Dr. Rastko Sknepnek

School of Engineering, Physics and Mathematics
University of Dundee
Dundee, DD1 4HN
Scotland, United Kingdom
e-mail: r.sknepnek@dundee.ac.uk
web: http://sites.dundee.ac.uk/rsknepnek/

RESEARCH INTERESTS

- Pattern formation in curved spaces;
- Interplay between topology, geometry, and order;
- Bioinspired materials design;
- Cell and tissue mechanics.

EXPERIENCE

Sept 2013 to present **University of Dundee** Dundee, Scotland

Lecturer in Physics and Dundee Fellow. Computational soft condensed matter physics and biophysics. Nanocomposite materials.

Sept 2012 to Sept 2015 **Syracuse University** Syracuse, New York

Distinguished University Postdoctoral Scholar. An independent three-year research position in the Soft Matter Physics Program.

Jun 2009 to Sept 2012 **Northwestern University** Evanston, Illinois

Research associate. Modeling of multicomponent elastic and liquid shells and membranes; DNA guided assembly of gold nanoparticles.
Prof. Monica Olvera de la Cruz research group.

Aug 2006 to Jun 2009 **Iowa State University/DOE Ames Laboratory** Ames, Iowa

Postdoc. Modeling of self-assembly in polymer/nanoparticle composites; superconductivity in iron pnictides.
Advisors: Prof. Joerg Schmalian and Prof. Monica H. Lamm

Aug 2004 to Aug 2006 **McMaster University** Hamilton, Ontario

Postdoc. Origin of quantum magnetism in Cs_2CuCl_4; Bogoliubov-de Gennes approach to vortices in type II superconductors.
Advisors: Prof. A. John Berlinsky and Prof. Catherine Kallin.

EDUCATION

May 2004 **PhD in physics** University of Missouri – Rolla, USA

Thesis: Magnetic and superconducting quantum critical behavior of itinerant electronic systems
Advisor: Prof. Thomas Vojta
Note: In 2008 University of Missouri – Rolla changed its name to Missouri University of Science and Technology

May 2000 **Diploma in theoretical physics** Belgrade University, Serbia

Thesis: Numerical Analysis of the Hopfield model of neural networks with diluted synapses
Advisor: Prof. Sava Milošević

TEACHING EXPERIENCE

Jun 2008 to Jul 2008 **Iowa State University/DOE Ames Laboratory** Ames, Iowa

REU student advisor. Supervised an REU student for a period of 6 weeks.

Jan 2009 to May 2009 **Iowa State University/DOE Ames Laboratory** Ames, Iowa

Undergraduate student advisor. Supervised an undergraduate student for one semester.

Feb 2002 to May 2004 **University of Missouri – Rolla** Rolla, Missouri

Teaching assistant. Physics 23/24 Lab - introductory physics course for engineering students (four semesters) Physics 301 (Computational Physics) Lab - senior undergraduate/introductory graduate course for physics majors (one semester)

HONORS AND AWARDS

2013 **Dundee Fellow**, University of Dundee
2012 **Distinguished University Postdoctoral Scholar** at Syracuse University
2002 **Scherer Graduate Research Prize** for best graduate student research
1995 **Scholarship for Talented Students** awarded by Oil Industry of Serbia

COMPUTER SKILLS

- C/C++ including Standard Template Library (STL) and boost library; wrote over to 150,000 lines of code
- Fortran 77/90; wrote over 10,000 lines of code
- Python (including numpy and scipy); wrote over 80,000 lines of code
- OpenMPI, MPI, boost mpi
- GNU Scientific Library, PETSc and SLEPc libraries, Intel Math Kernel Library
- Matlab, Mathematica
- Shell scripting, predominantly bash
- Programming for graphics cards using NVIDIA CUDA (contributing developer of HOOMD Blue package)
- Linux system administration
  - Built a 64-node Beowulf cluster at University of Missouri – Rolla
  - Principal system administrator of a heterogeneous GPU/CPU cluster (576 CPU cores) at Northwestern University

SCIENTIFIC SOFTWARE DEVELOPMENT

- **Membrane** – a flexible object-oriented Monte Carlo code for initializing, simulating, and analyzing multicomponent charged elastic and liquid membranes – approximately 35,000 lines of C++ and 12,000 lines of Python code
- **NPT integrator, Morse and electrostatic potentials for HOOMD-Blue** – approximately 2,000 lines of GPU CUDA C code
- **NanoBuilder** – object-oriented toolkit for rapid construction of initial configurations for simulations of nanoparticle/copolymer systems – approximately 15,000 lines of Python code
- **NanoAnalyzer** – a library of Python classes for data analysis of coarse grained molecular dynamics simulations – approximately 3,000 lines of Python code
- **pHMC** – lattice Monte Carlo simulation of pH and charge correlation effects on the dissociation curves charged lipid bilayers – approximately 1,500 lines of C++ code
- **GreenCarlo** – a Monte Carlo simulation of charged lipid bilayer using fast Green's function method – approximately 5,000 lines of C++ code
- **FLEX** – set of tools for solving and analyzing fluctuation exchange approximation (FLEX) equations for superconductors – approximately 18,000 lines of ANSI C and 1,000 lines of Python code, parallelized with OpenMP and MPI
- **MDSim** – general purpose molecular dynamics code – over 17,000 lines of C++ code, parallelized with MPI
- **BdG** – solver for Bogoliubov-de Gennes equations for type II superconductors in external magnetic field – approximately 5,000 lines of Fortran 90 code
- **Disorder** – Monte Carlo code for simulation of Ising and Heisenberg spin models with correlated disorder – approximately 4,000 lines of C/C++ code

PROFESSIONAL MEMBERSHIP

- American Physical Society

PUBLICATIONS
(* - designed project and guided student/junior postdoc)

Submitted:

1. S. Banerjee, **R. Sknepnek**, M. C. Marchetti
   Optimal shapes and stresses of adherent cells on patterned substrates
   submitted to Soft Matter (2013), arXiv:1312.6895
2. T. Zhang, **R. Sknepnek**, M. J. Bowick, J. M. Schwarz
   On the modeling of endocytosis in yeast
   submitted to Soft Matter (2013), arXiv:1310.8652

Published and accepted:

1. M. Bowick and **R. Sknepnek**
   Pathways to faceting of vesicles
   Soft Matter **9**, 8088 (2013).
2. T. Li, **R. Sknepnek**, M. Olvera de la Cruz
   The key to DNA guided crystallization: Active Hybridization
   JACS, 135, 8535 (2013).
3. Z. Yao, M. Bowick, X. Ma, **R. Sknepnek**
   Planar sheets meet negative curvature liquid interface, EPL **101**, 44007 (2013).
4. C. M. Funkhouser, **R. Sknepnek***, T. Shimi, A.E. Goldman, R.D. Goldman, M. Olvera de la Cruz, *A Mechanical Model of Blebbing in Nuclear Lamina Meshworks,* Proc. Natl. Acad. Sci. USA **110**, 3248 (2013).
5. C. M. Funkhouser, **R. Sknepnek***, M. Olvera de la Cruz, *Topological defects in the buckling of elastic membranes,* Soft Matter **9**, 60 (2013).
6. C. Leung, L.C. Palmer, B. Qiao, S. Kewalramani, **R. Sknepnek**, C. Newcomb, M. Greenfield, G. Vernizzi, S. Stupp, M. Bedzyk, M. Olvera de la Cruz, *Molecular Crystallization Controlled by pH Regulates Mesoscopic Membrane Morphology,* ACS Nano **6**, 10901 (2012).
7. Z. Yao, **R. Sknepnek**, C. K. Thomas, M. Olvera de la Cruz, *Shapes of pored membranes,* Soft Matter **8**, 11613 (2012), **cover page article**.
8. **R. Sknepnek**, G. Vernizzi, M. Olvera de la Cruz,*Charge renormalization of bilayer elastic properties,* J. Chem. Phys. **137**, 104905 (2012).
9. M. Demers, **R. Sknepnek***, M. Olvera de la Cruz, *A curvature-driven effective attraction in multicomponent membranes,* Phys. Rev. E **86**, 021504 (2012).
10. **R. Sknepnek** and M. Olvera de la Cruz, *Nonlinear elastic model for faceting of vesicles with soft grain boundaries,* Phys. Rev. E **85**, 050501(R) (2012).
11. T. Li, **R. Sknepnek***, R. Macfarlane, C. Mirkin, M. Olvera de la Cruz, *Modeling of DNA guided crystallization of DNA-coated gold nanoparticles,* Nano Letters **12**, 2509 (2012).

12. **R. Sknepnek**, G. Vernizzi, M. Olvera de la Cruz, *Buckling of multicomponent elastic shells with line tension,* Soft Matter **8**, 636 (2012) **cover page article**.
13. **R. Sknepnek**, G. Vernizzi, M. Olvera de la Cruz, *Shape change of nano-containers via a reversible ionic buckling,* Phys. Rev. Lett. **106**, 215504 (2011).
14. G. Vernizzi, **R. Sknepnek**, M. Olvera de la Cruz, *Platonic and Archimedean geometries in multi-component elastic membranes* Proc. Natl. Acad. Sci. USA **108**, 4292 (2011).
15. P. Guo, **R. Sknepnek***, M. Olvera de la Cruz, *Electrostatic driven ridge formation on icosahedral nanoparticles grafted with charged end group ligands,* J. Phys. Chem. C, **115**, 6484 (2011).
16. M. D. Donakowski, J. M. Godbe, **R. Sknepnek**, K. E. Knowles, M. Olvera de la Cruz, E. A. Weiss, *A Quantitative Description of the Binding Equilibria of para-Substituted Aniline Ligands and CdSe QDs,* J. Phys. Chem. C **114**, 897 (2010).
17. J. Zhang, **R. Sknepnek**, J. Schmalian, *Spectral analysis for the Fe-based superconductors: On anisotropic spin fluctuations and fully gapped $s^{+/-}$-wave superconductivity,* Phys. Rev. B **82**, 134527 (2010).
18. P. K. Jha, **R. Sknepnek***, G. I. Guerrero-Garcia, M. Olvera de la Cruz, *A Graphics Processing Unit Implementation of Coulomb Interaction in Molecular Dynamics,* J. Chem. Theory Comput. **6**, 3058 (2010).
19. J. A. Anderson, **R. Sknepnek**, A. Travesset, *Design of polymer nanocomposites in solution by polymer functionalization,* Phys. Rev. E **82**, 021803 (2010).
20. J. Zhang, **R. Sknepnek**, R. M. Fernandes, J. Schmalian, *Orbital coupling and superconductivity in the iron pnictides,* Phys. Rev. B **79**, 220502(R) (2009).
21. **R. Sknepnek**, G. Samolyuk, Y.B. Lee, J. Schmalian, *Anisotropic pairing in the iron pnictides,* Phys. Rev. B **79**, 054511 (2009).
22. **R. Sknepnek**, J. A. Anderson, M. H. Lamm, J. Schmalian, and A. Travesset, *Nanoparticle Ordering via Functionalized Block Copolymers in Solution,* ACS Nano **2**, 1259 (2008).
23. S. Papanikolaou, R. M. Fernandes, E. Fradkin, P. W. Phillips, J. Schmalian, **R. Sknepnek,** *Universality of liquid-gas Mott transitions at finite temperatures,* Phys. Rev. Lett. **100**, 026408 (2008).
24. T. Vojta and **R. Sknepnek**, *Quantum phase transitions of the diluted O(3) rotor mode,* Phys. Rev. B **74**, 094415 (2006).
25. D. Dalidovich, **R. Sknepnek**, A. J. Berlinsky, J. Zhang, and C. Kallin, *Spin structure factor of the frustrated quantum magnet Cs_2CuCl_4,* Phys. Rev. B **73**, 184403 (2006).
26. B. Fendler, **R. Sknepnek**, Thomas Vojta, *Dynamics at a smeared phase transition,* J. Phys. A: Math. Gen. **38**, 2349 (2005).
27. T.Vojta and **R. Sknepnek**, *Critical points and quenched disorder: From Harris criterion to rare regions and smearing,* Phys. Stat. Sol. (b) **241**, 2118 (2004).
28. **R. Sknepnek**, T. Vojta, M. Vojta, *Exotic vs. conventional scaling and universality in a disordered bilayer quantum Heisenberg antiferromagnet,* Phys. Rev. Lett. **93**, 097201 (2004).
29. **R. Sknepnek** and T. Vojta, *Smeared phase transition in a three-dimensional Ising model with planar defects: Monte-Carlo simulations,* Phys. Rev. B **69**, 174410 (2004).

30. **R. Sknepnek**, T. Vojta, R. Narayanan, *Order parameter symmetry and mode coupling effects at dirty superconducting quantum phase transitions,* Phys. Rev. B **70**, 104514 (2004).
31. T. Vojta and **R. Sknepnek**, *The quantum phase transition of itinerant helimagnets,* Phys. Rev. B **64**, 052404 (2001).
32. V. Miljković, S. Milošević, **R. Sknepnek**, I. Zivić, *Pattern recognition in damaged neural networks,* Physica A **295**, 526 (2001).

TALKS AND POSTER PRESENTATIONS

Invited:

1. *Faceting of multicomponent elastic vesicles,* Physics Seminar, University of Dundee, UK (2013).
2. *Faceting of multicomponent elastic vesicles,* Physics Seminar, University of Edinburgh, UK (2012).
3. *Faceting of multicomponent elastic vesicles,* Physics Seminar, Georgetown University (2012).
4. *Thin-shell Model for Faceting of Multicomponent Elastic Vesicles,* Physical Principles of Multiscale Modeling, Analysis and Simulation in Soft Condensed Matter Program, KITP (2012).
   podcast available at: http://online.kitp.ucsb.edu/online/multiscale12/sknepnek/
5. *Faceting of multicomponent elastic vesicles,* Colloquium, Department of Physics and Astronomy, University of Maryland Baltimore County (2012).
6. *Faceting of multicomponent elastic shell,* Seminar, Institute for Physical Science and Technology, University of Maryland (2011).
7. *Block copolymer guided self-assembly of nanoparticles,* Condensed Matter & Biological Physics *Seminar,* Department of Physics and Astronomy, Syracuse University (2011).
8. *Faceting of multicomponent elastic shells,* Physics Department Colloquium, Syracuse University (2011).
9. *Faceting of multicomponent elastic membranes,* Seminar of the Faculty of Physics, University of Belgrade, Serbia (2010).
10. *Self-assembly of nanoparticles via end-functionalized triblock copolymers*, Theory group meeting, Department of Chemistry, Northwestern University (2008).
11. *Spin Structure Factor of the Frustrated Quantum Magnet* Cs_2CuCl_4, Iowa State University (2006).
12. *Spin Structure Factor of the Frustrated Quantum Magnet* Cs_2CuCl_4, Duke University (2006).
13. *Quantum Phase Transitions of Itinerant Electrons*, Belgrade University, Serbia (2002).

Workshops:

1. *ICERM Semester Program on "Phase Transitions and Emergent Properties"*, Brown University, Spring 2015.
2. *Active Matter: Cytoskeleton, Cells, Tissues and Flocks*, Kavli Institute for Theoretical Physics, University of California Santa Barbara, Winter 2014.
3. *Physical Principles of Multiscale Modeling, Analysis and Simulation in Soft Condensed Matter*, Kavli Institute for Theoretical Physics, University of California Santa Barbara, Spring 2012.
4. *New Perspectives in Strongly Correlated Electrostatics in Soft Matter*, Aspen Center for Physics, Summer 2010.

Contributed:

1. M. Demers, **R. Sknepnek**, M. Olvera de la Cruz, *Curvature-driven domain formation in ternary lipid membranes*, APS March Meeting Boston (2012).
2. C. Funkhouser, **R. Sknepnek**, M. Olvera de la Cruz, *Morphologies of Elastic Membranes with Fluctuating Connectivity*, APS March Meeting Boston (2012).
3. T. Li, **R. Sknepnek**, R. Macfarlane, C. Mirkin, M. Olvera de la Cruz, *Modeling of DNA-Directed Colloidal Self-Assembly and Crystallization*, APS March Meeting Boston (2012).
4. C. Leung, *et al.*, Electrostatics-driven assembly of uni-lamellar catanionic facetted vesicles, APS March Meeting Boston (2012).
5. **R. Sknepnek**, M. Olvera de la Cruz, *Thin-shell model for faceting of multicomponent elastic vesicles*, APS March Meeting Boston (2012).
6. **R. Sknepnek**, G. Vernizzi, M. Olvera de la Cruz, *Buckling of Multicomponent Elastic Shells*, Gordon Research Conference in Soft Condensed Matter Physics (2011) (poster).
7. **R. Sknepnek**, C. Leung, L. C. Palmer, G. Vernizzi, S. I. Stupp, M. J. Bedzyk, M. Olvera de la Cruz, *Faceting of multicomponent charged elastic shells*, APS March Meeting, Dallas (2011) (talk).
8. C. Leung, **R. Sknepnek,** L. C. Palmer, G. Vernizzi, M. Greenfield, S. I. Stupp, M. J. Bedzyk, M. Olvera de la Cruz, *Crystallization Induced by Electrostatic Correlations in Vesicles of Mixed-Valence Ionic Amphiphiles*, APS March Meeting, Dallas (2011) (talk).
9. P. Guo, **R. Sknepnek**, M. Olvera de la Cruz, *Ridge formation of charged end group ligands grafted on faceted nanoparticle*, APS March Meeting, Dallas (2011) (talk).
10. **R. Sknepnek**, G. Vernizzi, M. Olvera de la Cruz, *Symmetry Selection via a Reversible Ionic Buckling of Elastic Membranes*, MRS Fall Meeting, Boston (2010) (talk).
11. **R. Sknepnek**, G. Vernizzi, M. Olvera de la Cruz, *The buckling transition of ionic shells and electrostatics*, APS March Meeting, Portland (2010) (talk).
12. J. Zwanikken, **R. Sknepnek** , M. Olvera de la Cruz , *Effective interactions between pH-responsive particles*, APS March Meeting, Portland (2010) (talk).
13. G. Vernizzi, **R. Sknepnek**, M. Olvera de la Cruz*, The shapes of two-component crystalline shell,* APS March Meeting, Portland (2010) (talk).

14. J. Zhang, **R. Sknepnek**, J. Schmalian , *Spectral information in the fluctuation induced superconducting state for iron based superconductors*, APS March Meeting, Portland (2010) (talk).
15. M. H. Lamm, **R. Sknepnek**, L. Wang, M. Nilsen-Hamilton, *Molecular dynamics simulation study of multimerization of the Mms6 protein from Magnetospirillum magneticum strain AMB-1*, APS March Meeting, Pittsburgh (2009) (talk).
16. J. Zhang, **R. Sknepnek**, J. Schmalian, *On the magnetic fluctuations and unconventional superconducting pairing in iron pnictides*, APS March Meeting, Pittsburgh (2009) (talk).
17. J. Anderson, **R. Sknepnek**, A. Travesset, Phases of functionalized polymer-inorganic composites in solution studied via molecular dynamics, APS March Meeting, Pittsburgh (2009) (talk).
18. **R. Sknepnek**, J. A. Anderson, M. H. Lamm, J. Schmalian, and A. Travesset, *End-Functionalized Triblock Copolymers as a Guide for Nanoparticle Ordering*, APS March Meeting, Pittsburgh (2009) (talk).
19. **R. Sknepnek**, J. A. Anderson, M. H. Lamm, J. Schmalian, and A. Travesset, *Ordering of Nanoparticles Mediated by End-Functionalized Triblock Copolymers*, Annual AIChE Meeting, Philadelphia (2008) (talk).
20. **R. Sknepnek**, J. A. Anderson, M. H. Lamm, J. Schmalian, and A. Travesset, *End-functionalized triblock copolymers as a robust template for assembly of nanoparticles*, APS March Meeting, New Orleans (2008) (talk).
21. S. Papanikolaou, R. M. Fernandes, E. Fradkin, P. W. Phillips, J. Schmalian, **R. Sknepnek**, *Mott transition and Universality at finite temperatures*, APS March Meeting, New Orleans (2008) (talk).
22. **R. Sknepnek**, J. Liu, J. Schmalian, *On the role of inhomogeneities for correlated d-wave superconductors*, APS March Meeting, Colorado (2007) (talk).
23. **R. Sknepnek**, D. Dalidovich, A. J. Berlinsky, J. Zhang, and C. Kallin, *Dynamical properties of the anisotropic triangular quantum antiferromagnet with Dzyaloshinskii-Moriya interaction*, APS March Meeting, Baltimore (2006) (talk).
24. **Sknepnek** and T. Vojta, *Smeared phase transition in a three-dimensional Ising model with planar defects: Monte-Carlo simulations*, CIAR Summer School 2005, Vancouver (2005) (poster).
25. **R. Sknepnek**, T. Vojta, R. Narayanan, *Order parameter symmetry and mode coupling effects at dirty superconducting quantum phase transitions*, APS March Meeting, Austin (2003) (talk).
26. **R. Sknepnek** and T. Vojta, *The quantum phase transition of itinerant helimagnets*, 65th Spring Conference of German Physics Society, Hamburg, Germany (2001) (poster).
27. **R. Sknepnek**, *Numerical simulation of Ehrenfest's dog-flea model*, XIII International Conference for Physics Students, Coimbra, Portugal (1998) (talk).

REFERENCES

- Prof. Monica Olvera de la Cruz, Department of Materials Science and Engineering, Northwestern University, *e-mail:* m-olvera@northwestern.edu, *phone:* +1 847 491 7801
- Prof. Joerg Schmalian, Institut fuer Theorie der Kondensierten Materie, Karlsruher Institut fuer Technologie, *e-mail:* joerg.schmalian@kit.edu, *phone:* +49 721 608-43590.
- Prof. Thomas Vojta, Department of Physics, Missouri University of Science and Technology, *e-mail:* vojtat@mst.edu, *phone:* +1 573 341 4793.
- Prof. Monica H. Lamm, Department of Chemical and Biological Engineering, Iowa State University, *e-mail:* mhlamm@iastate.edu, *phone:* +1 515 294 6533.