Jannis Teunissen

Ars longa, vita brevis

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Date of birth: July 8th, 1987

[Edited: January 20, 2024]

Academic experience

2018–now **Researcher**, *Centrum Wiskunde & Informatica (CWI), Amsterdam, the Netherlands*
I work in the Multiscale Dynamics group. My research focuses on the computational study of electric discharges, computational (plasma) physics and the application of machine learning in these contexts.

2016–2019 **Postdoc**, *KU Leuven, Belgium*
I received a three-year Belgian Postdoctoral Fellowship from FWO to work in the group of R. Keppens at the Centre for mathematical Plasma Astrophysics (CmPA).

2011–2015 **PhD**, *Centrum Wiskunde & Informatica (CWI)*
Thesis title: "3D Simulations and Analysis of Pulsed Discharges" *(cum laude)*, supervisor: Ute Ebert.

Education

2009–2011 **Master**, *University of Amsterdam, the Netherlands*
Computational Science *(cum laude)*

2005–2008 **Bachelor**, *University of Amsterdam, the Netherlands*
Physics & Astronomy *(cum laude)*

1999–2005 **Secondary education**, *Barlaeus Gymnasium, Amsterdam, the Netherlands*
Track: Nature & Technology

Other experience

2022–2023 **Member of local organizing committee**, *2023 International Conference on Phenomena in Ionized Gases (ICPIG)*

2022–2023 **Local organizer**, *2023 SIAM International Meshing Roundtable Workshop (IMR)*

2022 **Cluster chair**, *Chaired committee evaluating Open Competition projects (ENW-M) for the Dutch Research Council (NWO)*

2022 **Guest editor**, *Special issue on Verification and Validation in Plasma Sources Science and Technology*

2019–now **Co-organizer of Scientific Meetings**, *Centrum Wiskunde & Informatica*

2018–2019 **Member of the Advisory Board Information Sciences**, *University of Amsterdam*

2017–2018 **Seminar organization**, *KU Leuven, Centre for mathematical Plasma Astrophysics*

2016–2018 **Member of departmental council**, *KU Leuven, Department of Mathematics*

2015–2016 **Member of works council**, *Centrum Wiskunde & Informatica*

Grants & Projects

Acronyms: **NWO** *Dutch Research Council;* **H2020** *Horizon 2020*

2023 **REGENERATE**, *Public-private partnership (NWO)*
Co-PI, collaboration with e.g., Eindhoven University of Technology and ASML.

2019 **Plasma for Plants**, *Open Technology project (NWO)*
Co-PI, project in collaboration with Eindhoven University of Technology.

2019 **ESCAPE**, *H2020 (grant 824064)*
Co-PI (took over from E. Camporeale)

2018 **AIDA**, *H2020 (grant 776262)*
Work package leader (took over from E. Camporeale)

2018 **Opening Project**, *SKLEIPE, Xi'an Jiaotong University, China*
Project to support travel and collaboration with A. Sun

2016 **Personal Fellowship**, *Research Foundation – Flanders (FWO), Belgium*
Three-year postdoctoral fellowship

Honors & Awards

2023 IUPAP Early Career Scientist Prize, Commission on Plasma Physics (C16). IUPAP is the International Union of Pure and Applied Physics.

2015 Student Award of Excellence at the joint meeting of 68th Gaseous Electronics Conference (GEC), 9th Int. Conf. on Reactive Plasmas (ICRP), and 33th Symposium on Plasma Processing, Honolulu, Hawaii, USA.

Selection of simulation software

Afivo (author) Generic simulation framework with quadtree/octree adaptive mesh refinement, shared-memory parallelization and built-in geometric multigrid routines.
`https://github.com/MD-CWI/afivo`.

Afivo-streamer (author) Simulation models for streamer discharges in 2D, 3D and cylindrical coordinates, based on Afivo.
`https://github.com/MD-CWI/afivo-streamer`.

Afivo-PIC (author) Updated version of the 3D particle-in-cell code for (streamer) discharge simulations described in [35].
`https://github.com/MD-CWI/afivo-pic`

Particle swarm (author) A Monte Carlo tool to simulate electron swarms in arbitrary electric and magnetic fields, and record their transport properties. Such a Boltzmann solver provides the link between fluid and particle models.
`https://github.com/MD-CWI/particle_swarm`.

MPI-AMRVAC (one of the main developers 2016-2019) I started a large modernization in 2016 and added new features such as an elliptic solver, use of modern Fortran, automated tests and a website
`http://amrvac.org`.

Octree-mg (author) An MPI-parallel geometric multigrid solver that can be coupled to adaptive mesh refinement frameworks to solve elliptic equations.
`https://github.com/jannisteunissen/octree-mg`.

Invited conference talks

2019 *A computational study of positive streamer branching in air*, XXXIV ICPIG & ICRP-10, Sapporo, Japan

2018 *Investigating how streamers interact with dielectrics with 1D PIC & fluid simulations*, 2018 Asia-Pacific Conference on Plasma and Terahertz Science, Xi'an, China

2017 *Modeling streamer discharges in strong magnetic fields: from particle to fluid*, 70th Gaseous Electronics Conference, Pittsburgh (PA), United States

2017 *Modeling streamer discharges in strong magnetic fields*, DPG Spring Meeting, Bremen, Germany

2016 *Simulating fast pulsed discharges: The basics, the present and the future*, 19th WELTPP (EU-regional workshop), Kerkrade, The Netherlands

2015 *3D Models for nanosecond pulsed discharges: with new codes to quantitative understanding*, XXXII ICPIG, Iași, Romania

2015 *Streamer simulations in 3D with adaptive grids*, Meeting of ESF network TEA-IS, Vienna, Austria

PhD supervision and committee member

Starred PhD defense dates are upcoming; underlined names indicate I am/was the daily supervisor

2024* Hemaditya Malla (co-promotor), Eindhoven University of Technology, the Netherlands

2023 Baohong Guo (co-promotor), Eindhoven University of Technology, the Netherlands

2023 Zhen Wang (co-promotor), Eindhoven University of Technology, the Netherlands

2023 Dennis Bouwman (co-promotor), Eindhoven University of Technology, the Netherlands

2023 Xiaoran Li (co-promotor), Eindhoven University of Technology, the Netherlands

2023 Hani Francisco (co-promotor), Eindhoven University of Technology, the Netherlands

2022 Brecht Laperre, KU Leuven, Belgium

2022 Andy Martinez (co-promotor), Eindhoven University of Technology, the Netherlands

2021 Alejandro Malagon, University of Granada, Spain

2021 Shahriar Mirpour (co-promotor), Eindhoven University of Technology, the Netherlands

Postdoc supervision

2022–now Alejandro Malagon, on personal Ramón Areces fellowship from Spain

2019–2021 Andong Hu, hired on H2020 project AIDA

2020–2022 Ajay Tiwari, hired on H2020 project ESCAPE

Journal publications (underline indicates supervision)

[1] Guo, Baohong, Ute Ebert, and **Teunissen, Jannis**. 3D particle-in-cell simulations of negative and positive streamers in C_4F_7N-CO_2 mixtures. *Plasma Sources Science and Technology*, October 2023.

[2] Guo, Baohong, Ute Ebert, and **Teunissen, Jannis**. 3D modeling of positive streamers in air with inhomogeneous density. *Plasma Sources Science and Technology*, 32(9):095015, September 2023.

[3] Malla, H, A Martinez, U Ebert, and **Teunissen, J**. Double-pulse streamer simulations for varying interpulse times in air. *Plasma Sources Science and Technology*, 32(9):095006, September 2023.

[4] Wang, Zhen, Siebe Dijcks, Yihao Guo, Martijn Van Der Leegte, Anbang Sun, Ute Ebert, Sander Nijdam, and **Teunissen, Jannis**. Quantitative modeling of streamer discharge branching in air. *Plasma Sources Science and Technology*, 32(8):085007, August 2023.

[5] **Teunissen, Jannis** and Schiavello, Francesca. Geometric multigrid method for solving Pois-

son's equation on octree grids with irregular boundaries. *Computer Physics Communications*, 286:108665, May 2023.

[6] Guo, Baohong and **Teunissen, Jannis**. A computational study on the energy efficiency of species production by single-pulse streamers in air. *Plasma Sources Science and Technology*, 32(2):025001, February 2023.

[7] Guo, Baohong, Xiaoran Li, Ute Ebert, and **Teunissen, Jannis**. A computational study of accelerating, steady and fading negative streamers in ambient air. *Plasma Sources Science and Technology*, 31(9):095011, September 2022.

[8] Li, Xiaoran, Baohong Guo, Anbang Sun, Ute Ebert, and **Teunissen, Jannis**. A computational study of steady and stagnating positive streamers in N2–O2 mixtures. *Plasma Sources Sci. Technol.*, page 15, 2022.

[9] Dennis Derek Bouwman, **Teunissen, Jannis**, and Ute Ebert. 3D particle simulations of positive air-methane streamers for combustion. *Plasma Sources Sci. Technol.*, April 2022.

[10] Gianluca Napoletano, Raffaello Foldes, Enrico Camporeale, Giancarlo Gasperis, Luca Giovannelli, Evangelos Paouris, Ermanno Pietropaolo, **Teunissen, Jannis**, Ajay Kumar Tiwari, and Dario Moro. Parameter Distributions for the Drag-Based Modeling of CME Propagation. *Space Weather*, January 2022.

[11] Wang, Zhen, Anbang Sun, and **Teunissen, Jannis**. A comparison of particle and fluid models for positive streamer discharges in air. *Plasma Sources Sci. Technol.*, 31(1):015012, January 2022.

[12] N. Moens, J. O. Sundqvist, I. El Mellah, L. Poniatowski, **Teunissen, J.**, and R. Keppens. Radiation-hydrodynamics with MPI-AMRVAC: Flux-limited diffusion. *A&A*, 657:A81, January 2022.

[13] Hani Francisco, **Teunissen, Jannis**, Behnaz Bagheri, and Ute Ebert. Simulations of positive streamers in air in different electric fields: Steady motion of solitary streamer heads and the stability field. *Plasma Sources Sci. Technol.*, 30(11):115007, November 2021.

[14] Li, Xiaoran, Siebe Dijcks, Sander Nijdam, Anbang Sun, Ute Ebert, and **Teunissen, Jannis**. Comparing simulations and experiments of positive streamers in air: Steps toward model validation. *Plasma Sources Sci. Technol.*, 30(9):095002, September 2021.

[15] Rony Keppens, **Teunissen, Jannis**, Chun Xia, and Oliver Porth. MPI-AMRVAC: A parallel, grid-adaptive PDE toolkit. *Computers & Mathematics with Applications*, 81:316–333, January 2021.

[16] Behnaz Bagheri, **Teunissen, Jannis**, and Ute Ebert. Simulation of positive streamers in CO_2 and in air: The role of photoionization or other electron sources. *Plasma Sources Sci. Technol.*, 29(12):125021, December 2020.

[17] Sander Nijdam, **Teunissen, Jannis**, and Ute Ebert. The physics of streamer discharge phenomena. *Plasma Sources Sci. Technol.*, 29(10):103001, November 2020.

[18] S Mirpour, A Martinez, **Teunissen, J**, U Ebert, and S Nijdam. Distribution of inception times in repetitive pulsed discharges in synthetic air. *Plasma Sources Sci. Technol.*, 29(11):115010, November 2020.

[19] **Teunissen, Jannis**. Reply to comment on 'Improvements for drift-diffusion plasma fluid models with explicit time integration'. *Plasma Sources Sci. Technol.*, 29(9):098001, September 2020.

[20] Hu, A., M. Sisti, F. Finelli, F. Califano, J. Dargent, M. Faganello, E. Camporeale, and **Teunissen, J.** Identifying Magnetic Reconnection in 2D Hybrid Vlasov Maxwell Simulations with Convolutional Neural Networks. *ApJ*, 900(1):86, September 2020.

[21] Li, Xiaoran, Anbang Sun, and **Teunissen, Jannis**. A computational study of negative surface discharges: Characteristics of surface streamers and surface charges. *IEEE Trans. Dielect. Electr. Insul.*, 27(4):1178–1186, August 2020.

[22] Li, Xiaoran, Anbang Sun, Guanjun Zhang, and **Teunissen, Jannis**. A computational study of positive streamers interacting with dielectrics. *Plasma Sources Sci. Technol.*, 29(6):065004, June 2020.

[23] **Teunissen, Jannis**. Improvements for drift-diffusion plasma fluid models with explicit time integration. *Plasma Sources Sci. Technol.*, 29(1):015010, January 2020.

[24] A. Malagón-Romero, **Teunissen, J.**, H. C. Stenbaek-Nielsen, M. G. McHarg, U. Ebert, and A. Luque. On the Emergence Mechanism of Carrot Sprites. *Geophys. Res. Lett.*, 47(1), January 2020.

[25] **Teunissen, J.** and R. Keppens. A geometric multigrid library for quadtree/octree AMR grids coupled to MPI-AMRVAC. *Computer Physics Communications*, 245:106866, December 2019.

[26] B. Ripperda, F. Bacchini, O. Porth, E. R. Most, H. Olivares, A. Nathanail, L. Rezzolla, **Teunissen, J.**, and R. Keppens. General-relativistic Resistive Magnetohydrodynamics with Robust Primitive-variable Recovery for Accretion Disk Simulations. *ApJS*, 244(1):10, September 2019.

[27] B Bagheri and **Teunissen, J**. The effect of the stochasticity of photoionization on 3D streamer simulations. *Plasma Sources Sci. Technol.*, 28(4):045013, April 2019.

[28] **Teunissen, Jannis** and Ute Ebert. Afivo: A framework for quadtree/octree AMR with shared-memory parallelization and geometric multigrid methods. *Computer Physics Communications*, 233:156–166, December 2018.

[29] Nadine E. Mascini, **Teunissen, Jannis**, Rob Noorlag, Stefan M. Willems, and Ron M.A. Heeren. Tumor classification with MALDI-MSI data of tissue microarrays: A case study. *Methods*, 151:21–27, December 2018.

[30] B Bagheri, **Teunissen, J**, U Ebert, M M Becker, S Chen, O Ducasse, O Eichwald, D Loffhagen, A Luque, D Mihailova, J M Plewa, J van Dijk, and M Yousfi. Comparison of six simulation codes for positive streamers in air. *Plasma Sources Sci. Technol.*, 27(9):095002, September 2018.

[31] B. Ripperda, F. Bacchini, **Teunissen, J.**, C. Xia, O. Porth, L. Sironi, G. Lapenta, and R. Keppens. A Comprehensive Comparison of Relativistic Particle Integrators. *ApJS*, 235(1):21, March 2018.

[32] C. Xia, **Teunissen, J.**, I. El Mellah, E. Chané, and R. Keppens. MPI-AMRVAC 2.0 for Solar and Astrophysical Applications. *The Astrophysical Journal Supplement Series*, 234(2):30, February 2018.

[33] Marc van der Schans, Patrick Böhm, **Teunissen, Jannis**, Sander Nijdam, Wilbert IJzerman, and Uwe Czarnetzki. Electric field measurements on plasma bullets in N $_2$ using four-wave mixing. *Plasma Sources Sci. Technol.*, 26(11):115006, October 2017.

[34] **Teunissen, Jannis** and Ute Ebert. Simulating streamer discharges in 3D with the parallel adaptive Afivo framework. *Journal of Physics D: Applied Physics*, 50(47):474001, October 2017.

[35] **Teunissen, Jannis** and Ute Ebert. 3D PIC-MCC simulations of discharge inception around a sharp anode in nitrogen/oxygen mixtures. *Plasma Sources Science and Technology*, 25(4):044005, June 2016.

[36] S Nijdam, **Teunissen, J**, E Takahashi, and U Ebert. The role of free electrons in the guiding of positive streamers. *Plasma Sources Science and Technology*, 25(4):044001, May 2016.

[37] Aram H Markosyan, **Teunissen, Jannis**, Saša Dujko, and Ute Ebert. Comparing plasma fluid models of different order for 1D streamer ionization fronts. *Plasma Sources Science and Technology*, 24(6):065002, October 2015.

[38] Anbang Sun, **Teunissen, Jannis**, and Ute Ebert. The inception of pulsed discharges in air: Simulations in background fields above and below breakdown. *J. Phys. D: Appl. Phys.*, 47(44):445205, October 2014.

[39] Anbang Sun, **Teunissen, Jannis**, and Ute Ebert. 3-D Particle Modeling of Positive Streamer Inception From a Needle Electrode in Supercritical Nitrogen. *IEEE Transactions on Plasma Science*, 42(10):2416–2417, October 2014.

[40] S Nijdam, E Takahashi, **Teunissen, J**, and U Ebert. Streamer discharges can move perpendicularly to the electric field. *New Journal of Physics*, 16(10):103038, October 2014.

[41] Anna Dubinova, **Teunissen, Jannis**, and Ute Ebert. Propagation of a Positive Streamer Toward a Dielectric Tip in Pure Nitrogen and in Air Under Voltage Pulses With Subnanosecond Rise Time. *IEEE Trans. Plasma Sci.*, 42(10):2392–2393, October 2014.

[42] **Teunissen, Jannis**, Anbang Sun, and Ute Ebert. A time scale for electrical screening in pulsed gas discharges. *Journal of Physics D: Applied Physics*, 47(36):365203, September 2014.

[43] **Teunissen, Jannis** and Ute Ebert. Controlling the weights of simulation particles: Adaptive particle management using k-d trees. *Journal of Computational Physics*, 259:318–330, February 2014.

[44] A. B. Sun, **Teunissen, J.**, and U. Ebert. Why isolated streamer discharges hardly exist above the breakdown field in atmospheric air. *Geophys. Res. Lett.*, 40(10):2417–2422, May 2013.

[45] Chao Li, **Teunissen, Jannis**, Margreet Nool, Willem Hundsdorfer, and Ute Ebert. A comparison of 3D particle, fluid and hybrid simulations for negative streamers. *Plasma Sources Science and Technology*, 21(5):055019, September 2012.