Jannis Teunissen

Ars longa, vita brevis

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Date of birth: July 8th, 1987

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Academic experience

2018–present **Tenure track**, *Centrum Wiskunde & Informatica (CWI)*, Multiscale Dynamics group.
My research now focuses on two topics: computational plasma physics (mostly applied to electric discharges) and machine learning (mostly applied to space weather phenomena).

2016–2019 **Postdoc**, *KU Leuven*, Centre for mathematical Plasma Astrophysics.
Received three-year FWO Postdoctoral Fellowship, worked with R. Keppens.

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

Education

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

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

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

Other experience

2019–now **Co-organizer of the 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

2019 **Plasma for Plants**, *OTP project (TTW/NWO)*.
Co-PI, project in collaboration with TU/e.

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

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

2018 **Opening Project**, *SKLEIPE, Xi'an Jiaotong University, China*.
Collaboration with A. Sun

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

Honors & Awards

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://gitlab.com/MD-CWI-NL/afivo`.

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

Afivo-PIC (author) Updated version of the 3D particle-in-cell code for (streamer) discharge simulations described in [27].
`https://gitlab.com/MD-CWI-NL/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://gitlab.com/MD-CWI-NL/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

Journal publications

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

[2] Gianluca Napoletano, Raffaello Foldes, Enrico Camporeale, Giancarlo Gasperis, Luca Giovan-

nelli, Evangelos Paouris, Ermanno Pietropaolo, Jannis Teunissen, Ajay Kumar Tiwari, and Dario Moro. Parameter Distributions for the Drag-Based Modeling of CME Propagation. *Space Weather*, January 2022.

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

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

[5] Hani Francisco, Jannis Teunissen, 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 Science and Technology*, 30(11):115007, November 2021.

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

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

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

[9] Shahriar Mirpour, Andy Martinez, Jannis Teunissen, Ute Ebert, and Sander Nijdam. Distribution of inception times in repetitive pulsed discharges in synthetic air. *Plasma Sources Science and Technology*, September 2020.

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

[11] Xiaoran Li, Anbang Sun, and Jannis Teunissen. A computational study of negative surface discharges: Characteristics of surface streamers and surface charges. *IEEE Transactions on Dielectrics and Electrical Insulation*, 27(4):1178–1186, August 2020.

[12] Sander Nijdam, Jannis Teunissen, and Ute Ebert. The physics of streamer discharge phenomena. *Plasma Sources Science and Technology*, July 2020.

[13] Rony Keppens, Jannis Teunissen, Chun Xia, and Oliver Porth. MPI-AMRVAC: A parallel, grid-adaptive PDE toolkit. *Computers & Mathematics with Applications*, Apr 2020.

[14] Xiaoran Li, Anbang Sun, Guan-Jun Zhang, and Jannis Teunissen. A computational study of positive streamers interacting with dielectrics. *Plasma Sources Science and Technology*, May 2020.

[15] Jannis Teunissen. Improvements for drift-diffusion plasma fluid models with explicit time integration. *Plasma Sources Science and Technology*, 29(1):015010, Jan 2020.

[16] A. Malagón-Romero, J. Teunissen, H. C. Stenbaek-Nielsen, M. G. McHarg, U. Ebert, and A. Luque. On the emergence mechanism of carrot sprites. *Geophysical Research Letters*, 47(1), Jan 2020.

[17] J. Teunissen and R. Keppens. A geometric multigrid library for quadtree/octree amr grids coupled to mpi-amrvac. *Computer Physics Communications*, page 106866, Aug 2019.

[18] B. Ripperda, F. Bacchini, O. Porth, E. R. Most, H. Olivares, A. Nathanail, L. Rezzolla, J. Teunissen, and R. Keppens. General-relativistic resistive magnetohydrodynamics with robust primitive-variable recovery for accretion disk simulations. *The Astrophysical Journal Supplement Series*, 244(1):10, Sep 2019.

[19] B Bagheri and J Teunissen. The effect of the stochasticity of photoionization on 3d streamer simulations. *Plasma Sources Science and Technology*, 28(4):045013, Apr 2019.

[20] Behnaz Bagheri, Jannis Teunissen, Ute Ebert, et al. Comparison of six simulation codes for positive streamers in air. *Plasma Sources Science and Technology*, Aug 2018.

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

[22] Nadine E. Mascini, Jannis Teunissen, Rob Noorlag, Stefan M. Willems, and Ron M.A. Heeren. Tumor classification with maldi-msi data of tissue microarrays: A case study. *Methods*, Apr 2018.

[23] B. Ripperda, F. Bacchini, J. Teunissen, C. Xia, O. Porth, L. Sironi, G. Lapenta, and R. Keppens. A comprehensive comparison of relativistic particle integrators. *The Astrophysical Journal Supplement Series*, 235(1):21, Mar 2018.

[24] C. Xia, J. Teunissen, 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, Feb 2018.

[25] Marc van der Schans, Patrick Böhm, Jannis Teunissen, Sander Nijdam, Wilbert IJzerman, and Uwe Czarnetzki. Electric field measurements on plasma bullets in N2 using four-wave mixing. *Plasma Sources Science and Technology*, 26(11):115006 [14 pages], Oct 2017.

[26] Jannis Teunissen and Ute Ebert. Simulating streamer discharges in 3D with the parallel adaptive afivo framework. *Journal of Physics D: Applied Physics*, 50(47):474001 [13 pages], Oct 2017.

[27] Jannis Teunissen 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 [13 pages], Jun 2016.

[28] S Nijdam, J Teunissen, E Takahashi, and U Ebert. The role of free electrons in the guiding of positive streamers. *Plasma Sources Science and Technology*, 25(4):044001 [13 pages], May 2016.

[29] Aram H Markosyan, Jannis Teunissen, 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 [13 pages], Oct 2015.

[30] S Nijdam, E Takahashi, J Teunissen, and U Ebert. Streamer discharges can move perpendicularly to the electric field. *New Journal of Physics*, 16(10):103038 [9 pages], Oct 2014.

[31] Anna Dubinova, Jannis Teunissen, 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 Transactions on Plasma Science*, 42(10):2392–2393, Oct 2014.

[32] Anbang Sun, Jannis Teunissen, and Ute Ebert. 3D particle modeling of positive streamer inception from a needle electrode in supercritical nitrogen. *IEEE Trans. Plasma Sci.*, 42(10):2416–2417, Oct 2014.

[33] Anbang Sun, Jannis Teunissen, 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 [9 pages], Oct 2014.

[34] Jannis Teunissen, Anbang Sun, and Ute Ebert. A time scale for electrical screening in pulsed gas discharges. *J. Phys. D: Appl. Phys.*, 47(36):365203 [7 pages], Aug 2014.

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

[36] A. B. Sun, J. Teunissen, 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.

[37] Chao Li, Jannis Teunissen, Margreet Nool, Willem Hundsdorfer, and Ute Ebert. A comparison of 3D particle, fluid and hybrid simulations for negative streamers. *Plasma Sources Sci. Technol.*, 21(5):055019 [14 pages], Sep 2012.