFIC ACHIEVEMENTS***

*Main achievements in the area of molecular biology:*

- 1) Detected four mutations in beta-globin gene in various human populations that cause beta-thalassemia, one of the most common and severe human hereditary diseases, which affects tens of millions of humans all around the World.
- 2) Optimized the method of characterization of genomic repetitive elements using restriction endonucleases and showed that this approach can be used for species identification. This optimized method is a valuable tool for conservation biology in the characterization of rare species.
- 3) Analyzed the process of neuron regeneration at the molecular level and generated a database of genes that are actively expressed during regeneration of neurons. Characterized two genes with specific expression during neuronal regeneration. Characterized several genes actively expressed in neurons: two types of  $\alpha$ -tubulins, C/EBP-like transcription factor, synapsin, calmodulin-like protein, Band 4.1-related structural protein, and several novel proteins. This area of research is very important for medicine dealing with spinal cord injuries and various neurological disorders.
- 4) Characterized a novel form of metabotropic glutamate receptor 4 mRNA specifically expressing in mammalian taste buds. The main application of these data is in the food industry.
- 5) Generated hypothesis of the origin of introns

*Main achievements in bioinformatics:*

- 1) Carried out the statistical analysis of the distribution of introns with respect to their phases, determining that the non-randomness in intron phase distribution is a universal phenomenon for eukaryotic organisms.
- 2) Characterized the influence of exon duplication and shuffling on intron phase distribution.
- 3) Created the Exon-Intron Database, publicly available on the Internet (<http://hsc.utoledo.edu/depts/bioinfo/database.html>).
- 4) Developed the INTRONMAP program for mapping all known introns from GenBank on all proteins with known 3-D structure from Protein Data Bank.
- 5) Elucidated human exonic splicing enhancers – essential genomic elements that are required for the correct gene expression.
- 6) Discovered regularities in context-dependent codon bias in different eukaryotic genomes including human.
- 7) Generated a novel theory of the origin of the first eukaryotic cell via investigations of 50 completely sequenced genomes of various species.
- 8) Performed the comparison of introns in all known genes of animals, plants, and fungi.

**SCIENTIFIC INTERESTS**

- Principles of mammalian genome organization.
- Origin, evolution, and functioning of introns.
- Computer prediction of constitutive and alternative splicing.
- Structure, function, and evolution of non-protein coding RNA.
- Information content of genes beyond the coding meaning.

**PUBLICATIONS**

52. Bechtel J.M., Wittenschlaeger T., Dwyer T., Song J., Arunachalam S., Ramakrishnan S.K., Shepard S., Fedorov A. Genomic mid-range inhomogeneity impacts RNA secondary structures. *Genome Biology* 2007 (submitted, MS ID 2023183612167122)
51. Bechtel J. M., Rajesh P., Ilikchyan I., Deng Y., Mishra P.K., Wang G., Wu X., Afonin K., Grose W., Wang Y., Khuder S., and Fedorov A. Deciphering RNA splicing potential. *BMC Bioinformatics* 2007, (submitted after revision).
50. Bazeley P.S., Shepelev V., Talebizadeh Z., Butler M.G., Fedorova L., Filatov V., Fedorov A. snoTARGET shows that human orphan snoRNA targets locate close to alternative splice junctions. *Gene* 2008, 408:172-179.
49. Havlioglu N., Wang J., Fushimi K., Vibranovski M.D., Kan Z., Gish W., Fedorov A., Long M., Wu J.Y. An intronic signal for alternative splicing in the human genome. *PloS ONE* 2007, 11:e1246.
48. Fedorov A., Fedorova L. Where is the difference in the genomes of humans and annelids? *Genome Biology* 2006, Vol. 7, No. 1, Article 203, pp 1-2.
47. Shepelev V., Fedorov A. Advances in the Exon-Intron Database. *Briefings in Bioinformatics* 2006, 7: 178-185.
46. Shao X., Shepelev V., Fedorov A. Bioinformatic analysis of exon repetition, exon scrambling and trans-splicing in humans. *Bioinformatics* 2006, 22:692-698.
45. Fedorova L., Fedorov A. Puzzles of the human genome: why do we need our introns? *Current Genomics* 2005, Vol. 6, No 8, 589-595.
44. Fedorov A., Stombaugh J., Harr M.W., Yu S., Nasalean L., Shepelev V. Computer identification of snoRNA genes using a Mammalian Orthologous Intron Database. *Nucl. Acids Res.* 2005. 33, 4578-4583.
43. Fedorov A., Fedorova L. Introns: mighty elements from RNA world. *J. Molec. Evol.* 2004, 59, 718-721.

42. Fedorov A. and Hartman H. What does microsporidian *E.cuniculi* tell us about the origin of the eukaryotic cell? *J. Molec. Evol.* 2004, 59, 695-702.
41. Fedorov A., Roy S., Fedorova L., Gilbert W. Mystery of intron gain. *Genome Research* 2003, 13, 2236-2241.
40. Fedorov A., Fedorova L. Exonic splicing enhancers. 2003 in *Encyclopedia of the Human Genome*, Nature Publishing Group, London, v 2, 386-391.
39. Fedorova L., Fedorov A. Introns in gene evolution. *Genetica* 2003, 118: 123-131.
38. Roy S\*, Fedorov A\*, Gilbert W. Large-scale comparison of intron positions in mammalian genes shows intron loss but no gain. *PNAS*, 2003, 100: 7158-7162. (\*equal contribution)
37. Fedorov A., Roy S., Cao X., Gilbert W. Phylogenetically older introns strongly correlate with module boundaries in ancient proteins. *Genome Research* 2003, 13: 1155-1157.
36. Fedorov A., Merican A.F., Gilbert W. Large-scale comparison of intron positions between plant, animal and fungal genes. *PNAS*, 2002, 99, 16128-16133.
35. Roy S., Fedorov A., Gilbert W. The signal of ancient introns is obscured by intron density and homolog number. *PNAS* 2002, 99, 15513-15517.
34. Hartman H. & Fedorov A. The origin of the eukaryotic cell – a genomic investigation. *PNAS* 2002, 99, 1420-1425.
33. Fedorov A., Saxonov S., Gilbert W. Regularities of context-dependent codon bias in eukaryotic genes. *Nucl. Acids Res.* 2002, 30 (5), 1192-1197.
32. Endo T., Fedorov A., DeSouza S., Gilbert W. Do introns favor or avoid regions of amino acid conservation? *Mol. Biol. Evol.* 2002, 19, 521-525.
31. Roy S., Lewis B., Fedorov A., Gilbert W. Footprints of primordial introns on the eukaryotic genome *TIG* 2001, 17, 496-499.
30. Fedorov A., Cao X., Saxonov S., DeSouza S., Roy S.W., Gilbert W. Intron distribution difference for 276 ancient and 131 modern genes suggests the existence of ancient introns. *PNAS* 2001, 98, 13177-13182.
29. Fedorova L., Daizadeh I., Fedorov A., Ryskov A.P. *In silico* analysis of the restriction fragment length distribution of the human genome. *Genetika (Russian)* 2001, 37, 456-466.
28. Fedorov A., Saxonov S., Fedorova L., Daizadeh I. Comparison of intron-containing and intron-lacking genes elucidates putative exonic splicing enhancers. *Nucl. Acids Res.* 2001, v. 29, 1464-1469.
27. Saxonov S., Daizadeh I., Fedorov A., Gilbert W. EID: The Exon-Intron Database: An exhaustive database of protein-coding intron-containing genes. *Nucleic Acids Res.*, 2000, 28, 185-190 (web site <http://mcb.harvard.edu/gilbert/EID>).
26. Fedorov A., Fedorova L., Grechko V.V., Ryabinin D., Sheremet'eva V.A., Bannikova A.A., Lomov A.A., Ryskov A.P., Darevsky I.S. Variable and invariable DNA repeat characters revealed by taxonprint approach is useful for molecular systematics. *J Mol. Evol.* 1999, 48, 69-76.
25. Fedorov A., Johnston H., Korneev S., Blackshaw S., Davies J. Cloning, characterization and expression of the alpha-tubulin genes of the leech *Hirudo medicinalis*. *Gene*, 1999, 227, 11-19.
24. Fedorov A., Starshenko V., Fedorova L., Filatov V., Grigor'ev E. Influence of exon duplication and shuffling on intron phase distribution. *J. Mol. Evol.* 1998, 46, 263-271.
23. Korneev S., Fedorov A., Collins R., Blackshaw S.E., Davies J.A. A subtractive cDNA library from an identified regenerating neuron is enriched in sequences up-regulated during nerve regeneration. *Invertebrate Neuroscience*, 1997, 3, 185-192.
22. Grechko V.V., Fedorova L.V., Fedorov A.N., Slobodyanyuk S.Ya., Ryabinin D.M., Melnikova M.N., Bannikova A.A., Lomov A.A., Sheremet'eva V.A., Gorshkov V.A., Sevostyanova G.A., Semenova S.K., Ryskov A.P., Mednikov B.M., Darevsky I.S. Restriction endonuclease analysis of highly repetitive DNA as a phylogenetic tool. *J. Mol. Evol.* 1997, 45, 332-336.
21. Grechko V.V., Ryabinin D.M., Fedorova L., Fedorov A., Ryskov A.P., Darevski I.S. Parentage of Caucasian parthenogenetic rock lizard species (*Lacerta*) as revealed by restriction endonuclease analysis of highly repetitive DNA. *Amphibia-Reptilia* 1997, 18, 407-418.
20. Fedorov A., Nasyrova F., Bocharova T., Smirnova E., Limborska S.A. G - C in IVS-I,-1, and C - G in -42 of promoter region of beta-globin gene in Tajikistan. *Hemoglobin*, 1993, 17, 275-278.
19. Fedorov A., Suboch G., Bujakov M., Fedorova L. Analysis of nonuniformity in intron phase distribution. *Nucleic Acids Res.*, 1992, 20, 2553-2557.
18. Fedorov A.N., Rasulov E.M., Smirnova E.A., Bocharova T.N., Limborska S.A. The T-A mutation at position -30 of the  $\beta$ -globin gene found in a Karachai patient with  $\beta$ -thalassemia intermedia. *Hemoglobin*, 1992, 16, 521-523.
17. Limborska S.A., Fedorov A.N., Prosnjak M.I., Vlasov M.S., Barysheva E.V., Rasulov E.M. The investigation of mutant genes and human normal polymorphism. in: *Metabolism and enzymology of nucleic acids including*

*gene and protein engineering*, edited by J. Balan, 1991, 7, 247-253, Slovak Academy of Sciences, Bratislava, Czechoslovakia.

16. Limborska S.A., Fedorov A.N., Bukhman V.L., Prosnjak M.I. Detection of beta-globin intron mutation in a beta-thalassemic patient from Azerbaijan. in: *Metabolism and enzymology of nucleic acids including gene manipulations*, edited by J. Zelinka and J. Balan, 1988, 6, 197-201, Plenum Press, New York and London.

#### PUBLICATIONS IN INTERNATIONALLY RECOGNISED RUSSIAN JOURNALS:

15. Grechko V.V., Ryabinin D.M., Fedorova L.V., Rudykh I.A., Fedorov A.N., Ryskov A.P., Semenova S.K., Darevskiy I.S. DNA –taxonprints of some Lacertidae lizards – taxonomic and phylogenetic implications. *Molecular Biology* (Russian), 1998, 32, 151-160.
14. Grechko V.V., Fedorova L.V., Fedorov A.N., Slobodyanyuk S.Y., Ryabinin D.M., Melnikova M.N., Bannikova A.A., Lomov A.A., Sheremeteva V.A., Gorshkov V.A., Sevostyanova G.A., Semenova S.K., Ryskov A.P., Mednikov B.M., Darevskii I.S. Restriction endonuclease analysis of highly repeated DNA sequences sheds light on genetic relatedness of lower taxa of animals. *Molecular Biology* (Russian), 1997, 31, 202-209.
13. Bannikova A.A., Dolgov V.A., Fedorova L.V., Fedorov A.N., Lomov A.A., Mednikov B.M. Divergence of shrews (Insectivora, Soricidae) from the data of DNA restriction analysis. *Zoologicheskyy zhurnal* (Russian), 1996, 75, 256-270.
12. Bannikova A.A., Dolgov V.A., Fedorova L.V., Fedorov A.N., Troitsky A.V., Lomov A.A., Mednikov B.M. Taxonomic relationships among hedgehogs of the subfamily Erinaceinae (mammal, Insectivora) determined basing on the data of restriction-endonuclease analysis of total DNA. *Zoologicheskyy zhurnal* (Russian), 1995, 74, 95-106.
11. Bannikova A.A., Fedorova L.V., Fedorov A.N., Troitsky A.V., Grechko V.V., Dolgov V.A., Lomov A.A., Mednikov B.M. Comparison of DNA repeats elements of mammals fam. Erinacea using restriction analysis. *Genetika* (Russian), 1995, 31, 1498-1506.
10. Slobodyanyuk S.Y., Pavlova M.E., Fedorov A.N., Belikov S.I. Bsp-family of tandemly repeated DNA-sequences of Baikal cottoid fishes (Cottoidea). *Molecular Biology* (Russian), 1994, 28, 282-288.
9. Lebedeva I.V., Ivanovskaya M.G., Fedorov A.N., Limborskaya S.A., Shabarova Z.K. New method of nonradioactive labeling of oligonucleotides and their use as allele-specific probes for mutations causing beta-thalassemia. *Molecular biology* (Russian), 1994, 28, 521-526.
8. Grechko V.V., Ryabinin D.M., Fedorova L.V., Fedorov A.N., Darevskii I.S., Ryskov A.P. DNA taxonprint analysis of family Lacertidae species. *Molecular Biology* (Russian), 1993, 27, 883-890.
7. Grechko V.V., Ryabinin D.M., Fedorova L.V., Fedorov A.N., Darevskii I.S., Ryskov A.P. DNA taxonprint analysis of certain lizard species from the Lacertidae family. *Molecular Biology* (Russian), 1993, 27, 1404-1414.
6. Fedorov A.N., Suboch G.M., Buiakov M.I., Fedorova L.V. Study of the minimum frequency of phase 2 introns. *Molecular Biology* (Russian), 1993, 27, 519-530.
5. Fedorov A.N. Investigation of beta-globin gene mutations in certain regions of the Caucasus and Central Asia. In: Autoreferat, Moscow, 1992.
4. Fedorov A.N., Grechko V.V., Slobodyanyuk S.Ya., Fedorova L.V., Timochina G.I. Taxonomic analysis of DNA repeated sequences. *Molecular Biology* (Russian), 1992, 26, 464-469.
3. Limborskaya S.A., Bukhman V.L., Prosnjak P.M., Fedorov A.N., Slominsky P.A., Ninkina N.N., Ryskov A.P. Molecular investigation of thalassemia .4. Cloning of beta-globin gene of beta-thalassemic patient from Azerbaijan and determination of a point mutation in minor intron. *Genetika* (Russian), 1987, 23, 228-238.
2. Moskaleva E.I., Iliushina N.A., Zakharov V.N., Fedorov A.N., Karaulov A.V. DNA repair capacity of peripheral blood lymphocytes from healthy donors. *Terapevticheskii Arkhiv* 57 116-118, 1985.
1. Egorov V.S., Fedorov A.N. Anomaly in lithium-magnesium alloys. *JETP letters*, 1982, 35, 462-465.

#### AWARDS

- BDNX medal by the Russian National Government (1986).
- Stipend by the George Soros foundation (program Biodiversity), 1993
- NSF CAREER Development award MCB-0643542, (2007)

#### JOURNAL PEER REVIEW

Nucleic Acids Research; Gene; Bioinformatics; Journal of Molecular Evolution; BMC Bioinformatics; Molecular Biology and Evolution; Genetics; Genome Research; Proceedings of National Academy of Science; Trends in Genetics.

#### REVIEW PANELS:

NSF (2007); Biomedical Research Council (BMRC) - A\*STAR (2006-2007).

**COMMITTEES, THE UNIVERSITY OF TOLEDO:**

Computer Cluster Management Committee (Head),  
Program Bioinformatics and Genomics/Proteomics

**PAST RESEARCH SUPPORT, TRAINING GRANTS**

Start-up funds for Bioinformatics Laboratory, University of Toledo (2003-2006)

**CURRENT RESEARCH SUPPORT, TRAINING GRANTS**

NSF CAREER Development award MCB-0643542

Title: "Investigation of intron cellular roles"

Funding agency: National Science Foundation

Period of support: from June 2007 to June 2012

PI: Alexei Fedorov, Department of Medicine, UT

**INVITED PRESENTATIONS** (selected)

- *Intron sliding during evolution*. Chicago University, Department of Ecology and Evolution. January 1998 (Oral presentation).
- *Intron sliding during evolution*. Harvard University, Biological Laboratories. May 1998 (Oral presentation).
- *Correlation of intron positions with protein module boundaries*. MIT, Seminar Series "RNA World" May 1999 (Oral presentation)..
- *Hunting for exonic splicing enhancers*. Maryland University, May 14, 2001 (Oral presentation).
- *Introns in gene evolution*. SUNY at Albany, February 2002 (Oral presentation).
- *Introns in gene evolution*. Arizona State University, March 26<sup>th</sup> 2002 (Oral presentation).
- *Conceptions of intron evolution*. NCBI, December 9<sup>th</sup> 2003, Bethesda (Oral presentation)
- *Exon scrambling, repetition, and trans-splicing*. July 2005, Cold Spring Harbor (Oral presentation)