

Vadim A. Naumov  
**Curriculum Vitae**

November 12, 2023

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## **FORMATION**

**1961–1969:** Normal secondary school, Kemerovo City.

**1969–1971:** Physico-Electrotechnical Lyceum under the Kemerovo Pedagogical Institute and Extra-mural Physico-Mathematical Lyceum under the Novosibirsk State University.

**1971–1976:** Tomsk State University, Department of Theoretical Physics (1971–1974) and Department of Quantum Electrodynamics & Field Theory (1975–1976); Moscow State University (Dubna branch), Blokhintsev's Department of Theoretical Nuclear Physics (1974–1975).

- Academic year research works

- \* “*Superluminal Velocities in Special Relativity*” (1973)

- \* “*Goldstone Mechanism in Nonrelativistic Quantum Mechanics*” (1974),

- \* “*Indefinite Metrics in Quantum Electrodynamics*” (1975).

- Diploma of Physicist (July, 1976)

- \* Title of the Master Thesis: “*Nucleon Compton Effect within a Current Algebra Based Model with Hard Pions*”.

- \* Thesis Advisor: Prof. G. M. Radutsky (Research Institute for Nuclear Physics, Tomsk Polytechnic Institute, Tomsk).

**1979–1980:** Moscow State University, Dubna branch, Faculty for Improvement of Skill for Higher School Lecturers in Physics.

**1980–1984:** Institute for Nuclear Research (INR) of the Academy of Sciences of USSR (Moscow), Extra-mural postgraduate studentship.

**Nov. 1988:** Candidate of Phys. & Math. Sci. (PhD) in field of Physics of Atomic Nucleus and Elementary Particles (INR, Moscow).

- Title of the Thesis: “*Low Energy Neutrinos and Cosmic Rays*”.

- Thesis Advisor: Prof. G. V. Domogatsky (INR, Moscow).

**June 1999:** Degree of Senior Scientific Researcher in field of Theoretical Physics.

## PROFESSIONAL POSITIONS

- Junior Researcher of the Lab. for High Energy Physics, Research Institute for Nuclear Physics, Tomsk Polytechnic Institute, Tomsk, Russia (December 1975 – June 1976).
- Assistant Lecturer, Lecturer and then Senior Lecturer of the Department of Theoretical Physics, Irkutsk State University, Irkutsk, Russia (October 1976 – March 1992).
- Researcher and then Senior Scientific Researcher of the Group for Theoretical Physics, Institute of Applied Physics (IAP), Irkutsk State University, Irkutsk, Russia (January 1981 – January 1989).
- Research Leader of the Group for Cosmic Rays and Neutrino Astrophysics, IAP, Irkutsk State University, Irkutsk, Russia (January 1981 – January 1989).
- Head of the Lab. of Theoretical Physics, IAP, Irkutsk State University, Irkutsk, Russia (January 1989 – October 1999).
- Senior Scientific Researcher at the National Institute for Nuclear Physics (INFN), Florence branch, Florence, Italy (March 1992 – October 1996).
- Research Leader of the IAP, Irkutsk State University, Irkutsk, Russia (October 1999 – June 2002).
- Associate Professor of the Department of Theoretical Physics, Irkutsk State University, Irkutsk, Russia (November 1999 – June 2002).
- Scientific Researcher at the Department of Physics, Ferrara University; Associated Scientific Researcher at INFN, Ferrara branch, Ferrara, Italy (November 2000 – November 2002).
- Associate Professor of the Department of Physics, Florence University; Associated Scientific Researcher at INFN, Florence branch, Florence, Italy (November 2002 – October 2005).
- Senior Scientific Researcher at the Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research (JINR), Dubna, Russia (June 2002 – June 2014).
- Head of Sector of Neutrino Physics, Department “Particle and Fields” at the Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research (JINR),<sup>1</sup> Dubna, Russia (**current, since June 2014**).

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<sup>1</sup>URL: <http://www.jinr.ru/>.

## TEACHING EXPERIENCE

**1976–1978:** Foundation course on Physics at the Physico-Mathematical Lyceum attached to Irkutsk State University.

**1976–1992:** Undergraduate & graduate courses and practical training at the Physics Faculty, Irkutsk State University:

- Higher Mathematics:
  - \* Linear Algebra and Analytic Geometry,
  - \* Differential and Integral Equations (Analytic and Numerical Methods),
  - \* Calculus of Variations;
- Theoretical Physics:
  - \* Nonrelativistic Quantum Mechanics,
  - \* Relativistic Quantum Mechanics,
  - \* Thermodynamics and Statistical Physics,
  - \* Quantum Theory of Many-Particle Systems (Part I: Bosons),
  - \* Classical Theory of Radiation,
  - \* Quantum Field Theory,
- Special Subjects:
  - \* Current Algebras in Particle Physics,
  - \* Particle Physics Phenomenology,
  - \* Cosmic Ray Physics,
  - \* Neutrino Astrophysics.

**1981–1992:** Guidance of a regular Physics Seminar for the teaching staff of the Department of Theoretical Physics, Irkutsk State University (basic items: Topological and Algebraic Methods in Physics, Advanced Quantum Mechanics, Particle Physics, Neutrino Astrophysics).

**1992–1996:** Graduate lectures on Selected Topics of Astroparticle Physics at Dipartimento di Fisica, Università degli Studi di Firenze, Florence, Italy.

**1996–2000:** Graduate and postgraduate courses at the Physics Faculty, Irkutsk State University:

- Theoretical Physics:
  - \* Physical Kinetics,
  - \* Particle Transport Theory,
- Special Subjects:
  - \* Particle Physics Phenomenology,
  - \* Cosmic Ray Physics and Neutrino Astronomy.

**2002–2005:** Postgraduate course “Introduction to Cosmic Rays” at the Dipartimento di Fisica, Università degli Studi di Firenze, Florence, Italy.

**2007–2023:** A course of lectures “Neutrino in Physics and Astrophysics” for V-VI course students of JINR-based Department of Fundamental and Applied Problems of Microworld Physics of Moscow Institute of Physics and Technology, Physics Department of Lomonosov Moscow State University, and for post-graduates of the JINR University Center, Dubna.

## BOOKS, GUIDANCE, ETC.

- Two educational supplies “Problems in Thermodynamics and Statistical Physics” (in collaboration with S. I. Sinegovsky, Irkutsk University Press, 1978, 1979).
- Textbook “Physical Kinetics” (in collaboration with A. N. Vall and A. E. Rastegin, Irkutsk University Press, 2001).
- Online textbook “Introduction to Cosmic Rays”.<sup>2</sup>
- Online textbook “Neutrino in Physics and Astrophysics”.<sup>3</sup>
- An editor of the Proceedings “Astrophysics and Microworld Physics” (together with Y. V. Parfenov and S. I. Sinegovsky, Irkutsk University Press, 1998).<sup>4</sup>
- An editor of the Proceedings of the “19th European Cosmic Ray Symposium” (together with O. Adriani et al.), Int. J. Mod. Phys. A **20** (2005) 6533-7077 (special issue).<sup>5</sup>
- Scientific guidance at Irkutsk State University, Florence University, and University Center of JINR, Dubna (13 academic-year works, 15 master theses, and 3 PhD theses).

## EXTENDED SCIENTIFIC VISITS

- Scientific visitor at the Lab. for Theoretical Physics, Joint Institute for Nuclear Research (JINR), Dubna (September 1979 – March 1980).
- Scientific visitor at the Institute for Nuclear Research of the Academy of Sciences of USSR, Moscow – Troitsk (3 to 4 months per year during the period from January 1981 to March 1992).
- Scientific visitor at the National Lab. for High Energy Physics, KEK, Tsukuba and invited professor at the Physics Department of Niigata University (November – December, 1991).
- Scientific visitor at the PPE Division of CERN, Geneva (1 to 2 months per year, starting from 1995).
- Scientific visitor at the INFN (Sezione di Firenze), Florence (1 to 2 months per year, starting from 1996).
- Invited professor at the Korea Institute for Advanced Study (KIAS), Seoul (November – December, 1998).
- Invited professor at the Physics Department of Ferrara University, Ferrara (March – May, 2000).
- Scientific visitor at KEK, Tsukuba (January – February, 2009).

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<sup>2</sup>URL (INFN): <http://hep.fi.infn.it/PAMELA/naumov/UHECR/UHECR.htm>,  
URL (JINR): <http://theor.jinr.ru/~vnaumov/Eng/UHECR/UHECR.html>.

<sup>3</sup>URL: [http://theor.jinr.ru/~vnaumov/Eng/JINR\\_Lectures/NPA.html](http://theor.jinr.ru/~vnaumov/Eng/JINR_Lectures/NPA.html) (living document).

<sup>4</sup>URL: <http://www.api.isu.ru/school/Bsyph98/Bsyph98.htm>.

<sup>5</sup>URL: <http://www.worldscinet.com/ijmpa/20/2029/S0217751X052029.html>.

## PARTICIPATION IN INTERNATIONAL COLLABORATIONS

- BAIKAL NT Collaboration (1981–1992)
- NESTOR Collaboration (1992–2000)
- L3+COSMICS Collaboration (1996–2011)
- GENIE<sup>6</sup> Collaboration (**current, since 2017**).

## FIELDS OF ACTIVITY

- Neutrino Astrophysics, Cosmic Ray Physics, Particle Transport Theory:
  - Neutrino oscillations in vacuum and matter;
  - Solar and atmospheric neutrinos;
  - Cosmic-ray muon and neutrino production and propagation through matter;
  - Nuclear-cascade process in the atmosphere and geomagnetic effects of cosmic rays;
  - Physics of large-volume underground/water/ice Cherenkov detectors and magnetic spectrometers.
- Particle Physics Phenomenology:
  - Topological phases in quantum physics;
  - CP violation in quark and lepton sectors of the Standard Model;
  - Charmed particle hadroproduction;
  - Radiative and weak decays of hadrons;
  - Interactions of leptons, neutrinos, and SUSY particles with matter;
  - Axial structure of the nucleon;
  - Polarization phenomena in  $\nu N$  interactions;
  - Reactor antineutrinos;
  - Accelerator neutrino long-baseline experiments.
- Applied Mathematics and Programming:
  - Numerical methods for solution of differential, integral and integro-differential equations;
  - Quadrature and cubature algorithms;
  - Spline interpolation algorithms.

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<sup>6</sup>Event Generator & Global Analysis of Neutrino Scattering Data, see URL: <https://hep.ph.liv.ac.uk/~costasa/genie/index.html>.

## MAIN SCIENTIFIC RESULTS

- Semi-analytic methods to solve the transport equations for high-energy muon and neutrino propagation through dense and homogeneous media.
- Semi-analytic methods for calculating energy spectra and spatial distributions of the cosmic-ray secondaries, including leptons, at low, intermediate, high, and super-high energies (*taking account for scaling violation in hadron-nucleus interactions, energy losses, geomagnetic and meteorological effects, muon depolarization,  $K_{\ell 3}$  form factors, etc.*).
- Calculation of the atmospheric neutrino flux at low energies and neutrino induced event rates in underground neutrino detectors.
- Evaluation of “prompt” muon and neutrino fluxes at high energies within the recombination quark-parton model and quark-gluon string model for charm hadroproduction.
- Constraints to the density of supersymmetric relativistic dark matter particles (*massive photinos*) in the Universe from the data of underground neutrino detectors.
- An extension of the Rein-Sehgal model for single pion neutrino production through baryon resonances by taking account for the final lepton mass and spin.
- Adiabatic quantum-mechanical theory of neutrino oscillations in inhomogeneous media (*effects from electro-weak radiative corrections and CP violation in the leptonic sector; conditions to the nonlocal resonance in topological phases for three-neutrino oscillations in inhomogeneous media*).
- A covariant field-theoretical  $S$ -matrix approach to neutrino oscillations.

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A current summary of citations to articles recorded in the iNSPIRE HEP database is shown in Fig. 1.

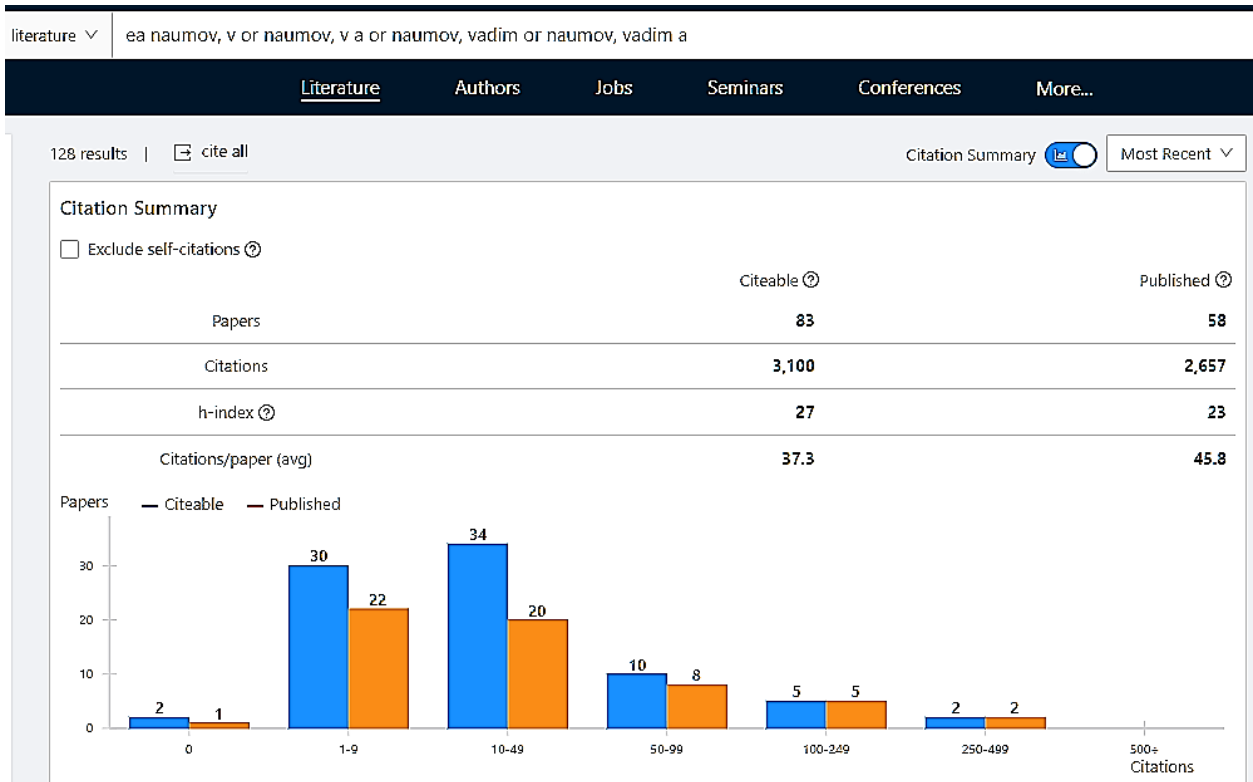


Figure 1: Summary of citations of articles included in the iNSPIRE HEP database as of November 12, 2023.

## Most cited articles according to the iNSPIRE HEP Database on November 12, 2023<sup>7</sup>

	citations
1. E. V. Bugaev, A. Misaki, V. A. Naumov, T. S. Sinegovskaya, S. I. Sinegovsky, and N. Takahashi, <i>Atmospheric muon flux at sea level, underground, and underwater</i> , Phys. Rev. D <b>58</b> (1998) 054001; arXiv:hep-ph/9803488.	467
2. The L3 Collaboration (P. Achard <i>et al.</i> ), <i>Measurement of the atmospheric muon spectrum from 20 to 3000 GeV</i> , Phys. Lett. B <b>598</b> (2004) 15–32; arXiv:hep-ex/0408114.	250
3. E. V. Bugaev and V. A. Naumov, <i>On the interpretation of the Kamiokande neutrino experiment</i> , Phys. Lett. B <b>232</b> No. 3 (1989) 391–397.	221
4. T. K. Gaisser, M. Honda, K. Kasahara, H. Lee, S. Midorikawa, V. A. Naumov, and T. Stanev, <i>Comparison of atmospheric neutrino flux calculations at low energies</i> , Phys. Rev. D <b>54</b> (1996) 5578–5584; arXiv:hep-ph/9608253.	175
5. G. Fiorentini, V. A. Naumov, and F. L. Villante, <i>Atmospheric neutrino flux supported by recent muon experiments</i> , Phys. Lett. B <b>510</b> , No. 1–4 (2001) 173–188; arXiv:hep-ph/0103322.	152
6. E. V. Bugaev, V. A. Naumov, S. I. Sinegovsky, and E. S. Zaslavskaya, <i>Prompt leptons in cosmic rays</i> , Nuovo Cimento <b>12 C</b> , No. 1 (1989) 41–73.	150
7. K. S. Kuzmin, V. V. Lyubushkin, and V. A. Naumov, <i>Quasielastic axial-vector mass from experiments on neutrino-nucleus scattering</i> , Eur. Phys. J. C <b>54</b> (2008) 517–538; arXiv:0712.4384 [hep-ph].	108
8. V. A. Naumov, <i>Three neutrino oscillations in matter, CP violation and topological phases</i> , Int. J. Mod. Phys. D <b>1</b> (1992) 379–399; KEK-Preprint-91-176.	95
9. K. S. Kuzmin, V. V. Lyubushkin, and V. A. Naumov, <i>Lepton polarization in neutrino nucleon interactions</i> , Mod. Phys. Lett. A <b>19</b> (2004) 2815–2829; arXiv:hep-ph/0312107.	81
10. D. V. Naumov and V. A. Naumov, <i>A Diagrammatic treatment of neutrino oscillations</i> , J. Phys. G <b>37</b> (2010) 105014; arXiv:1008.0306 [hep-ph].	77
11. V. A. Naumov and L. Perrone, <i>Neutrino propagation through dense matter</i> , Astropart. Phys. <b>10</b> (2-3) (1999) 239–252; arXiv:hep-ph/9804301.	75
12. V. A. Naumov, <i>Atmospheric muons and neutrinos</i> , in <i>Proceedings of the 2nd Workshop on Methodical Aspects of Underwater/Ice Neutrino Telescopes. Hamburg, Germany, August 15–16, 2001</i> , edited by R. Wischnewski (DESY-PROC-2002-01, DESY, Germany, 2002), pp. 31–46; arXiv:hep-ph/0201310.	63
13. The GENIE Collaboration (L. Alvarez-Ruso <i>et al.</i> ), <i>Recent highlights from GENIE v3</i> , Eur. Phys. J. ST <b>230</b> (2021) 4449–4467; arXiv:2106.09381 [hep-ph].	57
14. The GENIE Collaboration (J. Tena-Vidal <i>et al.</i> ), <i>Neutrino-nucleon cross-section model tuning in GENIE v3</i> , Phys. Rev. D <b>104</b> (2021) 072009; arXiv:2104.09179 [hep-ph].	57
15. K. S. Kuzmin, V. V. Lyubushkin, and V. A. Naumov, <i>Axial masses in quasielastic neutrino scattering and single-pion neutrino production on nucleons and nuclei</i> , Acta Phys. Polon. B <b>37</b> (2006) 2337–2348; arXiv:hep-ph/0606184.	54
16. The L3 Collaboration (P. Achard <i>et al.</i> ), <i>Measurement of the shadowing of high-energy cosmic rays by the Moon: A search for TeV-energy antiprotons</i> , Astropart. Phys. <b>23</b> (2005) 411–434; arXiv:astro-ph/0503472.	54
17. The Baikal NT Collaboration (L. A. Belolaptikov <i>et al.</i> ), <i>The lake Baikal deep underwater detector</i> , Nucl. Phys. B (Proc. Suppl.) <b>19</b> (1991) 388–395.	51

<sup>7</sup>Articles 2, 16 and 17 were published as part of experimental collaborations.