Curriculum Vitae
updated on 24 Mar 2023

Name: Natalia Chepiga
Nationality: Ukrainian
Place of birth: Kharkiv, Ukraine
Date of birth: December 27, 1988
Marital status: married (1 child)
Address: Kavli Institute of Nanoscience,
Delft Univesity of Technology,
Lorentzweg 1, 2628 CJ
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ORCID: 0000-0002-5313-5035
Languages: English, Ukrainian, Russian, (all fluent),
French(B1), Dutch(B1), German(A2)

Expertise:

Computational physics, condensed matter physics, quantum many-body physics and strongly correlated systems, tensor networks, quantum phase transitions, conformal field theory, quantum magnetism, chiral melting, constrained systems (non-abelian anyons, quantum dimers and quantum loops, supersymmetric models), low-dimensional quantum systems, Rydberg atoms, topological phases, systems with multi-component Hilbert space, comb tensor networks

Education:

04/13 – 04/17 Docteur ès sciences, Institute of Physics, École Polytechnique Fédérale de Lausanne,
Supervisor: prof. Frédéric Mila
Thesis Title: ***Dimerization and exotic criticality in spin-S chains***
Private defense: 21/02/2017; Public defense: 23/03/2017
Distinction from Doctoral School of Physics, EPFL

08/11 – 02/13 Master in Physics, École Polytechnique Fédérale de Lausanne,
Supervisor: prof. Frédéric Mila
Thesis Title: ***Topological phase transitions in spin ladders***

09/07 – 07/11 BSc in Applied Physics with First Class Honors, V.N.Karazin Kharkiv National University, Department of Theoretical Nuclear Physics
Supervisor: Sergey I. Shevchenko; Thesis Title: Description of the e*lectrons-holes superfluidity in terms of the order parameter*

09/00 – 06/07 High School Certificate with First Class Honors

Employment:

01/21-now **Assistant professor,** Kavli Institute of Nanoscience, Faculty of Applied Sciences, Delft University of Technology, Netherlands

01/19-12/20 **Postdoc** in the group of **prof. P.Corboz** at the University of Amsterdam, Netherlands. The work has been supported by the Swiss National Science Foundation (grant number P400P2_183847) and by prof. Corboz's funds.

05/17-12/18 **Postdoc** in the group of **prof. S.R. White** at the University of California, Irvine, USA. The work has been supported by the Swiss National Science Foundation (grant number P2ELP2_172271) and by prof. White's funds.

04/13 – 04/17 **Doctoral assistant** at the Chair of condensed matter theory, Institute of Physics, École Polytechnique Fédérale de Lausanne, Supervisor: prof. Frédéric Mila

Selected Awards:

11/21 **Minerva prize** by Dutch Physics Council and Netherlands' Physical Society (https://dutchphysicscouncil.nl/613-4)
01/20 Delft Technology Fellowship (Tenure-track appointment + start-up funds)
12/17 **Distinction from the Doctoral School of Physics**, EPFL for the thesis *Dimerization and exotic criticality in spin-S chains*
10/11 – 02/13 **Excellence scholarship** provided by École Polytechnique Fédérale de Lausanne
09/07 – 06/11 Government scholarships for university students with outstanding results
09/06 – 08/08 **2xPresident of Ukraine Scholarships**
09/03 – 06/11 Several diploma including 1st and 2nd prizes in Olympiads in Physics; 1st prize in Ukrainian Competition of Research projects

01/23-now **Visiting professor**, Université Paul Sabatier, Toulouse, France

Grants and funding (personal):

02/23 GBP 9.5k from IQTN/EPSRC for the workshop "Tensor networks for constrained systems";
08/22 1M CPU hours by SURFSARA national supercomputing cluster Snellius (EINF 3879);
02/22 100k CPU hours by SURFSARA national supercomputing cluster Lisa (EINF 2722);
02/21 500k CPU hours by SURFSARA national supercomputing cluster Cartesius (EINF 1137)
02/21 100k CPU hours by SURFSARA national supercomputing cluster Lisa (EINF 1137)

02/19-09/20 **PostdocMobility** by the Swiss National Science Foundation, University of Amsterdam, The Netherlands. Project title: Further development of infinite Projected Entangled Pair States (iPEPS): network of clusters and hard constraints

04/17-09/18 **EarlyPostdocMobility** by the Swiss National Science Foundation, University of California, Irvine, USA. Project title: Efficient Density Matrix Renormalization Group (DMRG) algorithm for two-dimensional systems and its applications.

Collective grants and networks:
10/22-now "Materials for the quantum age", a consortium of 43 PIs and 34 PhD and postdocs, supported by Dutch research council (NWO), https://qumat.org/people/

02/22-01/24 International Quantum Tensor Networks, funded by EPSRC, GBP ~300k. I am one of the 12 Project partners together with M.-C.Banuls, B.Bauer, S.Choi, M.Foss-Feig, C.Kollath, F.Pollmann, A.C.Potter, M.Stoudenmire, N.Schuch, F.Verstraete, G.Vidal; network organizers: A.Daley, A.Green, B.Lovett, D.Jaksch and Z.Papic (https://iqtn.phys.strath.ac.uk/)

01/2021-now Member of the **European Tensor Network** (quantumtensor.pks.mpg.de)

2013-2017 Member of MaNEP network and Swiss National Science Foundation

Publications:

24. **Natalia Chepiga**, Frédéric Mila, *Eight-vertex criticality in the interactive Kitaev chain;* Phys. Rev. B 107, L081106 (2023)

23. **Natalia Chepiga**, *From Kosterlitz-Thouless to Pokrovsky-Talapov transitions in spinless fermions and spin chains with next-nearest-neighbor interactions;* **Phys. Rev. Research** 4, 043225 (2022)

22. Ivo A. Maceira, **Natalia Chepiga**, Frédéric Mila, *Conformal and chiral phase transitions in Rydberg chains;* **Phys. Rev. Research** 4, 043102 (2022)

21. **Natalia Chepiga,** *Critical properties of quantum three- and four-state Potts models with boundaries polarized along the transverse field* SciPost Phys. Core **5**, 031 (2022)

20. **Natalia Chepiga**, Ian Affleck, Frédéric Mila, *From SU(2)_5 to SU(2)_3 Wess-Zumino-Witten transitions in a frustrated spin-5/2 chain* Phys. Rev. B **105**, 174402 (2022); **Editors' Suggestion**

19. **Natalia Chepiga,** Jiří Minář, Kareljan Schoutens, *Supersymmetry and multicriticality in a ladder of constrained fermions* SciPost Phys. **11**, 059 (2021)

18. **Natalia Chepiga** and Frédéric Mila, *Lifshitz point at commensurate melting of 1D Rydberg atoms* **Phys. Rev. Research, 3**, 023049 (2021)

17. **Natalia Chepiga** and Frédéric Mila, *Kibble-Zurek exponent and chiral transition of the period-4 phase of Rydberg chains* **Nature Communications, 12**, 414 (2021)

16. Mario Motta, Claudio Genovese, Fengjie Ma, Zhi-Hao Cui, Randy Sawaya, Garnet Kin-Lic

Chan, **Natalia Chepiga,** Phillip Helms, Carlos Jimenez-Hoyos, Andrew J. Millis, Ushnish Ray, Enrico Ronca, Hao Shi, Sandro Sorella, Edwin M. Stoudenmire, Steven R. White, Shiwei Zhang (Simons collaboration on the many-electron problem)
Ground-state properties of the Hydrogen chain: insulator-to-metal transition, dimerization, and magnetic phases
Phys. Rev. X 10, 031058 (2020)

15. **Natalia Chepiga**, Steven R. White,
Critical properties of a comb lattice
SciPost Phys. **9**, 013 (2020)

14. **Natalia Chepiga**, Ian Affleck, and Frédéric Mila,
Floating, critical, and dimerized phases in a frustrated spin-3/2 chain
Phys. Rev. B **101**, 174407 (2020)

13. Laurens Vanderstraeten, Elisabeth Wybo, **Natalia Chepiga,** Frank Verstraete, and Frédéric Mila,
Spinon confinement and deconfinment in a spin-1 chain
Phys. Rev. B **101**, 115138 (2020);

12. **Natalia Chepiga** and Frédéric Mila,
Dimerization and effective decoupling in two spin-1 generalizations of the spin-1/2 Majumdar-Ghosh chain
Phys. Rev. B **100**, 104426 (2019)*;*

11. **Natalia Chepiga** and Steven R. White,
Comb tensor networks
Phys. Rev. B **99**, 235426 (2019)

10. **Natalia Chepiga** and Frédéric Mila,
DMRG investigation of constrained models: from quantum dimer and quantum loop ladders to hard-boson and Fibonacci anyon chains
SciPost Phys. **6**, *033 (2019);*

9. **Natalia Chepiga** and Frédéric Mila,
Floating phase versus chiral transition in a 1D hard-boson model
Phys. Rev. Lett. 122, 017205 (2019)

8. **Natalia Chepiga** and Frédéric Mila,
Rigorous decoupling between edge states in frustrated spin chains and ladders
Phys. Rev. B **97**, 174434 (2018)

7. **Natalia Chepiga** and Frédéric Mila,
Exact zero modes in frustrated Haldane chain
Phys. Rev. B **96**, 060409 (2017), **Rapid Communication**

6. **Natalia Chepiga** and Frédéric Mila,
Excitation spectrum and Density Matrix Renormalization Group iterations

Phys. Rev. B **96**, 054425 (2017)

5. L.Wang, **N.Chepiga**, D.-K.Ki, L.Li, F.Li, W.Zhu, Y.Kato, O.S.Ovchinnikova, F.Mila, I.Martin, D.Mandrus, A.F.Morpurgo,
Controling the topological sectors of magnetic solitons in exfoliated $Cr_{1/3}NbS_2$ crystals
Phys. Rev. Lett. 118, 257203 (2017), Editor's Suggestion

4. **Natalia Chepiga**, Ian Affleck, and Frédéric Mila,
Spontaneous dimerization, critical lines, and short-range correlations in a frustrated spin-1 chain
Phys. Rev. B **94**, 205112 (2016)

3. **Natalia Chepiga**, Ian Affleck, and Frédéric Mila,
Comment on "Frustration and Multicriticality in the Antiferromagnetic Spin-1 Chain"
Phys. Rev. B **94**, 136401 (2016)

2. **Natalia Chepiga**, Ian Affleck, and Frédéric Mila,
Dimerization transitions in spin-1 chains
Phys. Rev. B **93**, 241108 (2016), **Rapid Communication**

1. **Natalia Chepiga**, Frédéric Michaud, and Frédéric Mila,
Berry phase investigation of spin-S ladders
Phys. Rev. B **88**, 184418 (2013)

Pre-prints:

1. **Natalia Chepiga**, Nicolas. Laflorencie, *Topological and quantum critical properties of the interacting Majorana chain;* arXiv:2211.15598 (2022)

Invited conference talks (12+9):

11/23 (upcoming) "*Chaos and information dynamics in quantum many body systems*", Ettore Majorana Center, Erice, Italy
09/23 (upcoming) "*Quantum many-body methods in cond. matter systems*", RWTH Aachen, Germany
09/23 (upcoming) Korrelationstage 2023, Dresden, Germany
09/23 (upcoming) European Tensor Network school, Abingdon, UK
08/23 (upcoming) NG SCES 2023, Lido di Fermo, Italy
07/23 (upcoming) Workshop of The Grete Hermann Network, Wuerzburg, Germany
07/23 (upcoming) JSF Workshop on the fermion sign problem, Peyresq, France
06/23 (upcoming) Aspen program on "*Exotic Phases, Gauge Field Theories and Dynamics in Systems with Constraints*", USA
05/23 (upcoming) DRSTP condensed matter theory school, Callantsoog, The Netherlands

11/22 Entanglement Scaling and Criticality with Tensor Networks, Lausanne, Switzerland, *Critical properties of an interacting Majorana chain. The power of Friedel oscillations*
10/22 Symmetry and Duality in Quantum Many-Body Systems, Ghent, Belgium, *Dual boundary conditions in minimal models*

09/22 Computational aspects of Tensor Networks, Vienna, Austria, *Eight vertex criticality in interacting Kitaev chains*
01/22 Physics@Veldhoven, *Lifshitz point or Why the transition becomes chiral?*
10/21 CECAM flagship workshop: Computational materials discovery of unconventional magnets, Lausanne, Switzerland, *Floating phases in quantum spin chains*
02/21 Entanglement in Strongly Correlated Systems, Benasque, Spain, *Supersymmetric point in a ladder of constrained fermions*
12/20 European Tensor Network online series, *Chiral transitions in chains of Rydberg atoms*
11/19 Delta-ITP triangle meetings: Quantum and Topological Matter, University of Utrecht, The Netherlands, *Comb tensor networks*
07/19 Computational Approaches to Quantum Many-body Problems, ISSP, Kashiwa, Japan, *Practical introduction to MPS + Comb tensor networks + DMRG for constrained models (in total: 3 hours of lectures)*
03/19 DPG Frühjahrstagung 2019, Regensburg, Germany, *DMRG investigation of constrained models: from quantum dimer and quantum loop ladders to hard-boson and Fibonacci anyon chains*
02/19 Constrained Many-body Dynamics, MPI PKS, Dresden, Germany, *DMRG investigation of constrained models: from quantum dimer and quantum loop ladders to hard-boson and Fibonacci anyonQuantum many-body chains*
06/18 TOPMAT, Paris-Saclay, France, *DMRG investigation of quantum dimer ladders*

Invited seminars (17):

01/23 Vision Seminar at TUDelft; *When Kosterlitz and Thouless meet Pokrovsky and Talapov*
11/22 Seminar at **CNRS** LPT Toulouse; host: Nicolas Laflorencie; *When Kosterlitz and Thouless meet Pokrovsky and Talapov*
11/22 Seminar at **Nijmengen**, The Netherlands; host: A.Bagrov; *When Kosterlitz and Thouless meet Pokrovsky and Talapov*
06/22 Physical Sciences Seminar at **ISTA**, Austria; host: Maksym Serbyn; *Supersymmetry and multicriticality in a ladder of constrained fermions*
06/22 **TUWien**, Austria; host: Julian Leonard; *Chiral transitions in chains of Rydberg atoms*
12/21 Utrecht Condensed Matter Theory Seminar, Netherlands; *Chiral transitions in chains of Rydberg atoms*
10/21 **Brookhaven National Laboratory**, USA, *Probing conformal towers of states with Density Matrix Renormalization Group algorithms*
02/21 **Harvard** Condensed Matter Theory Seminar, Harvard, USA; *Chiral transitions in chains of Rydberg atoms*
12/20 University of **Amsterdam**, The Netherlands; host: P.R.Corboz, *Constrained tensor networks: a new approach to quantum criticality*
02/20 TU Delft, The Netherlands; *Tensor network investigation of constrained models: from quantum dimer and quantum loop ladders to chains of Rydberg bosons*
06/19 **University of Nottingham**, UK; host: Juan P. Garrahan, *Constrained DMRG as a byway to investigate critical properties of frustrated magnets*
02/19 University of Amsterdam, The Netherlands; host: P.R.Corboz, *Floating phase versus chiral transition in constrained models*
10/18 University of California, **Irvine**, USA; host: Steven R.White, *Floating phase versus chiral transition in constrained models: from hard-boson chain to quantum dimer and*

quantum loop ladders

03/18 HISKP, Universität **Bonn**, Germany; host: Corinna Kollath, D*MRG investigation of quantum dimer ladders*

02/18 Max-Planck-Harvard Institute for Quantum Optics, **Garching**, Germany; host: Ignacio Cirac, *Frustrated spin chains: exotic criticality, exact zero modes and quantum dimer model.*

11/17 **Perimeter Institute**, Waterloo, Canada; host: Guifre Vidal, *Spontaneous dimerization, critical lines and exact zero modes in frustrated spin-1 chain.*

10/17 University of **British Columbia**, host: Ian Affleck, *Exact zero modes in frustrated spin chains*

Contributed talks (19):

07/22 International conference on strongly correlated electron systems (SCES) 2022, Amsterdam, The Netherlands, *From SU(2)_5 to SU(2)_3 Wess-Zumino-Witten transitions in a frustrated spin-5/2 chain*

06/22 Highly Frustrated Magnetism (HFM) 2022, Paris, France, *From SU(2)_5 to SU(2)_3 Wess-Zumino-Witten transitions in a frustrated spin-5/2 chain*

01/21 Waiting for Highly Frustrated Magnetism 2021, Dresden, Germany, *Floating, critical and dimerized phases in a frustrated spin-3/2 chain*

12/20 Exploring quantum many-body physics with ultra-cold atoms and molecules, Bad Honnef, Germany, *Kibble-Zurek exponent and chiral transition of the period-4 phase of Rydberg chains*

02/20 Entanglement in Strongly Correlated Systems, Benasque, Spain, *Ashkin-Teller transition of Rydberg atoms with two-site blockade*

01/20 Physics@Veldhoven 2020, Veldhoven, The Netherlands, *Simulating constrained models with tensor networks*

09/19 Korrelationstage 2019, Dresden, Germany, *Comb tensor networks*

10/18 Topological phases in condensed matter and cold atom systems, Cargese, Corsica, France *Constrained DMRG as a byway to investigate critical properties of frustrated magnets*

06/18 Trends in quantum magnetism, Bad Honnef, Germany, *DMRG investigation of quantum dimer ladders*

02/18 Entanglement in Strongly Correlated Systems, Benasque, Spain, *DMRG investigation of quantum dimer ladders*

11/17 Novel Quantum States in Condensed Matter 2017, Kyoto, Japan, *Spontaneous dimerization, critical lines, and exact zero modes in a frustrated spin-1 chain*

06/17 Many Electron Collaboration Summer School, Stony Brook, USA, *Excitation spectrum and Density Matrix Renormalization Group iterations*

02/17 Entanglement if strongly correlated systems, Benasque, Spain, *Dimerization and exotic criticality in spin-S chains*

09/16 Recent Progress in Low-Dimensional Quantum Magnetism, Lausanne, Switzerland, C*ritical lines and short-range correlations in a frustrated spin-1 chain*

07/16 Swiss Physical Society Meeting, Lugano, Switzerland, *Dimerization transitions in spin-1 chains*

07/16 Swiss Workshop on Materials with Novel Electronic Properties 2016, Les Diablerets, Switzerland, *Dimerization transitions in spin-1 chains*

05/16 Japan-Swiss Workshop 'Trends in Theory of Correlated Materials', PSI, Villigen,

Switzerland, *Dimerization transitions in spin-1 chains*

10/14 Japan-Swiss Workshop 'Trends in Theory of Correlated Materials', Tokyo, Japan, *Berry phase investigation of spin-S ladders*

07/14 Swiss Physical Society Annual Meeting, Fribourg, Switzerland, *Berry phase investigation of spin-S ladders*

Poster presentations (8):

09/21 Quantum Field Theory at the Boundary, Mainz, Germany, *Boundary critical phenomena in the 4-state Potts model*

04/21 Korrelationstage 2021, Dresden, Germany, *Chiral transitions in chains of Rydberg atoms*

10/18 Topological phases in condensed matter and cold atom systems, Cargese, Corsica, France, *A comb tensor network*

09/17 Korrelationstage 2017, Dresden, Germany, *Dimerization and exotic criticality in spin-S chains*

09/16 8th International Conference on Highly Frustrated Magnetism, Taipei, Taiwan, *Dimerization transitions in spin-1 chains*

01/15 Theory Winter School on New Trends in Frustrated Magnetism, Tallahassee, Florida, USA, *Frustration and spontaneous dimerization in spin-1 chain*

10/13 School on Advanced Algorithms for Correlated Quantum Matter, Würzburg, Germany, *Berry phase investigation of spin-S ladders*

07/13 Swiss Workshop on Materials with Novel Electronic Properties, Les Diablerets, Switzerland, *Berry phase investigation of frustrated quantum magnets*

Event organization:

10/2023 The organizer of the IQTN/EPSRC funded workshop “Tensor networks for constrained systems” (https://iqtn.phys.strath.ac.uk)

02/2022-now Member of the program committee of the inaugural and plenary meetings of International Quantum Tensor Network (https://iqtn.phys.strath.ac.uk)

05/2022-now Delft Many-Body Workshop Series (6 workshops to date, 35+ speakers), the founder and the main organizer; https://nchepiga.github.io/homepage/workshop

Refereeing for journals:
Nature, Nature Communications, Communications Physics;
Physical Review Letters, Physical Review Research, Physical Review B;
SciPost Physics;
New Journal of Physics

Refereeing for funding agencies:

- Swiss National Science Foundation (SNSF)

Member of committees:

01/23 Member of the Minerva prize 2022 committee, The Netherlands
06/22 Member of the poster prize committee at Highly Frustrated Magnetism 2022, Paris, France
01/20 Member of the poster prize committee at Physics@Veldhoven 2020, Veldhoven, Netherlands

07/21 Appointment committee for a tenure-track position at Kavli Institute of Nanoscience, TUDelft

03/21 Member of Schelto Crone's PhD committee at the University of Amsterdam, Netherlands

11/22 Expert at Luka van der Heiden's defence, TU Delft, Netherlands
07/22 Expert at Huang Tianyue's MSc defence, EPFL, Switzerland
07/22 Expert at Baptiste Demazure's MSc defence, EPFL, Switzerland
07/21 Expert at Bernhard Luescher's MSc defence, EPFL, Switzerland
06/21 Member of Isabel Postmes' MSc defense committee at TU Delft, Netherlands

Teaching & supervision:

05/23 Lecturer in '**Quantum Phase Transitions**' at DRSTP postgraduate school, Callantsoog, Netherlands
02/22 – now Lecturer in '**Mechanics and Relativity**' at TUDelft
02/22 – now Lecturer in '**Fairy Tails of Theoretical Physics**' at TUDelft (topics: supersymmetry; frustrated magnetism)
09/14 – 01/17 Teaching Assistant in '**Physique Statistique I**' at EPFL
02/16 – 06/16 Teaching Assistant in '**Mathematical Methods for Physicists**' at EPFL
02/15 – 06/15 Teaching Assistant in '**Physique Statistique II**' at EPFL
09/13 – 12/13 Teaching Assistant in '**Statistiques et probabilités**' at EPFL
11/07 – 06/11 High School Teacher in Advanced Physics and Mathematics at Private Boiko School, Ukraine
08/08 – 08/09 Summer School Teacher for Granted Youth (supported by Kharkov City Council)

Courses on teaching skills:
04/21 DEVELOP, TU Delft, ~40 hours on the development of own course from scratch
05/21 SUPERVISE, TU Delft, ~40 hours on how to manage the group and supervise students

Supervision:

- Bowy La Rivière, PhD thesis on numerical investigation of magnetic and non-magnetic quantum phase transitions with constrained tensor networks, TU Delft, Netherlands
- Jose Soto Garcia, PhD thesis on dynamical properties of exotic quantum phase transitions, TU Delft, Netherlands
- Bernhard Luescher internship on critical properties of the chiral Ashkin-Teller model, TU Delft, Netherlands;
- Ivo Maceira's PhD project on chiral transitions in Rydberg atoms, EPFL, Switzerland (co-supervised);
- Randy Sawaya's PhD project on Hubbard model with long-range interactions, University of California Irvine (co-supervised);
- Robin Kaech's master thesis on critical Ising chains, EPFL (co-supervised);
- Guillaume Meyrat's master project on quantum dimer model, EPFL (co-supervised);
- Samuel Gozel's master thesis on dynamics in spin-3/2 chain, EPFL (co-supervised)

Outreach and volunteer projects:

Since 2022: The mentor in EPFL's Alumni mentoring program

Public lectures at the Private Boiko School, Ukraine:

2017, 2020	AskMeAnything sessions
2018	"The night of science"
2016	"The day of science"

08/10	Environmental volunteer program in Vichy, France
07/10	Camp leader in the international volunteer project, Lyubotin, Kharkiv district, Ukraine
08/09	Volunteer in Summer Camp in Spangenberg, Germany
11/07	Team leader in Ukraine-China exchange program in Shitzyatjuan, China

References:

1. Prof. Frédéric Mila, École Polytechnique Fédérale de Lausanne, frederic.mila@epfl.ch
2. Prof. Ian Affleck, University of British Columbia, iaffleck@phas.ubc.ca
3. Prof. Kareljan Schoutens, University of Amsterdam, c.j.m.schoutens@uva.nl
4. Prof. Nicolas Laflorencie, LPT Toulouse, laflo@irsamc.ups-tlse.fr
5. Prof. Philippe Corboz, University of Amsterdam, P.R.Corboz@uva.nl
7. Prof. Steven R. White, University of California, Irvine, srwhite@uci.edu