Prof. Dr. Michael Engel — Curriculum Vitae

CONTACT INFORMATION

Friedrich-Alexander-University Erlangen
Institute for Multiscale Simulation
Nägelsbachstraße 49b
91052 Erlangen, Germany

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E-MAIL michael.engel@fau.de

POSITIONS

Assistant Professor (W1, tenure track) — since February 2016
Department of Chemical and Biological Engineering
Friedrich-Alexander-University Erlangen

Adjunct Assistant Research Scientist — since February 2016
Assistant Research Scientist (Research Faculty) — September 2015 – January 2016
Research Investigator — July 2011 – August 2015
Postdoctoral Fellow (DFG) — Jan 2009 – June 2011
Department of Chemical Engineering
University of Michigan, Ann Arbor

Visiting Postdoctoral Fellow — May – July 2008
Condensed Matter Theory and Statistical Physics Group
Kyushu University, Fukuoka, Japan

Graduate Research Associate — 2004 – 2008
Teaching Assistant — 2000 – 2004
Institute for Theoretical and Applied Physics
University of Stuttgart, Germany

EDUCATION

Ph.D. Physics (Dr. rer. nat.) — 2004 – 2008
with highest distinction ('mit Auszeichnung')
University of Stuttgart, Germany

M.S. Mathematics (Diploma) — 2000 – 2004
M.S. Physics (Diploma) — 1999 – 2004
Institute for Theoretical and Applied Physics, University of Stuttgart, Germany

Correspondence Study of Physics (FiPS) — 1998 – 1999
University of Kaiserslautern, Germany; parallel to military service

RESEARCH TOPICS

Current research focus and interests

- *Soft Matter and Nanoscience:* Nanoparticles, Colloids, Polymers, Molecules
- *Materials Properties:* Optimization and Design, Photonics, Rheology
- *Statistical Physics:* Self-assembly, Topological Defects, Active Matter
- *Scientific Computing:* Molecular Dynamics, Monte Carlo simulation, Force Fields
- *Crystallography:* Structure Solution, Group Theory, Quasicrystals
- *Data analysis:* Visualization, Order Parameters, Machine Learning

HONORS AND AWARDS

Rising Star Professorship, Cluster of Excellence Engineering of Advanced Materials	2016
Postdoctoral Research Fellowship, German Research Foundation (DFG)	2009 – 2011
Short-Term Postdoctoral Fellowship, Japan Society for the Promotion of Science	2008
Graduiertenkolleg Scholarship, Max-Planck-Institute for Metals Research	2004 – 2005
Member of the German National Merit Foundation ('Studienstiftung')	2001 – 2004

RESEARCH FUNDING

Past and current research funding

(1) Project Title: "Modeling of Self-organization Processes"
Source of Support: Cluster of Excellence Engineering of Advanced Materials (DFG)
Award Period Covered: since 2/1/16

(2) Project Title: "PRAC: Large-scale, Long-time Molecular Dynamics Simulation of Crystal Growth: From Close-packing to Clathrates and Quasicrystals"
Source of Support: NSF ACI-1515306 (PI; with S.C. Glotzer and J. Anderson)
Award Period Covered: 8/1/15 to 7/31/16

(3) Project Title: "Simulation and Design of Structurally Complex Crystals for Self-Assembly"
Source of Support: DFG Postdoctoral Research Fellowship EN 905/1-1
Award Period Covered: 7/1/9 to 6/30/11

(4) Project Title: "Phase Diagram, Dynamics, and Defects with the Lennard-Jones-Gauss Potential"
Source of Support: JSPS Short-Term Fellowship
Award Period Covered: 4/1/8 to 6/30/8

STUDENTS

Thesis Committee Membership

- Sangmin Lee, Chemical Engineering
- Wenbo Shen, Physics (expected 2016)
- M. Eric Irrgang, "Thermodynamic and structural phase behavior of colloidal and nanoparticle systems", Materials Science and Engineering (2016)
- Pablo F. Damasceno, "Using directional entropic forces for target pattern design", Applied Physics (2015)
- Jaime A. Millan, "Self-assembly of complex structures through competing entropic and enthalpic patchiness", Materials Science and Engineering (2015)

Ph.D. Students (co-advised with Sharon Glotzer at U-Michigan)
Nguyen H.P. Nguyen (Mechanical Engineering, 2014), Amir Haji-Akbari (Chemical Engineering, 2011)

Diploma Students (co-advised with Hans-Rainer Trebin at U-Stuttgart)
Steffen Sonntag (Physics, 2006), Hansjörg Lipp (Physics, 2005)

TEACHING EXPERIENCE

Courses Taught

Symmetry and Crystallography (Michigan)	SS 2011, WS 2015/2016
Group Theory in Physics, Seminar (Stuttgart)	SS 2006, WS 2007/2008

Teaching Assistantships (Stuttgart)

Group Theory in Physics 1&2	WS 2006/2007, SS 2007
Continuum Mechanics	WS 2005/2006
Special & General Theory of Relativity	SS 2004, WS 2004/2005
Calculus for Engineers 1&2	WS 2001/2002, SS 2002
Experimental Physics 1&2	WS 2000/2001, SS 2001

COMMUNITY SERVICE

Reviewer for Journals
ACS Nano, Acta Crystallographica, Acta Materialia, AIP Advances, Angewandte Chemie, Chemical Physics Letters, Discrete and Computational Geometry, Granular Matter, Journal of Chemical Physics, Journal of Physics C, Nature Communications, Nature Physics, Philosophical Magazine, Physical Review B, Physical Review E, Physical Review X, Physical Review Letters, Soft Matter

SCIENTIFIC COMPUTING

Programming (15+ years experience)
C, C++, Python, Java, Javascript, OpenGL, Mathematica, Matlab, Unix-shell scripting

Software Development
Interactive Java Visualization (injavis) and Interactive C Simulation (incsim)

Particle-based Monte Carlo and Molecular Dynamics simulation and visualization;
in use by >30 Students and Researchers at University of Michigan and elsewhere, since 2007

PEER-REVIEWED PUBLICATIONS AND PREPRINTS

* CO-FIRST AUTHOR

University of Michigan

[37] Self-Assembly of Colloidal Nanocrystals: From Intricate Structures to Functional Materials
M.A. Boles*, M. Engel*, Dmitri V. Talapin
review in preparation

[36] Fluid-to-Solid Transition of Hard Regular Polygons
J.A. Anderson, J. Antonaglia, J.A. Millan, M. Engel, S.C. Glotzer
preprint: arXiv:1606.00687

[35] The role of short-range order and hyperuniformity in the formation of band gaps in disordered photonic materials
L.S. Froufe-Perez, M. Engel, P.F. Damasceno, N. Muller, J. Haberko, S.C. Glotzer, F. Scheffold
Physical Review Letters, in press (2016)

[34] Controlling chirality of entropic crystals
P.F. Damasceno, A.S. Karas, B.A. Schultz, M. Engel, S.C. Glotzer
Physical Review Letters **115**, 158303 (2015)

[33] Metastable orientational order of colloidal discoids
L.C. Hsiao, B.A. Schultz, J. Glaser, M. Engel, M.E. Szakasits, S.C. Glotzer, M.J. Solomon
Nature Communications **6**, 8507 (2015)

[32] Shape control and compartmentalization in active colloidal cells
M. Spellings, M. Engel, D. Klotsa, S. Sabrina, A.M. Drews, N.H.P. Nguyen, K.J.M. Bishop, S.C. Glotzer
Proceedings of the National Academy of Sciences **112**, E4642-E4650 (2015)

[31] Symmetry considerations for the targeted assembly of entropically stabilized colloidal crystals via Voronoi particles
B.A. Schultz, P.F. Damasceno, M. Engel, S.C. Glotzer
ACS Nano **9**, 2336-2344 (2015)

[30] Computational discovery of a one-component quasicrystal via self-assembly
M. Engel, P.F. Damasceno, C.L. Phillips, S.C. Glotzer
Nature Materials **14**, 109-116 (2015)

[29] Understanding shape entropy through local dense packing
G. van Anders, N.K. Ahmed, D. Klotsa, M. Engel, S.C. Glotzer
Proceedings of the National Academy of Sciences **111**, E4812-E4821 (2014)

[28] Controlled self-assembly of periodic and aperiodic cluster crystals
K. Barkan, M. Engel, R. Lifshitz
Physical Review Letters **113**, 098304 (2014)

[27] Emergent collective phenomena in a mixture of hard shapes through active rotation
N.H.P. Nguyen, D. Klotsa, M. Engel, S.C. Glotzer
Physical Review Letters **112**, 075701 (2014)

[26] Complexity in surfaces of densest packings for families of polyhedra
E.R. Chen, D. Klotsa, M. Engel, P.F. Damasceno, S.C. Glotzer
Physical Review X **4**, 011024 (2014)

[25] Entropically patchy particles: engineering valence through shape entropy
G. van Anders, N.K. Ahmed, R. Smith, M. Engel, S.C. Glotzer
ACS Nano **8**, 931-940 (2014)

[24] Directional entropic force approach to anisotropic nanoparticle assembly
K.L. Young, M.L. Personick, M. Engel, P.F. Damasceno, S.N. Barnaby, R. Bleher, T. Li, S.C. Glotzer, B. Lee, C.A. Mirkin
Angewandte Chemie International Edition **52**, 1-6 (2013)

[23] Shape alloys of nanorods and nanospheres from self-assembly
X. Ye*, J.A. Millan*, M. Engel*, J. Chen, B.T. Diroll, S.C. Glotzer, C.B. Murray
Nano Letters **13**, 4980-4988 (2013)

[22] Massively parallel Monte Carlo for many-particle simulations on GPUs
J.A. Anderson, E. Jankowski, T.L. Grubb, M. Engel, S.C. Glotzer
Journal of Computational Physics **254**, 27-38 (2013)

[21] Packing and self-assembly of truncated triangular bipyramids
A. Haji-Akbari, E.R. Chen, M. Engel, S.C. Glotzer
Physical Review E **88**, 012127 (2013)

[20] Competition of shape and interaction patchiness for self-assembling nanoplates
X. Ye*, J. Chen*, M. Engel*, J.A. Milan*, W. Li, L. Qi, G. Xing, J.E. Collins, C.R. Kagan, J. Li, S.C. Glotzer, C.B. Murray
Nature Chemistry **5**, 466-473 (2013) [Cover Article]

[19] Hard disk equation of state: first-order liquid hexatic transition in two dimensions with three simulation methods
M. Engel, J.A. Anderson, S.C. Glotzer, M. Isobe, E.P. Bernard, W. Krauth
Physical Review E **87**, 042134 (2013)

[18] Confirmation of the random tiling hypothesis for a decagonal quasicrystal
A. Kiselev, M. Engel, H.-R. Trebin
Physical Review Letters **109**, 225502 (2012)

[17] Predictive self-assembly of polyhedra into complex structures
P.F. Damasceno*, M. Engel*, S.C. Glotzer
Science **337**, 453-457 (2012)

[16] Crystalline assemblies and dense packings of a family of truncated tetrahedra via directional entropic forces
P.F. Damasceno*, M. Engel*, S.C. Glotzer
ACS Nano **6**, 609-614 (2012)

[15] Low-temperature structure of ξ'-Al-Pd-Mn optimized by ab initio methods
B. Frigan, A. Santana, M. Engel, D. Schopf, H.-R. Trebin, M. Mihalkovic
Physical Review B **84**, 184203 (2011)

[14] Degenerate quasicrystal of hard triangular bipyramids
A. Haji-Akbari, M. Engel, S.C. Glotzer
Physical Review Letters **107**, 215702 (2011) [Cover Article]

[13] Phase diagram of hard tetrahedra
A. Haji-Akbari, M. Engel, S.C. Glotzer
Journal of Chemical Physics **135**, 194101 (2011)

[12] Entropic stabilization of tunable planar modulated superstructures
M. Engel
Physical Review Letters **106**, 095504 (2011)

[11] Dynamics of particle flips in two-dimensional quasicrystals
M. Engel, M. Umezaki, H.-R. Trebin, T. Odagaki
Physical Review B **82**, 134206 (2010)

[10] Dense crystalline dimer packings of regular tetrahedra
E. R. Chen, M. Engel, S.C. Glotzer
Discrete and Computational Geometry **44**, 253-280 (2010)

[9] Phason dynamics in one-dimensional lattices
H. Lipp, M. Engel, S. Sonntag, H.-R. Trebin
Physical Review B **81**, 064302 (2010)

[8] Disordered, quasicrystalline and crystalline phases of densely packed tetrahedra
A. Haji-Akbari*, M. Engel*, A.S. Keys, X. Zheng, R.G. Petschek, P. Palffy-Muhoray, S.C. Glotzer
Nature **462**, 773-777 (2009)

University of Stuttgart

[7] Structural complexity in monodisperse systems of isotropic particles
M. Engel, H.-R. Trebin
Zeitschrift für Kristallographie **223**, 721-725 (2008)

[6] Stability of the decagonal quasicrystal in the Lennard-Jones-Gauss system
M. Engel, H.-R. Trebin
Philosophical Magazine **88**, 1959-1965 (2008)

[5] Structural variations in ε-type Al-Mn-(Pd,Fe) complex metallic alloy phases
M. Heggen, M. Engel, M. Feuerbacher, H.-R. Trebin
Philosophical Magazine **88**, 507-521 (2008)

[4] Self-assembly of monatomic complex crystals and quasicrystals with a double-well interaction potential
M. Engel, H.-R. Trebin
Physical Review Letters **98**, 225505 (2007)

[3] Structure factors of harmonic and anharmonic Fibonacci chains with molecular dynamics
M. Engel, S. Sonntag, H. Lipp, H.-R. Trebin
Physical Review B **75**, 144203 (2007)

[2] Tiling models for metadislocations in AlPdMn approximants
M. Engel, H.-R. Trebin
Philosophical Magazine **86**, 979-984 (2006)

[1] A unified projection formalism for Al-Pd-Mn quasicrystal Ξ-approximants and their metadislocations
M. Engel, H.-R. Trebin
Philosophical Magazine **85**, 2227-2247 (2005)

Other Writings and Invited Commentaries

[7] News & Views: A triangular affair
M. Engel, S.C. Glotzer
Nature Physics **10**, 185-186 (2014)

[6] Brennpunkt: Aus Schaum gebaut
M. Engel
Physik Journal **6/2012**, 24-25 (2012)

[5] News & Views: Complex order in soft matter
S.C. Glotzer, M. Engel
Nature **471**, 309-310 (2011)

[4] Eine unmögliche Entdeckung – Nobelpreis für Quasikristalle
M. Engel, J. Roth, H.-R. Trebin
Physik Journal **12/2011**, 31-34 (2011) [Cover Article]

[3] Brennpunkt: Volle Packung
M. Engel
Physik Journal **9/2010**, 18-19 (2010)

[2] Simulating structure and physical properties of complex metallic alloys
H.-R. Trebin, P. Brommer, M. Engel, F. Gähler, S. Hocker, F. Rösch, J. Roth
in *Properties and Applications of Complex Intermetallics*, 293-330, World Scientific (2009)

[1] Dynamics and defects of complex crystals and quasicrystals: perspectives from simple model systems
M. Engel
Doctoral Thesis, Universität Stuttgart (2008)

INVITED CONFERENCE PRESENTATIONS

2016 "New Crystals for Soft Colloids"
CECAM Workshop on Structure Formation in Soft Colloids, Vienna, Austria (19-22 Sep)

"The Role of Short-Range Order and Hyperuniformity in the Formation of Band Gaps in Disordered Photonic Materials"
META '16, the 7th International Conference on Metamaterials, Malaga, Spain (25-28 Jul)

"Designing polyhedral particles for targeted self-assembly"
Dynamics Days Europe 2016, Corfu, Greece (6-10 Jun)

"Shape-based modeling of the self-assembly of nanoparticle and molecules"
SIAM Conference on Mathematical Aspects of Materials Science, Philadephia, PA (8-12 May)

2015 "Simulation and modeling of self-assembly processes on the nanoscale and beyond"
EAM Symposium 2015, Kloster Banz, Bad Staffelstein, Germany (23-25 Nov)

"Quasicrystals on the computer: The role of complexity for crystal growth"
Workshop: Open Space between Heavy Fermions and Quasicrystals, Nagoya, Japan (17-19 Nov)

"Cabinet of curiosities: self-assembly of unusual crystal structures"
Aperiodic 2015, Prague, Czech Republic (30 Aug-4 Sep)

"Packing and crystallization of hard shapes: from disks to tetrahedra"
Workshop on Crystals and Random Networks, ICERM, Providence, RI (9-13 Feb)

2014 "When and how can densest packings be achieved with nanoparticles?"
Workshop: Jam-Packed, Erlangen, Germany (15-18 Sep)

"Beyond close packing: complex order with simple models"
Mini Stat Mech Meeting, Berkeley, CA (10-12 Jan)

2013 "Self-assembly and packing of polyhedra into complex crystal structures"
DPG Frühjahrstagung, Regensburg, Germany (11-15 Mar)

"When shapes collide: finding order in disorder"
CECAM Workshop on Self-assembly, EPFL, Lausanne, Switzerland (4-6 Mar)

2012 "Predictive self-assembly of polyhedra into complex structures"
MRS Fall Meeting, Boston, MA (26-30 Nov)

"Aperiodic order in self-assembly with anisotropic particles and competing distances"
Mathematics of Distances and Applications, Varna, Bulgaria (2-5 Jul)

"Towards structural complexity with colloids"
APS March Meeting, Boston, MA (27 Feb-2 Mar)

2011 "Unusual crystal structures with hard polyhedra"
22nd Congress International Union of Crystallography, Madrid, Spain (22-30 Aug)

2010 "Quasicrystalline phase of densely packed tetrahedra"
11th International Conference on Quasicrystals, Sapporo, Japan (13-18 Jun)

2009 "Spontaneous formation of a dense aperiodic crystal from hard tetrahedra"
Aperiodic 2009, Liverpool, United Kingdom (13-18 Sep)

"Entropic stabilization of quasicrystals in the Lennard-Jones-Gauss system"
10th International Conference on Quasicrystals, ETH Zürich, Switzerland (6-11 Jul)

"Observation of one-component quasicrystals in simulations"
Quasiperiodic Tilings and Related Topics, Kochi University, Japan (19-22 Jun)

2007 "Metadislocations in Al-Pd-Mn-phases as examples for partial dislocations in CMAs"
Euro. Conference on Advanced Materials, Nürnberg, Germany (10-13 Sep)

Conference Contributions (as Presenter)

2016 Spring School: Imaging Particles, Erlangen, Germany (4-8 Apr)

2015 Workshop: Particle Simulations 2015, Erlangen, Germany (21-24 Sep)
Mainz Materials Simulation Days, Mainz, Germany (10-12 Jun)
MRS Spring Meeting, San Francisco, CA (6-10 Apr)
APS March Meeting, San Antonio, TX (2-6 Mar)

2014 23rd Congress International Union of Crystallography, Montreal, Canada (5-12 Aug)
9th Liquid Matter Conference, Lisbon, Portugal (21-25 Jul)
APS March Meeting, Denver, CO (3-7 Mar)

2013 AIChE Annual Meeting, San Francisco, CA (3-8 Nov)
APS March Meeting, Baltimore, MD (18-22 Mar)

2012 Workshop on Packing Problems, Trinity College Dublin, Ireland (2-5 Sep)
Workshop: Ordered and Non-ordered Superstructures of Nanosized Objects, Max Planck-Institute for the Physics of Complex Systems, Dresden, Germany (9-13 Jul)

2011 APS March Meeting, Dallas, TX (21-25 Mar)
Materials and the Imagination, Aspen Center for Physics, Aspen, CO (3-7 Jan)

2010 MRS Spring Meeting, San Francisco, CA (5-9 Apr)
APS March Meeting, Portland, OR (15-19 Mar)
Mini StatMech Meeting, University of California, Berkeley, CA (8-10 Jan)

2009 Foundations of Molecular Modeling and Simulation, Blaine, WA (12-16 Jul)

2007 Quasicrystals–The Silver Jubilee, Tel Aviv, Israel (14-19 Oct)
23rd International Conference on Statistical Physics, Genova, Italy (9-13 Jul)
DPG Frühjahrstagung, Regensburg, Germany (26-30 Mar)

2006 9th International Conference on Quasicrystals, Iowa State University, Ames, IA (22-26 May)
DPG Frühjahrstagung, Dresden, Germany (27-31 Mar)

2005 DPG Frühjahrstagung, Berlin, Germany (4-9 Mar)

2004 WE Heraeus Summer School, University of Chemnitz, Germany (27 Sep-8 Oct)

Seminar Talks

2016 Institute for Theoretical Physics, FAU Erlangen-Nuremberg, Germany (28 Jun)
Institute of Materials Simulation, FAU Erlangen-Nuremberg, Germany (23 Jun)

2015 Institute of Industrial Sciences, University of Tokyo, Japan (20 Nov)
Mathematics Department, Physical Mathematics Seminar, MIT, Boston, MA (6 Oct)
Department of Materials Science and Engineering, Carnegie Mellon, Pittsburgh, PA (17 Sep)
Department of Physics, Fribourg University, Fribourg, Switzerland (22 Jun)
Condensed Matter Theory Group, Johannes Gutenberg University Mainz, Germany (12 Jun)

2014 Department of Chemistry, Iowa State University, IA (4 Dec)
Institute for Computational Physics, University of Stuttgart, Germany (30 Jul)

2013 Institute for Theoretical Physics, University of Erlangen, Germany (8 Mar)
Department of Physics, Case Western Reserve University, Cleveland, OH (11 Feb)
2012 School of Engineering and Applied Sciences, Harvard, Boston, MA (16 Oct)
2011 Max-Planck-Inst. for Dynamics and Self-Organization, Göttingen, Germany (16 Dec)
Department of Physics, University of Düsseldorf, Germany (27 Jul)
2010 Courant Institute, Geometry Seminar, New York University, NY (5 May)
Theoretical and Applied Physics, University of Stuttgart, Germany (26 Feb)
2009 Department of Physics, Cornell University, PA (5 May)
2008 Materials Theory Group, University of Pennsylvania, Philadelphia, PA (16 Sep)
Laboratory for Computational Nanoscience, University of Michigan, MI (10 Sep)
Department of Engineering, Hokkaido University, Sapporo, Japan (5 Jun)
Institute for Advanced Materials, Tohoku University, Sendai, Japan (3 Jun)
Department of Physics, Chuo University, Tokyo, Japan (30 May)
Yukawa Institute for Theoretical Physics, Kyoto University, Japan (26 May)
2006 Department of Physics, Kyushu University, Fukuoka, Japan (13&17 Oct)
Max-Planck-Institute for Metals Research, Stuttgart, Germany (4 Jul)
Institute for Microstructure Research, Research Center Jülich, Germany (8 Feb)
2005 Theoretical and Applied Physics, University of Stuttgart, Germany (12 Feb)
2004 Graduiertenkolleg Innere Grenzflächen, Ellwangen, Germany (18 Oct)

Last Updated: July 11, 2016.