Jannis Teunissen

Ars longa, vita brevis

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Date of birth: July 8th, 1987

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Career summary

For about 10 years my focus has been on computational science, and in particular on computational physics. Over these years I have built up expertise on numerical methods, (parallel) computer programming, plasma physics, devising approximations, data analysis and data visualization. During my PhD (Centrum Wiskunde & Informatica, Amsterdam) I developed novel models for electric discharges. What attracted me to this topic is that most of the computational methods can be applied to many other phenomena. As a postdoc I moved to the Centre for Mathematical Plasma Astrophysics (KU Leuven) to gain more expertise on computational (magneto-)hydrodynamics and high-performance computing, while also continuing research on electric discharges.

Academic experience

2016–present **Postdoc**, *Centre for mathematical Plasma Astrophysics, KU Leuven*.
Received a three-year FWO Postdoctoral Fellowship to improve our understanding of sprites (discharges high up in the atmosphere). One of the goals is to develop a highly efficient parallel elliptic solver, which will not only enable realistic 3D simulations of sprites but also extend the applicability of the group's magneto-hydrodynamics code.

2015–2016 **Postdoc**, *Centrum Wiskunde & Informatica (CWI)*.
Stayed for four months as a postdoc to write proposals, finish papers and transfer knowledge.

2011–2015 **PhD**, *CWI & Eindhoven University of Technology*.
Title: "3D Simulations and Analysis of Pulsed Discharges" *(cum laude)*, supervisor: Ute Ebert.
I developed Monte Carlo particle simulations as well as continuum models for electric discharges, and worked on the link between them. I also developed a parallel simulation framework that combined adaptive mesh refinement with geometric multigrid.

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

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.

Grants

2016 **Postdoctoral Fellowship**, *Research Foundation – Flanders (FWO)*.
Received a 3-year FWO postdoctoral fellowship to work on "Understanding the formation and 3D structure of sprite discharges"

Teaching

2016 **Teaching assistant**, *KU Leuven*.
Computational methods for Astrophysical applications (Master)

2008–2009 **Student assistant**, *University of Amsterdam*.
Physics Lab Courses 1 & 2 (Bachelor)

Administrative experience

2017–present **Seminar organization**, *Centre for mathematical Plasma Astrophysics*.

2016–present **Works council member**, *Department of Mathematics, KU Leuven*.

2015–2016 **Works council member**, *Centrum Wiskunde & Informatica*.

Selection of simulation software

MPI-AMRVAC (developer) In order to later implement an efficient parallel elliptic solver into this (magneto-)hydrodynamics framework, I have first modernized and modularized the code and introduced automatic tests.
URL: `https://gitlab.com/mpi-amrvac/amrvac`.

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

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

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.
URL: `https://gitlab.com/MD-CWI-NL/particle_swarm`.

Pamdi3D (author) A 3D particle-in-cell code for (streamer) discharge simulations, as described in [1]. URL: `https://github.com/jannisteunissen/pamdi3d`

Invited talks

2017 (Nov.) *Modeling streamer discharges in strong magnetic fields: from particle to fluid*, 70$^{\text{th}}$ 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*, 19$^{\text{th}}$ Workshop on the Exploration of Low-Temperature Plasma Physics (EU-regional workshop), Kerkrade, The Netherlands

2015 *3D Models for nanosecond pulsed discharges: with new codes to quantitative understanding*, XXXII International Conference on Phenomena In Ionized Gases (ICPIG), Iași, Romania

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

Journal publications

[1] 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.

[2] 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.

[3] 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.

[4] 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.

[5] 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.

[6] 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.

[7] 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.

[8] 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.

[9] 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.

[10] 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.

[11] 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.

Submitted

J. Teunissen, U. Ebert. Afivo: a simulation framework with multigrid routines for quadtree and octree grids (submitted to Computer Physics Communications), `https://arxiv.org/abs/1701.04329`

M. van der Schans, P. Böhm, J. Teunissen, S. Nijdam, W. IJzerman, U. Czarnetzki. Electric field measurements on plasma bullets in N2 using four-wave mixing (submitted to Plasma Sources Sci. Technol.)