

# Curriculum Vitae

## Dr. David Dulin

Assistant Professor

d.dulin@vu.nl

Faculty of Sciences/Division of Physics and Astronomy

Vrije Universiteit Amsterdam

De Boelelaan 1081

1081 HV, Amsterdam, The Netherlands

Webpage : <https://daviddulinlab.com>

Date of birth : 25<sup>th</sup> of February 1982

Group Leader

david.dulin@uk-erlangen.de

IZKF

FAU Erlangen-Nuremberg

IZNF, Cauerstr. 3

91058 Erlangen, Germany

Citizenship : French

## Education

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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

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Since 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*

11/2009-08/2014 **Post-doc** in the lab of Nynke Dekker, *Department of Bionanosciences, TU Delft, The Netherlands*

2006-2009 **Research Assistant** in the lab of Nathalie Westbrook, *Laboratory Charles Fabry of the Institut d'Optique*

## Languages

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

## Teaching activities

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### 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

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### 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<sup>\*</sup>, 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<sup>\*</sup>  
*Pausing controls branching between productive and non-productive pathways during initial transcription in bacteria*  
BioRxiv, <https://doi.org/10.1101/199307>, (2017) (<sup>\*</sup> : 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

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All citations : 858 ; h-index : 18  
Source : Google Scholar

## Award

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**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

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### 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.
- 2021 **VU Amsterdam - Assistant Professor position** 5 years funded position, 400 k€ funding, including for 4 years PhD student salary.

### 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.* Principal investigator.  
276.6 k€, including 2.5 years postdoc salary and consumables. Started in March 2020.
- 2020 **Deutsche Forschungsgemeinschaft (DFG)** Individual Research Grant, 2.5 years funding  
*Determinants and dynamics of RNA polymerase I transcription initiation.* Principal investigator.  
276.3 k€, including 2.5 years postdoc salary and consumables. Starting in April 2021.
- 2020 **Deutsche Forschungsgemeinschaft (DFG)** Individual Research Grant, 2 years funding  
*Revealing the mechanism of nucleotide selection, addition and proofreading of the SARS-coronavirus-1 replication transcription complex at the single molecule level.* Principal investigator.  
221.6 k€, including 2 years postdoc salary and consumables. Starting in July 2021.
- 2021 **National Institute of Health (NIH)** R01, 5 years funding  
*Coronavirus replication.* Co-applicant.  
600 k\$, including 5 years postdoc salary and consumables. Starting in June 2021.

## Talks at conferences

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\* indicates since Principal Investigator

- 19\*. Dutch Annual Virology Symposium (Invited Speaker), *Amsterdam, The Netherlands* (2021)
- 18\*. CSHL COVID/SARS-CoV-2 Rapid Research Report (Invited Speaker), *Cold Spring Harbour, USA* (2020)
- 17\*. Journées 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 Prokaryotic 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

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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

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\* indicates based in Erlangen

- 31\*. Laboratoire Architecture et Fonction des Macromolécules 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 Macromolécules 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 Pathogènes et Biotechnologies pour la Santé, *Montpellier (France)* (2015)
18. DIIIID 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 Macromolécules Biologiques (AFMB), *Marseille (France)* (2013)
11. Physics-Biology interface seminar, Laboratoire de Physique Statistique, *Orsay (France)* (2013)
10. Laboratoire de Virologie Moléculaire 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 Génétique Moléculaire, *Gif/Yvette (France)* (2012)
6. Laboratoire Charles Fabry of the Institut d'Optique, *Palaiseau (France)* (2010)
5. Centre de Génétique Moléculaire, *Gif/Yvette (France)* (2010)
4. TU Delft, *Delft (The Netherlands)* (2009)
3. Amherst University, *Amherst Massachusetts (USA)* (2009)
2. Columbia University, *New-York City (USA)* (2009)
1. Cornell University, *New-York City (USA)* (2009)

## Mentorship

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### Service on PhD examination committees outside of FAU Erlangen-Nuremberg

Jetty van Ginkel, TU Delft (The Netherlands)

### Supervision

*Vrije Universiteit Amsterdam (The Netherlands)*

**PhD candidate** Pim America

*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

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**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)