



Aliaksei (Alex) Halavanau

Resume

Summary

PhD in Accelerator Physics with 4 years of theoretical and experimental work in electron linear accelerators. PhD in Mathematical Physics with 8 years of experience in numerical differential equations solving and numerical methods. Strong multidisciplinary background in Physics, Math and Computer Science. Collaborative and leadership qualities, able to quickly and effectively resolve key issues in a limited period of time. Versatile analytical and practical skill set, excellent communication abilities, teaching experience, extremely driven and result oriented.

Areas of Expertise

- Electron linear accelerators: photoinjectors
- Advanced phase-space manipulations, N-body simulations
- Beam dynamics simulations: Impact-T, ASTRA, Elegant, GPT
- Numerical methods and high performance computing: Nonlinear dynamics
- Mathematical methods in Physics: Partial Differential Equations
- Data acquisition and analysis: Python, Matlab
- General Relativity, Astronomy, Classical Field Theory, Chaos theory
- Critical thinking, project management, problem-solving skills

Education

- 2013 - 2018 **PhD**, *Northern Illinois University*, DeKalb, IL, USA.
Research topic: Electron Beam Shaping and its Applications
- 2013 - 2015 **PhD**, *Belarusian State University*, Minsk, Belarus.
Research topic: Topological Solitons in Scalar Field Theory
- 2012 - 2013 **MSc**, *Belarusian State University*, Minsk, Belarus.
Research topic: Coupled ϕ^4 Scalar Field Theory
- 2007 - 2012 **BSc**, *Belarusian State University*, Minsk, Belarus.
Research topic: ϕ^4 and ϕ^6 Scalar Field Theory Models

PhD thesis

Title *Electron Beam Shaping and its Applications*

Advisors Prof. Philippe Piot, Dr. Charles Thangaraj

Abstract New transverse and longitudinal electron beam shaping methods are proposed. Significant improvement of electron beam quality with microlens array laser transverse shaping is demonstrated. Numerical models of experimental beamlines are benchmarked according to the experimental data. Transport properties of the superconducting accelerating cavity are investigated. Canonical angular momentum dominated and flat beams are produced and transported in the accelerator. Longitudinal space-charge amplification process is explored as a microbunching technique.

PhD thesis

Title *Topological Solitons in Scalar Field Theory*

Advisor Prof. Yakov Shnir

Abstract The properties of one-, two- and three-dimensional soliton solutions in scalar ϕ^4 and Faddeev-Skyrme model are investigated. A comprehensive numerical model for solving the corresponding field equations is developed. New types of solutions found and classified.

Experience

Professional

2016 - 2018 **Visitor**, *Argonne Wakefield Accelerator, Argonne National Lab*, Lemont, IL, USA.

- Microlens array laser transverse shaping
- Electron beam dynamics simulations
- Emittance measurements, beam optimization
- Magnetized beam experiments
- THz radiation generation, bunch length studies
- Bunch train generation in EEX

2015 - 2018 **Joint Fermilab Accelerator PhD program fellow**, *Fermilab*, Batavia, IL, USA.

- Beam dynamics simulations of FAST injector
- 1.3 GHz SRF accelerating cavity transport matrix measurement
- Magnetized and flat beam generation
- Flat beam compression, 4D emittance preservation
- Beam emittance studies, lattice optimization, commissioning
- Crystal channeling X-ray radiation generation

2012 **Visiting Scholar**, *Durham University*, Durham, UK.

- Boundary scattering in classical field theory
- Boundary collisions in ϕ^4 field theory model
- Mathematical analysis and numerical simulations

2011 **Summer Intern**, *Fermi National Laboratory*, Batavia, IL, USA.

- Project-X beam dynamics simulations
- Beam optics matching with TRACK

Teaching

2013 - 2017 **Teaching Assistant**, *Northern Illinois University*, DeKalb, IL, USA.

Mechanics 210/211, Electricity and Magnetism 273, Introduction to Astronomy 101

- 2012 **Teaching Assistant**, *Belarusian State University*, Minsk, Belarus.
Classical Mechanics, Quantum Mechanics, Nonlinear Methods in Physics
- 2011 **Astronomy instructor**, *Belarusian State University Lyceum*, Minsk, Belarus.
Trained several high-school students for the state and international Astronomy Olympiads, where they were awarded with the first and second prizes.

Miscellaneous

- 2013-2016 **Graduate Physics Colloquium host**, *Northern Illinois University*, DeKalb, IL, USA.
Organized Physics Graduate Students Colloquium. Over the period service invited and hosted 11 speakers from top-tier US institutions to give seminars in Biophysics, String Theory, Cosmology, Material Science, Particle Physics.
- 2011-2012 **System administrator**, *Belarusian State University*, Minsk, Belarus.
Maintained Linux computing cluster for various nonlinear dynamics simulations

List of publications

- **A. Halavanau**, et. al. - Analysis and Measurement of the Transfer Matrix of a 9-cell 1.3-GHz Superconducting Cavity, *Phys. Rev. Accel. Beams* 20, 4, 040102 (2017)
- P. Dorey, **A. Halavanau**, J. Mercer, T. Romanczukiewicz, Y. Shnir - Boundary scattering in the ϕ^4 model, *Journal of High Energy Physics*, 107, 1705 (2017)
- **A. Halavanau**, et. al. - Microlens Array Laser Transverse Shaping Technique for Photoemission Electron Source, technical report, FERMILAB-TM-2634-APC (2016)
- **A. Halavanau**, P. Piot - Simulation of a cascaded longitudinal space charge amplifier for coherent radiation generation, *NIMA*, 819, (2016) 144-153
- **A. Halavanau**, Ya. Shnir - Isorotating Baby Skyrmions, *Phys.Rev. D88* (2013) 085028, *arXiv:1309.4318 [hep-th]*
- **A. Halavanau**, T. Romanczukiewicz, Ya. Shnir - Resonance structures in coupled two-component ϕ^4 model, *Physical Review D* 86, 085027 (2012), *arXiv:1206.4471 [hep-th]*
- A. Acus, **A. Halavanau**, E. Norvaisas and Ya. Shnir - Hopfion canonical quantization, *Physics Letters B* 711 (2012) 212-216, *arXiv:1204.0504 [hep-th]*
- **A. Halavanau** and Ya. Shnir - Modulated Kink-Antikink Collisions in System of ϕ^4 Coupled Models, *Nonlinear Phenomena In Complex Systems* 2012, Vol.15, No.1, pp.74-83, PDF

Conference proceedings

- **A. Halavanau**, et. al. - Coherent transition radiation from transversely modulated electron beams, FEL2017, FERMILAB-CONF-17-337-APC
- **A. Halavanau**, P. Piot, et. al. - Magnetized and flat beam experiment at FAST, IPAC2017, FERMILAB-CONF-17-172-APC
- **A. Halavanau**, et. al. - Application of Voronoi diagram to mask-based intercepting phase-space measurements, IPAC2017, FERMILAB-CONF-17-171-APC
- **A. Halavanau**, et. al. - Commissioning and First Results From Channeling Radiation At FAST, NAPAC2016, *arXiv:1612.07358*
- **A. Halavanau**, P. Piot, et. al. - A Simple Method For Measuring The Electron-beam Magnetization, NAPAC2016, FERMILAB-CONF-16-460-APC
- **A. Halavanau**, et. al. - Measurement Of The Transverse Beam Dynamics In A Tesla-type Superconducting Cavity, LINAC2016, FERMILAB-CONF-16-398-APC

- **A. Halavanau**, G. Ha, et. al. - Generation of Homogeneous and Patterned Electron Beams using a Microlens Array Laser-Shaping Technique, IPAC2016, THPOW021
- **A. Halavanau**, P. Piot, et. al. - Preliminary Measurement of the Transfer Matrix of a TESLA-type Cavity at FAST, IPAC2016, TUPMY038
- **A. Halavanau**, P. Piot - Numerical study of three dimensional effects in longitudinal space charge impedance, IPAC2015, FERMILAB-CONF-15-225-APC
- **A. Halavanau**, P. Piot - Numerical investigation of a cascaded longitudinal space charge amplifier at the Fermilab's Advanced Superconducting Test Accelerator, IPAC2015, FERMILAB-CONF-15-226-APC
- **A. Halavanau**, P. Piot - Simulation of Cascaded Longitudinal Space Charge Amplifier at the Fermilab Accelerator Science and Technology (FAST) Facility, FEL2015, FERMILAB-CONF-15-370-APC

Languages

English	Fluent	<i>Bilingual proficiency</i>
Belarusian	Native	<i>Native proficiency</i>
Russian	Native	<i>Native proficiency</i>

Computer skills

Programming languages	C/C++, Python, Bash, Wolfram, Matlab	Beam Physics	Impact-T, Astra, Elegant, GPT, self-written
Algebra	Mathematica, Maple	HPC	CUDA, MPI, Condor
Data analysis	Numpy, Scipy, Pandas, Matplotlib	Operating Systems	Linux/MacOS/Windows

Professional references

- Prof. Philippe Piot (piot@fnal.gov)
- Dr. Charles Thangaraj (jtobin@fnal.gov)
- Prof. Stephen P. Martin (spmartin@niu.edu)
- Prof. Vladimir Litvinenko (vl@bnl.gov)
- Dr. Vladimir Shiltsev (shiltsev@fnal.gov)
- Dr. John Power (jp@anl.gov)
- Prof. Yakov Shnir (shnir@maths.tcd.ie)
- Prof. Ilya D. Feranchuk (iferanchuk@gmail.com)
- Dr. Sergey Antipov (s.antipov@euclidtechlabs.com)

Interests

Soccer	Played in amateur soccer leagues
Photography	Keen on astrophotography
Electronics	Beginner in circuit board design
Chess	Frequent chess.com visitor