CURRICULUM VITAE

Professor Nikita Nekrasov
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Personal information: born April 10, 1973, in Moscow, Russia; two children
Nationality: Russian, French, US permanent resident

POSITIONS, present

2013-present: Full Professor (Physics), Simons Center for Geometry and Physics, and Yang Institute for Theoretical Physics, Stony Brook University

POSITIONS, previous

2018-2022 visiting professor, Center for Advanced Studies, Skoltech, Russia

2013-2022: interim lead researcher/visiting professor, Lab. #5 IPPI, Moscow

2009-2010 , 2011-2013: Visiting Professor, Simons Center for Geometry and Physics (founding member)

2007: Visiting Professor, Department of Mathematics, Department of Physics, Princeton University

2006: Visiting Scholar, New High Energy Physics Center, Physics Department, Rutgers University (also month-long visits in 2001, 2002, 2004)

2006, 2002: Member (2-3 months), School of Natural Sciences, IAS, Princeton

2003: Gastdotzent, Forschungsinstitut für Mathematik, ETH Zurich

2008, 2005: Program Coordinator, Kavli Institute for Theoretical Physics, UC Santa Barbara

1999, 2003: General Member, KITP, UC Santa Barbara

1995-2018 senior researcher, Theory Division, ITEP, Moscow, Russia, on leave

EDUCATION

1986-1989: Moscow State 57th School, class of B.M. Davidovich (tutors: V. Fock, Yu. Chekanov)

1989-1995: Moscow Physical-Technical Institute, Honors Diploma

1995: Candidate of Phys. and Math. Sci. from ITEP (Moscow, Russia), thesis "Topological theories and zonal spherical functions" defended in June 1995, adviser: Lev Okun

1994-1996: Graduate School, Princeton University, Department of Physics
Ph.D. Thesis "Four dimensional holomorphic theories" defended in June 1996, adviser: David Gross

1996-1999: Junior Fellow, Harvard Society of Fellows

1999-2000: Robert. H. Dicke Fellow, Physics Department, Princeton University

AWARDS

2023: Dannie Heineman Prize, American Physical Society, American Institute of Physics

2019: Drexler Lectures, Kansas State University

2015: Professor of the Russian Academy of Sciences (Division of Nuclear Physics)

2015: Aisenshtadt Chair, Centre des Recherches Mathematiques, Montreal, Canada

2009: Compositio Prize (together with D. Maulik, A. Okounkov and R. Pandharipande)

2008: Takagi Lectures, Tokyo University and Keio University

2007: Simons Lectures, SUNY Stony Brook

2004: Hermann Weyl Prize

2004: Grand Prix Jacques Herbrand (French Academy of Sciences)

1995-1996: Ogden Porter Jacobus Fellow (Princeton University)

LECTURES AT MAJOR CONFERENCES

2022: Jerusalem Winter School on theoretical physics

2022: Strings-Maths'2022, Warsaw University

2022: Eurostrings'2022, ENS Lyon

2021: International Congress of Mathematical Physics'2021, Geneva, plenary speaker

2003- Simons Summer workshop, every year

2019: 100th anniversary of the birth of I. Khalatnikov, Chernogolovka

2019: Strings-Maths'2019, Uppsala University

2017: Strings-Maths'2017, University of Hamburg and DESY, Hamburg

2016: Simons Program: Current themes in High Energy Physics and Cosmology, Niels Bohr Institute, Copenhagen

2016: Hebrew University of Jerusalem, IIAS, Quantum Field Theory, String Theory and Beyond

2016: Strings'2016, Tsinghua University, Beijing

2015-2016: Strings-Maths'2015, Tsinghua University, Sanya

2014: Strings'2014, Princeton University

2013: 100th anniversary of the birth of I Ya. Pomeranchuk, Alikhanov Institute, Moscow

2013: Strings-Maths'2013, Simons Center for Geometry and Physics, Stony Brook

2012: Strings'2012, Ludwig-Maximilians-Universität München

2011-2012: VICTOR ROTHSCHILD MEMORIAL SYMPOSIA THE HEBREW UNIVERSITY OF JERUSALEM, CURRENT TRENDS IN PARTICLE PHYSICS AND COSMOLOGY

2010: Strings'2010, Texas A& M University, College Station, Texas

2009: Strings'2009, "Aula Magna" of the Angelicum The Pontificia Università S. Tommaso, Rome

2008: L. Landau Memorial Conference on Advances in Theoretical Physics, Chernogolovka

2006: Strings'2006, Friendship Hotel, Beijing

2004: Strings'2004, College de France, Paris

2003: International Congress of Mathematical Physics'2003, Lisboa, plenary speaker

2003: Strings'2003, Kyoto International Conference Hall, Kyoto

2002: International Congress of Mathematicians, Beijing

2002: Strings'2002, DAMTP, Cambridge

1999: Strings'1999, Max-Planck-Institut für Gravitationsphysik, Albert-Einstein-Institut, Potsdam

BOARDS

2021- Association for Mathematical Research, founding member

2018- JHEP, Editorial Board

2016-2019 International Advisory Board: Department of Mathematics, National Research University Higher School of Economics, Moscow

2016-2018 Advisory Board: Hamilton Mathematics Institute, Trinity College Dublin

2012- Board of directors: Friends of IHES, Inc.

2004- Organizing committee and/or advisory board: Strings' and Strings-Math's conferences (every few years)

2010-2018 Advisory Board: International Centre for Mathematical Sciences, Edinburgh

2010- Scientific Advisory Committee: Simons Center for Geometry and Physics

2010- "Theoretical and Mathematical Physics" Series Editor, Springer UK

2009- Letters in Mathematical Physics, Editorial board

2008-2013: Nuclear Physics B, Editorial board

2004- Communications in Mathematical Physics , Editorial Board

2000-2013 Scientific committee: Institut des Hautes Etudes Scientifiques

RESPONSIBILITIES

management of grants, organization of conferences/workshops/programs/schools, outreach

2023-: PI on the NSF grant award "Research in novel symmetries of quantum field theory".

2022 Simons Center Program, "Enumerative geometry and integrability", Stony Brook, co-organizer

2022 Conference in honor of M. Douglas' 60'th anniversary, organizing committee, IHES, France, co-organizer

2012- SigmaCamp, annual one-week/10 days enrichment summer camp for science-oriented schoolchildren aged 12-16, from Europe and USA, co-organizer/lecturer/instructor

2020 "Physical practicum", online physics competition followed by 2-week research masterclass, co-organized with Leonid Levitov (MIT), with 300 students from fSU competing to participate in 1:2 research projects with active theoretical physicists from Europe and USA.

2019 "BPS/CFT correspondence", co-organizer (CRM, Luminy, France)

2019 "Future of the Universe", organizing committee (Paris, DAU project)

2018 Simons Center Program "Exactly Solvable Models of Quantum Field Theory and Statistical Mechanics", coordinator

2016 Strings-Math'2016, organizing committee

2016 Les Houches Summer School "Integrability: From Statistical Systems to Gauge Theory", co-organizer

2014-2017: PI on the NSF grant award "Research in novel symmetries of quantum field and string theory", $344,886.

2014 Simons Center Program "Gauge Theory, Integrability, and Novel Symmetries of Quantum Field Theory", coordinator.

2014 Simons Center Workshop "Future Prospects for Fundamental Particle Physics and Cosmology", co-organizer.

2014 Strings-2014, scientific advisory board

2006-2017: Co-PI on the Agence Nationale de Recherche (ANR, France) grants: "Structure of vacuum, topological strings and black holes", and "Geometry and integrability in Mathematical Physics"

2013 V. Knizhnik IHES memorial conference, co-organizer

2013 Euler Institute for Mathematical Sciences, Workshop "Gauge theories and integrability", co-organizer

2013 Simons Center Program "Quiver varieties in mathematics and physics", coordinator

2013 Strings-Math'2013, organizing committee

2012-2014 International Congress of Mathematicians 2014, sectional panel member

2012 Simons Center Program, "Integrability in Modern Theoretical and Mathematical Physics", coordinator?

2012 Strings'2012, scientific advisory board

2011 "Theory 1956", organizing committee (Kharkiv, DAU project)

2011 Strings-2011, scientific advisory board

2011- Theoretical Physics seminar at the Simons Center for Geometry and Physics, co-organizer

2011 IHES conference "Three string generations at the IHES", co-organizer

2011 Simons Center workshop "Branes and Bethe Ansatz in Supersymmetric Gauge Theories", co-organizer

2010 Simons Center workshop "Perspectives, Open Problems & Applications of Quantum Liouville Theory", co-organizer

2010 Simons Center workshop "Superstrings in Ramond-Ramond backgrounds", co-organizer

2010 Simons Center workshop "Quantum integrability and supersymmetric gauge theories", co-organizer

2009 Strings-2009, scientific advisory board

2009 "Gauge Fields, Cosmology and Mathematical String Theory", a programme at the Banff International Research Station, co-organizer

2008: IHES conference, "IHES 50 with Strings attached", co-organizer

2007-2013 *Black holes, topological strings, pure spinors*, joint IHES/Saclay seminar

2006-2009: *Structure of vacuum, topological strings and black holes*, ANR sponsored collaboration between CEA/Saclay and IHES

2006-2009: *Geometry and integrability in Mathematical Physics* , ANR sponsored collaboration between *DMA ENS Paris*, *LPTHE*, *SPhT*, *Inst, de Math. Jussieu*, *LPTMS Paris−Sud*, *IHES*, *Lab. Poncelet*, *ENS Lyon*, *U. Montpellier* 2, *CIRM*, *U. de Bourgogne*, *U. Toulouse* 3, *U. Poitiers*, *IRMA U.Angers*, *U. d′Artois*(*Lens*)

2004-05: *String and Field theory dualities* , IHES winter school for (under)graduate students.

2004-09: *Constituents, Fundamental Forces and Symmetries of the Universe*, principal investigator for the RTN node: IHES/Ecole Polytechnique

2004-05: *Pure Spinors, Twistors, and Superstrings* , IHES/Saclay workshop

2004-05 *Mathematical Structures of String Theory* , KITP program

2004: *Avant Strings* , IHES workshop

2003: *School on Mathematics in String and Field Theory*, ICTP, Trieste, co-director

2002: *Workshop on string/brane cosmology*, IHES

2001: *Summer school on "Unity from Duality"*, Les Houches

2001-2009 Seminar "String theory in greater Paris", co-organizer

2000-2009 Theoretical Physics seminar at IHES, co-organizer

SUPERVISION of (UNDER)GRADUATE STUDENTS

2002-2005: Sergey Shadchin, Ecole Polytechnique, PhD. thesis "On Some Aspects of Gauge/String Correspondence", defended with honours, 2005

2007: Mikhail Tikhonov, Ecole Normale Superieur, master project

2012-2017: Naveen Prabhakar, Yang Institute for Theoretical Physics, Stony Brook University, PhD. thesis "Non-perturbative studies in supersymmetric field theories via string theory", defended in May 2017

2012-2017: Xinyu Zhang, Yang Institute for Theoretical Physics, Stony Brook University, PhD. thesis "Exact Results in Supersymmetric Quantum Field Theory", defended in August 2017

2012-2017: Alex DiRe

2013-2019: Saebyeok Jeong, Yang Institute for Theoretical Physics, Stony Brook University, PhD. thesis "Studies on Correspondences in Supersymmetric Quantum Field Theories", defended in June 2019

2017-2021 Norton Lee, Yang Institute for Theoretical Physics, Stony Brook University, PhD. thesis "Quantum spins and tops from gluinos and stops", defended in June 2021

2020-2022 Vasily Iugov, Moscow Physical-Technical Institute/Skoltech, master project

2022- Vasily Iugov, Yang Institute for Theoretical Physics, Stony Brook University

2021- Andrey Grekov, Yang Institute for Theoretical Physics, Stony Brook University

Three most significant papers of the last ten years

(1) *BPS/CFT correspondence: non-perturbative Dyson-Schwinger equations and qq-characters*, JHEP **03** (2016), 181 doi:10.1007/JHEP03(2016)181 [arXiv:1512.05388 [hep-th]].

(2) *BPS/CFT Correspondence III: Gauge Origami partition function and qq-characters*, Commun.Math.Phys. 358 (2018) 3, 863-894 doi:10.1007/s00220-017-3057-9 [arXiv:1701.00189 [hep-th]].

(3) *Membranes and Sheaves*, [arXiv: 1404.2323 [math.AG]], with Andrei Okounkov doi:10.14231/AG-2016-015

MAJOR RESEARCH DIRECTIONS

The common theme of Nekrasov's work is the connection between the two dimensional conformal field theories (and their q-analogues, or integrable deformations), and the four dimensional supersymmetric gauge theories (and their q-analogues, or higher dimensional counterparts), which he explores since early nineties. In 2002 he formulated a series of conjectures on this topic, and in 2004 proposed to call this duality the *BPS/CFT-correspondence*. One of the consequences of this duality is the relation between the classical and quantum integrability, it also has many applications in geometric Langlands program. The BPS/CFT correspondence has spawned several further research directions.

1) *Lefschetz thimbles in quantum field theory*: an attempt to define the path integral as a contour integral in the complexified space of fields. As a first success, we managed to make sense of the intuitive instanton gas picture in quantum mechanics, and currently (together with I. Krichever) work on the classification of the thimbles in two dimensional sigma models:

(a) *Tying up instantons with anti-instantons*, e-Print: 1802.04202 [hep-th]

(b) *Two-dimensional Periodic Schrödinger Operators Integrable at Energy Eigen-level* (together with A. Ilina and I. Krichever), e-Print: 1903.01778 [math-ph]

(c) *Towards Lefschetz thimbles in sigma models*, (with I. Krichever), arXiv:2010.15575 [hep-th]

(d) *Novikov-Veselov symmetries of the two dimensional $O(N)$ sigma model*, (with I. Krichever), arXiv:2106.14201 [math-ph].

2) *Solid partitions and beyond M-theory*: we found an unexpected generalization of the story of random two and three dimensional partitions (the way we perform exact computations in supersymmetric gauge theories in four, five, six, and seven dimensions), also known as the melting crystal models, to the case of solid, or four dimensional, partitions. Whereas the partition functions of the melting crystal models (fully equivariant K-theoretic Donaldson-Thomas theory) have M-theoretic interpretation, as Witten indices of M-theory in asymptotically toric backgrounds, the corresponding gravitational interpretation of our *Magnificent Four* models is still a mystery:

(a) *Shifts of prepotentials (with an appendix by Michele Vergne)*, (with N. Piazzalunga and M. Zabzine), [arXiv:2111.07663 [hep-th]].

(b) *Playing with the index of M-theory*, (with M. Del Zotto, N. Piazzalunga and M. Zabzine), [arXiv:2103.10271 [hep-th]].

(c) *Magnificent Four*, e-Print: 1712.08128 [hep-th]

(d) *Magnificent Four with Colors* (with N. Piazzalunga), Commun.Math.Phys. 372 (2019) 2, 573-597, e-Print: 1808.05206

(e) *4G networks Global magni4icence, or: 4G Networks*, with N. Piazzalunga, [arXiv:2306.12995 [hep-th]].

3) *BPS/CFT correspondence and non-perturbative Dyson-Schwinger equations*
We found, in 2013, a "doubly-quantized" version of the Seiberg-Witten geometry. Its geometric, gauge theoretic, and string theoretic meaning are quite interesting. We explored it with several collaborators and continue to do so.

(a) *Parallel surface defects, Hecke operators, and quantum Hitchin system*, [arXiv: 2304.04656 [hep-th]], with Saebyeok Jeong, Norton Lee

(b) *Intersecting defects in gauge theory, quantum spin chains, and Knizhnik-Zamolodchikov equations*, arXiv:2103.17186 [hep-th math-ph math.AG math.QA math.RT], with Saebyeok Jeong, Norton Lee

(c) *Surface defects in gauge theory and KZ equation*, arXiv:2103.12611 [hep-th math.AG math.QA math.RT], with Alexander Tsymbaliuk

(d) *Opers, surface defects, and Yang-Yang functional*, [arXiv: 1806.08270 [hep-th]], with Saebyeok Jeong

(e) *BPS/CFT correspondence II: instantons at crossroads, moduli and compactness theorem*, Adv. Theor. Math. Phys. **21** (2017), 503-583 [arXiv:1608.07272 [hep-th]]

(f) *BPS/CFT Correspondence III: Gauge Origami partition function and qq-characters*, Commun. Math. Phys. **358** (2018) no.3, 863-894 doi:10.1007/s00220-017-3057-9 [arXiv:1701.00189 [hep-th]].

(g) *Blowups in BPS/CFT correspondence, and Painlevé VI*, e-Print: 2007.03646 [hep-th]

(h) *BPS/CFT correspondence V: BPZ and KZ equations from qq-characters*, e-Print: 1711.11582 [hep-th]

(i) *BPS/CFT correspondence IV: sigma models and defects in gauge theory*, Lett.Math.Phys. 109 (2019) 3, 579-622, e-Print: 1711.11011 [hep-th]

(j) *BPS/CFT correspondence: Instantons at crossroads and gauge origami*, Proc. Symp. Pure Math. 96 (2017) 183-246, Contribution to: String-Math 2015, 183-246

(k) *Spiked Instantons from Intersecting D-branes* (with Naveen S. Prabhakar), Nucl.Phys.B 914 (2017) 257-300, e-Print: 1611.03478 [hep-th]

(l) *BPS/CFT correspondence II: Instantons at crossroads, moduli and compactness theorem* Adv.Theor.Math.Phys. 21 (2017) 503-583, e-Print: 1608.07272 [hep-th]

(m) *BPS/CFT correspondence: non-perturbative Dyson-Schwinger equations and qq-characters* JHEP 03 (2016) 181, e-Print: 1512.05388 [hep-th]

(n) *Non-Perturbative Schwinger-Dyson Equations: From BPS/CFT Correspondence to the Novel Symmetries of Quantum Field Theory*, Contribution to: "Pomeranchuk-100", 133-149

(o) *Seiberg-Witten geometry of four dimensional N=2 quiver gauge theories*, (with V. Pestun) , e-Print: 1211.2240 [hep-th]

4) *Supersymmetric gauge theories and integrability*

We found, in 1997-2009, an intriguing connection between quantum integrable systems and gauge theories with $\mathcal{N} = 2\, d = 2$ super-Poincare symmetry.

(a) *Interfaces and Quantum Algebras, I: Stable Envelopes*, arXiv:2109.10941 [hep-th math-ph math.AG math.RT], with Mykola Dedushenko

(b) *Quantum Spin Systems and Supersymmetric Gauge Theories, I*, arXiv:2009.11199 [hep-th] , doi 10.1007/JHEP03(2021)093, with Norton Lee

(c) *Riemann-Hilbert correspondence and blown up surface defects*, arXiv:2007.03660 [hep-th math-ph math.CO math.DG], doi 10.1007/JHEP12(2020)006, with Saebyeok Jeong

(d) *Blowups in BPS/CFT correspondence, and Painlevé VI*, arXiv:2007.03646 [hep-th math-ph math.CO math.DG]

(e) *Superspin chains and supersymmetric gauge theories*, JHEP **03** (2019), 102 doi:10.1007/JHEP03(2019)102 [arXiv:1811.04278 [hep-th]].

(f) *Bethe/Gauge correspondence on curved spaces*, (with S. Shatashvili), JHEP **01** (2015), 100 doi:10.1007/JHEP01(2015)100 [arXiv:1405.6046 [hep-th]].

(g) *Classical Conformal Blocks and Painlevé VI*, (with A. Litvinov, S. Lukyanov and A. Zamolodchikov), JHEP 07 (2014) 144, e-Print: 1309.4700 [hep-th]

(h) *Darboux coordinates, Yang-Yang functional, and gauge theory*, (with A. Rosly and S. Shatashvili), Nucl. Phys. B Proc. Suppl. **216** (2011), 69-93 doi:10.1016/j.nuclphysbps.2011.04.150, [arXiv:1103.3919 [hep-th]].