Curriculum Vitae
Dr. David Dulin

Junior Research Group Leader
IZKF - Interdisciplinary Center for Clinical Research
FAU Erlangen-Nuremberg
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Webpage : https://www.n2.izkf.med.fau.de
Date of birth : 25th of February 1982
Place of birth : Tonneins, Lot-et-Garonne, France
Citizenship : French

Education

2006-2010 **PhD in Physics** *Paris-Sud XI University*
Laboratory Charles Fabry of the Institut d'Optique, France
Specialization in experimental biophysics (Grade : very honourable (highest))
Thesis : *"Observation of the translational activity of single ribosomes with fluorescence microscopy coupled to a microfluidic chip"*
Advisor : Prof. Nathalie Westbrook

2000-2006 **Bachelor and Master** Major : physics ; Minor : mathematics , *University of Bordeaux, France*

Employment

From 01/2021 **Assistant Professor** Physics Department at *Vrije Universiteit Amsterdam, The Netherlands.*

Since 09/2016 **Junior Research Group Leader** "Physics and Medicine" *IZKF - Interdisciplinary Center for Clinical Research, Friedrich-Alexander-University (FAU) Erlangen-Nuremberg, Germany.*
• Established a fully operational microscopy lab with temperature controlled high-throughput and high-resolution magnetic tweezers set-ups for force spectroscopy experiments.
• Established a fully operational molecular biology lab for the fabrication of nucleic acids scaffolds for single-molecule experiments
• Established a magnetic tweezers-TIRF set-up for single molecule experiments
• Established the first assay to study SARS-CoV-2 replication at the single molecule level

08/2014-06/2016 **Post-doc** in the lab of Achillefs Kapanidis, *Department of Physics, University of Oxford, UK*
• TIRF-based single molecule FRET study of bacterial transcription initiation dynamics

11/2009-08/2014 **Post-doc** in the lab of Nynke Dekker, *Department of Bionanosciences, TU Delft, The Netherlands*
• Pioneered novel massively multiplexed magnetic tweezers and high spatiotemporal resolution magnetic tweezers using GPU based software for real-time data analysis
• Pioneered single molecule characterization of the elongation dynamics on viral RNA dependent RNA polymerases. Studied the loading mechanism of a model replicative helicase at high resolution, DNA-Dps assembly and interactions, double stranded RNA mechanical properties and bacterial replication road-blocks with magnetic tweezers assays
• Worked in close collaboration with Dr. M. Depken (TU Delft) to the development of a novel analysis based on maximum likelihood estimation for single molecule force spectroscopy enzymology

2006-2009 **Research Assistant** in the lab of Nathalie Westbrook, *Laboratory Charles Fabry of the Institut d'Optique*
• Set up a new lab for the study of the ribosome elongation dynamics. Build up a single-molecule multi-color TIRF microscope and an optical tweezers apparatus

Languages

French (Native), English (Fluent, C1), German (Basics, B1.1)

Teaching activities

Lecture and practicum
Since 2018 Magnetic tweezers, *Bachelor of Integrated Life Science, FAU Erlangen-Nuremberg*
Lecture
2010 Micro and Nanofabrication for biophysics, *Nanosciences Master, TU Delft*
Teaching assistant for undergraduate laboratory practical course
2008-2009 Ray optics, microscopy, wave optics *Institut d'Optique Graduate School*

Publications

Publications, *preprint*

D. Dulin, Z. Yu, T.J. Cui, B. A. Berghuis, M. Depken and N.H. Dekker
Real-time observation of replicative helicase assembly onto single-stranded DNA
BioRxiv doi:https://doi.org/10.1101/077800, (2016).

M. Seifert, S.C. Bera, P. van Nies, R.N.Kirchdoerfer, A. Shannon, T.L. Grove, F.S. Papini, J.J. Arnold, S.C. Almo, B. Canard, M. Depken, C.E. Cameron, and D. Dulin
Signatures and mechanisms of efficacious therapeutic ribonucleotides against SARS-CoV-2 revealed by analysis of its replicase using magnetic tweezers
BioRxiv, https://doi.org/10.1101/2020.08.06.240325, (2020). *Under review in* ***Science***

Publications, *book chapter*

E. Ostrofet, F. S. Papini, A.M. Malinen and D. Dulin
A single-molecule view on cellular and viral RNA synthesis
In : Joo C., Rueda D. (eds) Biophysics of RNA-Protein Interactions. Biological and Medical Physics, Biomedical Engineering. Springer, New York, NY, (2019).
https://doi.org/10.1007/978-1-4939-9726-8, (2019).

Publications, *published in peer-reviewed journals*

24. E. Ostrofet, F. S. Papini, D. Dulin
Microscopy-spectroscopy SI : High spatiotemporal resolution data from a custom magnetic tweezers instrument
Data in Brief, 105397, (2020).

23 M. Seifert, P. van Nies, F.S. Papini, J.J. Arnold, M.M. Poranen, C.E. Cameron, M. Depken and D. Dulin
Temperature controlled high-throughput magnetic tweezers show striking difference in activation energies of replicating viral RNA-dependent RNA polymerases.
BioRxiv, https://doi.org/10.1101/2020.01.15.906032, (2020).
Nucleic Acids Research, 48 (10), 5591-5602 (2020)

22. F. S. Papini, M. Seifert and D. Dulin
High-yield fabrication of nucleic acid constructs for single-molecule force and torque spectroscopy experiments.
BioRxiv, https://doi.org/10.1101/661330, (2019).
Nucleic Acids Research, gkz851, https://doi.org/10.1093/nar/gkz851, (2019).

My lab has developed new methods to generate DNA and RNA constructs for single molecule force spectroscopy and provides in this article their detailed protocols.

21. E. Ostrofet, F. S. Papini, D. Dulin
Correction-free force calibration for magnetic tweezers
Scientific Reports, 8,15920, (2018).

My lab has established a straightforward and precise methodology to calibrate the applied force in a magnetic tweezers instrument.

20. D. Dulin*, D.L.V. Bauer, A.M. Malinen, J.J.W. Bakermans, M. Kaller, Z. Morichaud, I. Petushkov, M. Depken, K. Brodolin, A. Kulbachinskiy and A.N. Kapanidis*
Pausing controls branching between productive and non-productive pathways during initial transcription in bacteria
BioRxiv, https://doi.org/10.1101/199307, (2017) **(* : corresponding authors)**.
Nature Communications, 9 (1), 1478 (2018).

I used single-molecule total internal reflection fluorescence microscopy (TIRFM) and fluorescence resonance energy transfer (FRET) to characterise initial transcription kinetics of *Escherichia coli* bacteria RNA polymerase, describing the kinetics of a network of pauses that regulates promoter escape and gene expression level.

19. D. Dulin, J.J. Arnold, T. van Laar, H.-S. Oh, C. Lee, D.A. Harki, M. Depken, C.E. Cameron, and N.H. Dekker
Signatures of Nucleotide Analogue Incorporation by an RNA-Dependent RNA Polymerase Revealed Using High-Throughput Magnetic Tweezers
Cell Reports, 21 (4), 1063, (2017).

I performed the first study of the replication kinetics of the polymerase of a human RNA virus , i.e. poliovirus, at the single-molecule level using high throughput magnetic tweezers. I characterized the mechanism of action of several antiviral nucleotide analogues that target specifically viral replication.

18. O. Bugaud, N. Barbier, H. Chommy, N. Fiszman, A. Le Gall, D. Dulin, M. Saguy, N. Westbrook, K. Perronet and O. Namy
Kinetics of CrPV and HCV IRES-mediated eukaryotic translation using single-molecule fluorescence microscopy
RNA, 23, 1626, (2017).

I initiated during my PhD this study on non canonical eukaryotic translation initiation using a mammalian translation system.

17. F. Kriegel, N. Ermann, R. Forbes, D. Dulin, N. H. Dekker and J. Lipfert
Probing the salt dependence of the torsional stiffness of DNA by multiplexed magnetic torque tweezers
Nucl. Acids Res., 45 (10), 5920, (2017).
16. N. N. Vtyurina, D. Dulin, M. Docter, A. Meyer, N.H. Dekker and E. A. Abbondanzieri
Hysteresis in DNA compaction by Dps is described by an Ising model
Proc. Natl. Acad. Sci. U.S.A., 113, 4982, (2016).
15. D. Dulin*, T.J. Cui, J. P. Cnossen, M. W. Docter, J. Lipfert and N.H. Dekker*
High Spatiotemporal Resolution Magnetic Tweezers : Calibration and Applications to DNA Dynamics
Biophys. J., 109, 2113, (2015). **(* : corresponding author)**

I described the theoretical and experimental requirements to establish a high-resolution magnetic tweezers assay to observe single base pair translocation, i.e. 0.34 nm. This assay will enable the study of single molecular motors, e.g. polymerase or helicase, at high resolution.

14. D. Dulin, I. D. Vilfan, B. A. Berghuis, M. Poranen, M. Depken and N.H. Dekker
Backtracking behavior in viral RNA-dependent RNA polymerase provides the basis for a second initiation site
Nucl. Acids Res., 43 (21), 10421, (2015).
13. D. Dulin, B. A. Berghuis, M. Depken and N.H. Dekker
Untangling reaction pathways through modern approaches to high-throughput single-molecule force-spectroscopy experiments
Curr. Op. Struct. Biol., 34, 116, (2015).
12. B.A. Berghuis, D. Dulin, Z.-Q. Xu, T. van Laar, B. Cross, R. Janissen, S. Jergic, N. Dixon, M. Depken and N.H. Dekker
Strand separation suffices to establish a long-lived, foolproof DNA-protein lock at the Tus-Ter replication fork barrier
Nature Chem. Biol., 11, 579, (2015).
11. M.M. van Oene, L.E. Dickinson, F. Pedaci, M. Kober, D. Dulin, J. Lipfert, and N.H. Dekker
Biological magnetometry : Torque on superparamagnetic beads in magnetic fields
Phys. Rev. Lett., 114, 218301, (2015).
10. D. Dulin, I.D. Vilfan, B.A. Berghuis, S. Hage, D. Bamford, M. Poranen, M. Depken, and N.H. Dekker
Elongation-competent pauses govern the fidelity of a viral RNA-dependent RNA polymerase
Cell Reports, 10, 983, (2015).

I performed the first viral RNA-dependent RNA-polymerase replication study at the single-molecule level, which was the first biological application of the high throughput magnetic tweezers assay I pioneered. I shed light on a new model describing misincorporation by viral polymerase during genome replication.

9. Z. Yu, D. Dulin, J. P. Cnossen, M. Koeber, M. van Oene, O. Ordu, B. A. Berghuis, T. Hensgens, J. Lipfert and N.H. Dekker
A force calibration standard for magnetic tweezers
Rev. Sci. Inst., 85, 123114, (2014).
8. J. P. Cnossen, D. Dulin and N.H. Dekker
An optimized software framework for real-time, high-throughput tracking of spherical beads
Rev. Sci. Inst., 85, 103712, (2014).
7. J. Lipfert, G. M. Skinner, J. M. Keegstra, T. Hensgens, T. Jager, D. Dulin, M. Koeber, Z. Yu, S. P. Donkers, F.-C. Chou, R. Das, and N. H. Dekker
Double-Stranded RNA under Force and Torque : Similarities to and Striking Differences from Double- Stranded DNA
Proc. Natl. Acad. Sci. U.S.A., 111, 15408, (2014).
6. D. Dulin, S. Barland, X. Hachair and F. Pedaci
Efficient illumination for microsecond tracking microscopy
PLoS One, 9, e107335, (2014).
5. R. Janissen, B.A. Berghuis, D. Dulin, M. Wink, T. van Laar and N.H. Dekker
Invincible DNA tethers : covalent DNA anchoring for enhanced temporal and force stability in magnetic tweezers experiments
Nucl. Acids Res., 42, e137, (2014).
4. D. Dulin, J. Lipfert, C. M. Moolman, and N. H. Dekker
Studying genomic processes at the single-molecule level : introducing the tools and applications
Nature Rev. Gen., 14, 9, (2013).
3. A. Le Gall*, D. Dulin*, G. Clavier, R. Meallet-Renault, P. Bouyer, K. Perronet, and N. Westbrook
Improved Photon Yield from a Green Dye with a Reducing and Oxidizing System
Chem. Phys. Chem., 12 (9), 1657, (2011) **(* : equal contribution)**.
2. A. Le Gall, K. Perronet, D. Dulin, A. Villing, P. Bouyer, K. Visscher and N. Westbrook
Simultaneous calibration of optical tweezers spring constant and position detector response
Opt. Exp.,18 (25), 26469, (2010).

Peer-reviewed proceedings

1. D. Dulin, A. Le Gall, K. Perronet, N. Soler, D. Fourmy, S. Yoshizawa, P. Bouyer and N. Westbrook
Reduced photobleaching of BODIPY-FL
Proceedings of HBSM 2009, Physics Procedia, 3 (4), 1563, (2010).

Citations statistics

All citations : 787 ; h-index : 17
Source : Google Scholar

Award

Erasmus exchange fellowship, 2003-2004, *University of Bristol, UK*
ATIP-Avenir CNRS-INSERM, 2020, Competitive funding program from CNRS-INSERM to establish an independant lab in France. Short-listed for the interview ; *declined*.

Funding

Start-up package

2016 **FAU Hospital Erlangen-Nuremberg IZKF Junior Group Leader position** 6 years funded position, including 200 k€ equipment, 300 k€ consumables and 1,076 k€ personnel (one research technician, one post doc and one PhD student full time positions for the 6 years.

Third-party funding

2020 **Deutsche Forschungsgemeinschaft (DFG)** Individual Research Grant, 2.5 years funding
Revealing the mechanism of directional transcription termination at the single molecule level for the human mitochondrial transcription complex
276.6 k€, including 2.5 years postdoc salary and consumables. Started in May 2020.

2020 **Deutsche Forschungsgemeinschaft (DFG)** Individual Research Grant, 2.5 years funding
Determinants and dynamics of RNA polymerase I transcription initiation
276.3 k€, including 2.5 years postdoc salary and consumables. Starting in Fall 2020.

Talks at conferences

* indicates based in Erlangen

17*. Journees Francophone de la Virologie (Invited Speaker), *Lyon, France* (2019)
16*. Structure and Dynamics of Biomolecules (Invited Speaker), *Huenfeld, Germany* (2019)
15*. Single Molecule Biophysics, *Aspen, USA* (2019)
14*. GFV2018 Annual Meeting of the Society for Virology, *Wuerzburg, Germany* (2018)
13*. SFB960 Symposium The Biology of RNA-Protein Complexes, *Regensburg, Germany* (2017)
12*. FASEB Mechanism and Regulation of Procaryotic Transcription, *Saxons Rivers, USA* (2017)
11. Gordon Research Conference Viruses and Cells, *Girona, Spain* (2015)
10. Society for General Microbiology Annual Conference, *Birmingham, UK* (2015)
9. Biophysical Society Meeting, *San Francisco, USA* (2014)
8. Chemistry in Relation to Biology and Medical Research, *Veldhoven, The Netherlands* (2013)
7. Biophysical Society Meeting, *Philadelphia, USA* (2013)
6. Annual Dutch meeting on Molecular and Cellular Biophysics, *Veldhoven, The Netherlands* (2012)
5. Congress of the French Physical Society, *Bordeaux, France* (2011)
4. Harden Conference RNAP,*Cambridge, England* (2010)
3. Zurich/Paris young scientist meeting, *Paris, France* (2010)
2. Photonics For Life meeting, *Brussels, Belgium* (2008)
1. Congress of the French Physical Society, *Grenoble, France* (2007)

Posters at conferences

8. Single Molecule Biophysics Alpine, *Les Houches (France)* (2020)
7. GRC single molecule, *Mount Snow Resort West Dover, VT (USA)* (2018)
6. GRC single molecule, *Lucca (Barga), Italy* (2014)
5. Harden conference : Machines on genes II, *Oxford (England)* (2012)
4. GRC single molecule, *Mount Snow Resort West Dover, VT (USA)* (2012)
3. Biophysical Society Meeting, *San Diego (USA)* (2012)
2. Annual Dutch meeting on Molecular and Cellular Biophysics, *Veldhoven, The Netherlands* (2010)
1. Biophysical Society Meeting, *Boston (USA)* (2009)

Invited Seminars

* indicates based in Erlangen

31*. Laboratoire Architecture et Fonction des Macromolecules Biologiques (AFMB), *Marseille (France)* (2019)
30*. Institute for the Biology and Chemistry of Proteins, *Lyon* (France) (2019)
29*. Structural Biology and Biophysics Seminar, Basel Biozentrum, *Basel* (Switzerland) (2019)
28*. Muenchner Physik Kolloquium, Ludwig Maximilians University, *Munich (Germany)* (2019)
27*. Physikalisches Kolloquium, FAU Erlangen-Nuremberg, *Erlangen (Germany)* (2018)
26*. Bayern Biophotonics, Max Planck Institute Physics of Light, *Erlangen (Germany)* (2017)
25*. GRK1962, FAU Erlangen-Nuremberg, *Erlangen (Germany)* (2017)

24*. Department of Virology, FAU Erlangen-Nuremberg, *Erlangen (Germany)* (2017)
23*. Laboratoire Architecture et Fonction des Macromolecules Biologiques (AFMB), *Marseille (France)* (2017)
22*. Department of Immune Modulation, FAU Erlangen-Nuremberg, *Erlangen (Germany)* (2016)
21. Interdisciplinary Center for Clinical Research (IZKF), FAU Erlangen-Nuremberg, *Erlangen (Germany)* (2015)
20. King's College, *London (UK)* (2015)
19. Centre d'Etudes d'agents Pathogenes et Biotechnologies pour la Sante, *Montpellier (France)* (2015)
18. DIIID Seminar Series, King's College, *London (UK)* (2015)
17. Centre de Biochimie Structurale, *Montpellier (France)* (2015)
16. University of Warwick, *Coventry (UK)* (2015)
15. University of Oxford, *Oxford (UK)* (2014)
14. University of Wollongong, *Wollongong (Australia)* (2013)
13. Centre de Biochimie Structurale, *Montpellier (France)* (2013)
12. Laboratoire Architecture et Fonction des Macromolecules Biologiques (AFMB), *Marseille (France)* (2013)
11. Physics-Biology interface seminar, Laboratoire de Physique Statistique, *Orsay (France)* (2013)
10. Laboratoire de Virologie Moleculaire et Structurale, Gif/Yvette (France) (2012)
9. KNAW Biophysics Meeting, *Amsterdam (The Netherlands)* (2012)
8. Institut Jacques Monod, *University Paris 7, Paris (France)* (2012)
7. Centre de Genetique Moleculaire, *Gif/Yvette (France)* (2012)
6. Laboratoire Charles Fabry of the Institut d'Optique, *Palaiseau (France)* (2010)
5. Centre de Genetique Moleculaire, *Gif/Yvette (France)* (2010)
4. TU Delft, *Delft (The Netherlands)* (2009)
3. Amherst University, *Amherst Massachussets (USA)* (2009)
2. Columbia University, *New-York City (USA)* (2009)
1. Cornell University, *New-York City (USA)* (2009)

Mentorship

Service on PhD examination committees outside of FAU Erlangen-Nuremberg

Jetty van Ginkel, TU Delft (The Netherlands)

Supervision

Interdisciplinary Center for Clinical Research (IZKF), FAU Hospital Erlangen-Nuremberg (Germany)
PhD candidates Eugen Ostrofet, Mona Seifert, Yibulayin Wubulikasimu
Research Assistant Dr. Flavia Stal-Papini, Monika Spermann
Postdoc Dr. Subhas Chandra Bera, Dr. Salina Quack

Department of Physics, University of Oxford (UK)
PhD candidate Rebecca Andrews
Master Students Martin Kaller, Jacob Bakermans

Department of Bionanosciences, TU Delft (The Netherlands)
Postdoctoral fellow Dr. Zhongbo Yu
PhD candidates Natalia Vtyurina, Bojk A. Berghuis, Aartjan te Velthuis
Master Students Tao Ju Cui, Ruadrith Forbes, Jelmer Cnossen, Ivana Cvijovic, Cristina Sfiligoj, Tom Sassen, Matthew Pierotti, Sumit Sachdeva
Bachelor Student Kevin Esajas

Professional Service, Society Membership

Grant Reviewer Agence Nationale pour la Recherche (ANR), European Research Council (ERC)
Peer Reviewer for Nature Communications, Angewandte Chemie International Edition, Nucleic Acids Research, Molecular Cell, Methods, FEBS letter, Journal of Biological Chemistry.
Member of the Deutsche Physikalische Gesellschaft (DPG)

Referees

Prof. Andre Reis
Relationship : former Head of IZKF
Head of the Institute of Human Genetics
Universitaetsklinikum Erlangen
Schwabachanlage 10
91054 Erlangen
Phone : +49-(0)9131-85-22318
Email : *andre.reis@uk-erlangen.de*

Prof. Achillefs Kapanidis
Relationship : Postdoctoral adviser
Clarendon Laboratory, Department of Physics
University of Oxford
Parks Road
OX1 3PU Oxford, UK
Phone : +44-01865-272401
Email : *Achillefs.Kapanidis@physics.ox.ac.uk*

Prof. Craig E. Cameron
Relationship : long-standing collaborator
Jeffrey Houpt Distinguished Investigator and Chair
Department of Microbiology and Immunology
6012 Marsico Hall, CB 7290, 125 Mason Farm Road
School of Medicine
The University of North Carolina
Chapel Hill, NC 27599
Phone : +1-(919) 966-9699
Email : *craig.cameron@med.unc.edu*