

Theory of Biomolecular Matter, B.M. Mulder (2017-2022)

Biography



Bela Mate Mulder was born on July 16, 1956, in Leiden, The Netherlands. He obtained his PhD under the supervision of prof. Th. W. Ruijgrok at the Institute of Theoretical Physics in Utrecht in 1986. He worked as a postdoc with prof. H. Lekkerker at the van 't Hoff lab in Utrecht from 1986-1987. From 1988-1991 he worked at the NCPRS Demokritos in Athens, Greece, on a EU fellowship. In 1992 he became project leader Theory of Complex Liquids at AMOLF. Upon receiving tenure in 1997 he renamed his group Theory of Biomolecular Matter marking the shift of his interests towards biophysics.

From 2001-2018 he was adjoint full professor at Wageningen University. In 2019 he was appointed adjunct full professor in Utrecht in a joint appointment between the physics and biology departments. He twice acted as interim head of the Living Matter department at AMOLF and member of the AMOLF management team.

The research of Bela Mulder is aimed at understanding molecular structures and processes in living cells using the methods of statistical physics. Two main lines of research are the organization of the eukaryotic cytoskeleton, with a focus on microtubules in plants, and the spatial structure of chromosomes, with a focus on their spatial segregation prior to division. Additionally, he is interested in leveraging the unique properties of biomolecules to design self-assembling soft matter systems with designed properties.

Group output

Peer reviewed Publications 2017-2022

2017

1. Ioana C. Garlea and Bela M. Mulder, The Landau-de Gennes approach revisited : *A minimal self-consistent microscopic theory for spatially inhomogeneous nematic liquid crystals*, J. Chem. Phys. 147, 24: 244505: 1-12 (2017)
2. Panayiotis Foteinopoulos and Bela M. Mulder, *A microtubule-based minimal model for spontaneous and persistent cell polarity*, PLoS One 12, 9: e0184706: 1-15 (2017)
3. Jelle J.F. Sleeboom, Panayiotis Voudouris, Melle T.J.J.M. Punter, Frank J. Aangenendt, Daniel Florea, Paul van der Schoot and Hans M. Wyss, *Compression and reswelling of microgel particles after an osmotic shock*, Phys. Rev. Lett. 119, 9: 098001: 1-5 (2017)
4. Eva E. Deinum, Simon H. Tindemans, Jelmer J. Lindeboom and Bela M. Mulder, *How selective severing by katanin promotes order in the plant cortical microtubule array*, PNAS 114, 27: 6942–6947 (2017)

2018

1. P. Nghe, B.M. Mulder and S. J. Tans, A graph-based algorithm for the multi-objective optimization of gene regulatory networks, EJOR **270**, 2: 784-793 2018. **Green OA**

2. Chakraborty, V. Willemsen, T. de Zeeuw, C.Y. Liao, D. Weijers, B.M. Mulder and B. Scheres, A Plausible Microtubule-Based Mechanism for Cell Division Orientation in Plant Embryogenesis, *Current Biol.* **28**, 19: 3031-3043 2018. **Gold OA**
3. R.N.P. Creyghton and B.M. Mulder, Scratching a 50-year itch with elongated rods, *Molecular Physics* **116**, 21-22: 2742-2756 (2018). **Green OA**
4. Chakraborty, I. Blilou, B. Scheres and B.M. Mulder, A computational framework for cortical microtubule dynamics in realistically shaped plant cells, *PLoS Comp. Biol.* **14**, 2, e1005959: 1-26 2018. **Gold OA**
5. M. Nakamura, J. J. Lindeboom, Marco Saltini, B.M. Mulder and D. Erhardt, SPR2 protects minus ends to promote severing and reorientation of plant cortical microtubule arrays, *J. Cell Biol.* **217**, 3: 915-927 2018. **Gold OA**

2019

1. Q. Wu, M.T.J.J.M. Punter, T.E. Kodger, L. Arnaudov, B.M. Mulder, S. Stoyanov and J. Gucht, *Gravity-driven syneresis in model low-fat mayonnaise*, *Soft Matter* **15** (46), 9474-9481 (2019). **Hybrid OA**
2. F. Wu, P. Swain, L. Kuijpers, X. Zheng, K. Felter, M. Guurink, J. Solari, S. Jun, T.S. Shimizu, D. Chaudhuri, B.M. Mulder and C. Dekker, *Cell boundary confinement sets the size and position of the E. coli chromosome*, *Current Biol.* **29** (13), 2131- 2144.e1-e4, (2019). **Green OA**
3. E.E. Deinum, B.M. Mulder and Y.B. Alfonso, *From plasmodesma geometry to effective symplastic permeability through biophysical modelling*, *eLife* **8**, e49000, 1-40, (2019). **Gold OA**
4. P. Swain, B.M. Mulder and D. Chaudhuri, *Confinement and crowding control the morphology and dynamics of a model bacterial chromosome*, *Soft Matter* **15** (12), 2677-2687, (2019). **Green OA**
5. J.J. Lindeboom, M. Nakamura, M. Saltini, A. Hibbel, A. Walia, T. Ketelaar, A.M.C. Emons, J.C. Sedbrook, V. Kirik, B.M. Mulder and D.W. Ehrhardt, *CLASP stabilizes microtubule plus ends created by serving to drive cortical array reorientation*, *J. Cell Biol.* **218** (1), 190-205, (2019). **Hybrid OA**
6. Ioana C. Gârlea, Oliver Dammone, José Alvarado, Valerie Notenboom, Yunfei Jia, Gijsje H. Koenderink, Dirk G. A. L. Aarts, M. Paul Lettinga & Bela M. Mulder, *Colloidal Liquid Crystals Confined to Synthetic Tactoids*, *Scientific Reports* volume 9, Article number: 20391 (2019) **Gold OA**

2020

1. M.T.J.J.M. Punter, H.M. Wyss and B.M. Mulder, *Compression and swelling of hydrogels in polymer solutions: A dominant-mode model*, *Phys. Rev. E* **102**, (6), 062607: 1-8 (2020) **Hybrid OA**.
2. F.J. Aangenendt, M.T.J.J.M. Punter, B.M. Mulder, P. van der Schoot and H.M. Wyss, *Nonmonotonic swelling and compression dynamics of hydrogels in polymer solutions*, *Phys. Rev. E* **102**, (6), 062606: 1-14 (2020) **Green OA**.
3. M. Saltini and B.M. Mulder, *Microtubule-based actin transport and localization in a spherical cell*, *R. Soc. Open Sci.* **7**, (11), 201730: 1-13 (2020) **Gold OA**.
4. M. Saltini and B.M. Mulder, *Critical threshold for microtubule amplification through templated severing*, *Phys. Rev. E* **101**, (5), 052405: 1-16 (2020) **Green OA**.
5. A. Kumar, P. Swain, B.M. Mulder and D. Chaudhuri, *Impact of crowders on the morphology of bacterial chromosomes*, *EPL (Europhysics letters)* **128**, (6), 68003: 1-7 (2020) **Green OA**.
6. M.T.J.J.M. Punter, B.E. Vos, B.M. Mulder and G.H. Koenderink, *Poroelasticity of (bio)polymer networks during compression: theory and experiment*, *Soft Matter* **16**, (5), 1298-1305 (2020) **Green OA**.

2021

1. J. Teapal, L.J. Schuitman, B.M. Mulder and M.E. Janson, *Forced apart: a microtubule-based mechanism for equidistant positioning of multiple nuclei in single cells*, Eur. Phys. J. Plus **136**, (8), 858: 1-17 (2021) Hybrid OA
2. L. Olivi, M. Berger, R.N.P. Creighton, N. De Franceschi, C. Dekker, B.M. Mulder, N.J. Claassens, P.R. ten Wolde and J. van der Oost, *Towards a synthetic cell cycle*, Nature Commun. **12**, (1), 4531: 1-11 (2021) Gold OA
3. M. Saltini and B.M. Mulder, *A plausible mechanism for longitudinal lock-in of the plant cortical microtubule array after light-induced reorientation*, Quantitative Plant Biology **2**, e9: 1-9 (2021) Gold OA

2022

1. P. Foteinopoulos and B.M. Mulder, *Microtubule organization and cell geometry*, Phys. Rev. E **106**, (5), 054408: 1-17 (2022) Green OA
2. R. Subert and B.M. Mulder, *Frustration-induced complexity in order-disorder transitions of the J1-J2-J3 Ising model on the square lattice*, Phys. Rev. E **106**, (1), 014105: 1-17 (2022) Green OA

Contributions to scientific books (chapters or entire book) 2017-2022

2018

1. D. Chaudhuri and B.M. Mulder: *Molecular Dynamics Simulation of a Feather-Boa Model of a Bacterial Chromosome*, In: *Bacterial Chromatin: Methods and protocols* /ed. R.T. Dame, Springer Nature, (2018); 403-415 (Methods in molecular biology).
2. E. E. Deinum and B.M. Mulder: *Modelling the Plant Microtubule Cytoskeleton*, In: *Mathematical Modelling in Plant Biology*, Springer Nature, (2018); 53-67. **Green OA**

PhD theses 2017-2022

2019

1. Panagiotis Foteinopoulos, *Models for spatial organization of microtubules and cell polarization*, Wageningen University, September 12, -2019.
2. Marco Saltini, *Dynamic reorganization of microtubule networks: building the new by breaking down the old*, Wageningen University, December 3, 2019.

2020

1. M.T.J.J.M. Punter, *The mechanics of soft porous solids: from hydrogel dynamics to fibrin compression*, Wageningen University, 2020-02-03 OA

Masters and Bachelors theses 2017-2022

2018

1. MSc thesis; Xavi Fernandez-Luengo Flores (2018) *Modeling microtubule dynamics: A study on cell polarization*. University of Amsterdam
2. MSc thesis; Lisa Stigter (2018) *Modeling Neuronal Microtubules: Axonal and dendritic peculiarities*, Utrecht University
3. MSc thesis; Marieke Kral (2018) *Microtubule-based minimal models for polarity in tip growing cells*, University of Amsterdam

2019

1. Gytis Brazdziunas, *Bottom-up crystal design with DNA-coated colloids: predicting coupling constants using machine learning*, University of Amsterdam, November 2019.

2020

1. *"Antiparallel microtubule binding mechanics and cell polarity"* Daniel Slingerland, Wageningen University, October 2020.

2021

1. Tom van der Mijn, *"Feedback-induced bistability in actin networks"*, master's thesis, University of Amsterdam, 06/2021.
2. Felicio Gordilho-Frenandes, *"Numerical Analysis of the Influx of Diffusive Moving Particles into Partially Absorbing Non-spherical Cells"*, master's thesis, University of Amsterdam, 06/2021.
3. Kyriacos Nicolaou, *"A probabilistic algorithm for the steady-state diffusional flux into a partially absorbing convex body"*, master's thesis, TU Delft, 06/2021.
4. Rodolfo Subert, *"Order-Disorder Transition on a Range-3 Ising Model on the Square Lattice"*, master's thesis, University of Utrecht, 06/2021.

Invited lectures at international conferences and meetings

2017

1. Marco Saltini, *"Microtubule severing at crossovers: a competition model"*, Annual Symposium EPS Graduate School, Leiden University, The Netherlands (talk), 28 February.
2. Marco Saltini, *"Sever or die: a competition model for the dynamics at plant microtubule crossovers"*, Physical Biology Circle Meeting 2017, EMBL, Heidelberg, Germany (talk), 8-10 March.
3. Marco Saltini, *"Sever or die: a competition model for the dynamics at plant microtubule crossovers"* Jacques Monod conference - Actin and microtubule cytoskeleton: bridging scales from single molecules to tissues, Station Biologique, Roscoff, France. (poster), 8-12 May.
4. Marco Saltini, *"Microtubule reorientation driven by severing: a competition model"* INADILIC - Theory and Modeling of Complex Systems in Life Sciences, Euler International Mathematical Institute, Saint Petersburg, Russia. (poster), 18-22 September.
5. Marco Saltini, *"Microtubule reorientation driven by severing: a competition model"* Dutch Biophysics 2017, Veldhoven, The Netherlands. (talk), 2-3 October.
6. Melle Punter, *"Shocking Hydrogels: Osmotic Shock on a Spherical (polyacrylamide) Hydrogel"*, (poster), Physics@Veldhoven, Veldhoven, 18 January
7. Melle Punter, *"Shocking Hydrogels: Osmotic Shock on a Spherical (polyacrylamide) Hydrogel"* (poster), Interpore, Rotterdam, May 10
8. Melle Punter, *"Shocking Hydrogels: Dynamics of a Spherical Hydrogel in Response to an Osmotic Shock"*(talk), pitch, Interpore, Rotterdam, May 10
9. Melle Punter, *"Disturbed Mayonnaise: on the Cause and Quantification of Liquid Expulsion from Mayonnaise"* (talk), progress meeting Hybrid Soft Materials IPP, AMOLF, 8 June
10. Melle Punter, *"Shocking Hydrogels: Osmotic Shock on a Spherical (polyacrylamide) Hydrogel"* (poster), 6th Biot conference Poromechanics, 11 July
11. Melle Punter, *"A Poroelastic Model to Understand Mayonnaise Stability"* (talk), progress meeting Hybrid Soft Materials IPP, Unilever Research Vlaardingen, 30 November
12. Bandan Chakraborty, *"Microtubule order and cell division orientation in the early Arabidopsis embryo"* (talk) Annual Theme Meeting of the Graduate School Experimental Plant Sciences Theme 1: Developmental Biology of Plants, 28 February

13. Bela Mulder, "*A minimal model for actin dynamics with a limited g-actin pool*" (poster) Jacques Monod conference - Actin and microtubule cytoskeleton: bridging scales from single molecules to tissues, Station Biologique, Roscoff, France, 8-12 May.

2018

1. Bela Mulder (Keynote); Divide and Conquer: the role of entropy in bacterial chromosome segregation, International Conference on Complex & Functional Materials, December 13-16 (2018), Kolkata, India

Academic teaching 2017-2022

2017-2018

1. Lecturer Toolbox track Modelling Biological Systems, Wageningen University (2018)

2020

1. "*Advanced Statistical Mechanics on Onsager Theory*", Guest lecture in the course, Utrecht University, October 2020.

2021-2022

1. B.M. Mulder; Developed and taught the unit "Cytoskeletal dynamics" (6 hrs) of the MSc course "Physics of Biological Systems" at the TU Delft (05/2021).

Selected awards & recognitions 2017-2022

N/A

Valorization 2017-2022

N/A