

Matthias Hoelzl

Staff researcher
MHD and fast particles group
Max Planck Institute for Plasma Physics
Boltzmannstr. 2 · 85748 Garching · Germany
matthias-hoelzl.org · mhoelzl@ipp.mpg.de



Research Interests

The focus of my research is on **large-scale instabilities in tokamak plasmas**. Simulations in particular with the **non-linear MHD code JOREK** aim to interpret and predict fusion plasma experiments. The emphasis lies on **edge localized modes (ELMs)** and their interaction with resonant magnetic perturbation (RMP) fields and pellets as well as **disruptions** including mitigation via massive gas injection (MGI), vertical displacement events (VDEs) and conducting wall effects.

Curriculum Vitae

- Since 01/2015: Principal Investigator of EUROfusion Enabling Research Project *Global non-linear MHD modeling in toroidal geometry of disruptions, edge localized modes, and techniques for their mitigation and suppression*.
- Since 2013: Staff scientist at Max Planck Institute for Plasma Physics.
- 2010 to 2013: Postdoctoral Researcher at Max Planck Institute for Plasma Physics including four months of research visits to CEA/IRFM Cadarache and ITER Organization.
- 01/2010: PhD in physics from Technical University Munich: *Diffusive Heat Transport across Magnetic Islands and Stochastic Layers in Tokamaks*

Project Grants

Full list at matthias-hoelzl.org/projects.html

- Hoelzl M. (PI), Orain F., Strumberger E., Ratnani A., Hindenlang F., Meshcheriakov D., Huijsmans G., Nardon E., Latu G., Sommariva C., Artola Such J., Hu D., van Vugt D., Franck E., Atanasiu C. – *Computing time for non-linear simulations of MHD instabilities and associated code developments*. – **Marconi-Fusion Supercomputer** (08/2017–12/2018).
- Hoelzl M. (PI), Atanasiu C., Bandaru V.K., Strumberger E., Lackner K. – *Implementation and validation of a model for halo-currents in the non-linear MHD code JOREK and demonstration of 3-D VDEs simulations in ITER*. – **ITER Project** (12/2016–11/2018).
- Hoelzl M. (PI), M. Becoulet, Sonnendruecker E., Strumberger E., Pautasso G., Ratnani A., Orain F., Nardon E., Dif-Pradalier G., Latu G., Grandgirard V., Passeron C., Morales J., Nkonga B., Guillard H., Sangam A., Franck E., Pamela S., Cahyna P., Seidl J., Futatani S., Westerhof E. – *Global non-linear MHD modeling in toroidal geometry of disruptions, edge localized modes, and techniques for their mitigation and suppression*. – **EUROfusion Enabling Research Project** (1/2015–12/2018).

Publications

Full list at matthias-hoelzl.org/publications.html

- [Hoelzl M.](#), Huijsmans G.T.A., Orain F., Artola F.J., Pamela S., Becoulet M., van Vugt D., Liu F., Futatani S., Lessig A., Wolfrum E., Mink F., Trier E., Dunne M., Viezzer E., Eich T., Vanovac B., Frassinetti L., Guenter S., Lackner K., Krebs I., ASDEX Upgrade Team, EUROfusion MST1 Team – *Insights into type-I ELMs and ELM control methods from JOREK MHD simulations*. – Contributions to Plasma Physics (2018).
- Mink F., [Hoelzl M.](#), Wolfrum E., Orain F., Dunne M., Lessig A., Pamela S., Manz P., Maraschek M., Huijsmans G.T.A., Becoulet M., Laggner F.M., Cavedon M., Lackner K., Guenter S., Stroth U. – *Nonlinear coupling induced toroidal structure of edge localized modes*. – Nuclear Fusion 58, 026011 (2018).
- Sommariva C., Nardon E., Beyer P., [Hoelzl M.](#), Huysmans G.T.A., van Vugt D., JET Contributors. – *Test particles dynamics in the JOREK 3D non-linear MHD code and application to electron transport in a disruption simulation*. – Nuclear Fusion 58, 016043 (2018). arxiv:1704.08955
- Krebs I., Jardin S.C., Günter S., Lackner K., [Hoelzl M.](#), Strumberger E., Ferraro N. – *Magnetic flux pumping in 3D nonlinear magnetohydrodynamic simulations*. – Physics of Plasmas 24, 102511 (2017). arxiv:1706.06672
- Pamela S., Huijsmans G., Eich T., Saarelma S., Lupelli I., Maggi C., Giroud C., Chapman I., Smith S., Frassinetti L., Becoulet M., [Hoelzl M.](#), Orain F., Futatani S.. – *Recent Progress in the Quantitative Validation of JOREK Simulations of ELMs in JET*. – Nuclear Fusion 57, 076006 (05/2017).
- Nardon E., Fil A., [Hoelzl M.](#), Huijsmans G., JET Contributors. – *Progress in understanding disruptions triggered by massive gas injection via 3D non-linear MHD modelling with JOREK*. – Plasma Physics and Controlled Fusion 59, 014006 (10/2016).
- Orain F., [Hoelzl M.](#), Viezzer E., Dunne M., Willensdorfer M., Suttrop W., Strumberger E., Guenter S., Lessig A., ASDEX Upgrade Team, Becoulet M., Huijsmans G.T.A., Morales J., Kirk A., Pamela S., Cahyna P., EUROfusion MST1 Team. – *Non-linear modeling of the plasma response to RMPs in ASDEX Upgrade*. – Nuclear Fusion 57, 022013 (09/2016). arxiv:1602.07564
- Zakharov L., Atanasiu C., Lackner K., [Hoelzl M.](#), Strumberger E. – *Electromagnetic Thin Wall Model for Simulations of Plasma Wall Touching Kink and Vertical Modes*. – Journal of Plasma Physics 81, 515810610 (12/2015).
- Franck E., [Hoelzl M.](#), Lessig A., Sonnendrücker E. – *Energy conservation and numerical stability for the reduced MHD models of the non-linear JOREK code*. – ESAIM: Mathematical Modelling and Numerical Analysis 49, 1331 (08/2015). arxiv:1408.2099
- Fil A., Nardon E., [Hoelzl M.](#), Huijsmans G.T.A., Orain F., Bécoulet M., Beyer P., Dif-Pradalier G., Guirlet R., Koslowski H.R., Lehnen M., Morales J., Pamela S., Passeron C., Reux C., Saint-Laurent F. and JET contributors. – *Modeling a massive gas injection triggered disruption in JET with the JOREK code*. – Physics of Plasmas 22, 062509 (06/2015).
- [Hoelzl M.](#), Huijsmans G.T.A., Merkel P., Atanasiu C., Lackner K., Nardon E., Aleynikova K., Liu F., Strumberger E., McAdams R., Chapman I., Fil A. – *Non-Linear Simulations of MHD Instabilities in Tokamaks Including Eddy Current Effects and Perspectives for the Extension to Halo Currents*. – Journal of Physics: Conference Series 561, 012011 (12/2014). arxiv:1408.6379
- Krebs I., [Hoelzl M.](#), Lackner K., Günter S. – *Nonlinear excitation of low-n harmonics in reduced MHD simulations of edge-localized modes*. – Physics of Plasmas, 20, 082506 (08/2013). arxiv:1305.3727
- [Hoelzl M.](#), Merkel P., Huysmans G.T.A., Nardon E., McAdams R., Chapman I. – *Coupling the JOREK and STARWALL Codes for Non-linear Resistive-wall Simulations*. – Journal of Physics: Conference Series, 401, 012010 (12/2012). arxiv:1206.2748
- [Hoelzl M.](#), Günter S., Wenninger R.P., Mueller W.-C., Huysmans G.T.A., Lackner K., Krebs I., ASDEX Upgrade Team. – *Reduced-MHD Simulations of Toroidally and Poloidally Localized ELMs*. – Physics of Plasmas, 19, 082505 (08/2012). arxiv:1201.5765
- [Hoelzl M.](#), Günter S., Classen I., Yu Q., the TEXTOR Team, Delabie E. – *Determination of the heat diffusion anisotropy by comparing measured and simulated electron temperature profiles across magnetic islands*. – Nuclear Fusion, 49, 115009 (09/2009).

Conference and Workshop Contributions

Full list at matthias-hoelzl.org/conferences.html

- **Invited Oral** Hoelzl M., G.T.A. Huijsmans, F. Orain, F.J. Artola, S. Pamela, F. Liu, D. van Vugt, S. Futatani, M. Becoulet, A. Cathey, K. Lackner, S. Günter, et al – *Simulating tokamak edge instabilities: advances and challenges*. – 45th European Physical Society Conference on Plasma Physics (EPS), Prague, Czech Republic (7/2018).
- **Invited Oral** Hoelzl M., Huijsmans G.T.A., Orain F., Artola F.J., Liu F., Futatani S., van Vugt D., Wolfrum E., Mink F., Trier E., Dunne M., Vanovac B., Viezzer E., Lessig A., Becoulet M., Pamela S., Guenter S., Lackner K., Krebs I., Wenninger R., Eich T., Frassinetti L., JOREK Team, ASDEX Upgrade Team, EUROfusion MST1 Team. – *What non-linear simulations can teach about ELM physics*. – 16th International Workshop on Plasma Edge Theory in Fusion Devices, Marseille, France, I3 (09/2017).
- **Oral** Orain F., Hoelzl M., Lessig A., Günter S., Viezzer E., Dunne M., Becoulet M., Huijsmans G.T.A., Willensdorfer M., Suttrop W., Pamela S., Lackner K., Schwarz N., ASDEX Upgrade Team, EUROfusion MST1 Team. – *Modeling edge MHD instabilities and their interaction with magnetic perturbations in ASDEX Upgrade*. – 44th European Physical Society Conference on Plasma Physics (EPS), Belfast, Northern Ireland, O4.127 (06/2017).
- **Poster** Sommariva C., Nardon E., Huijsmans G.T.A., Hoelzl M., van Vugt D., Fil A., and JET Contributors. – *Investigating the hot tail runaway electron formation mechanism with test particles in a non-linear MHD disruption simulation*. – 44th European Physical Society Conference on Plasma Physics (EPS), Belfast, Northern Ireland, P1.129 (06/2017).
- **Poster** van Vugt D.C., Huijsmans G.T.A., Hoelzl M., Kamp L.P.J., Lopes Cardoso N.J., Loarte A. – *Kinetic simulations of W impurity transport by ELMs*. – 44th European Physical Society Conference on Plasma Physics (EPS), Belfast, Northern Ireland, P2.140 (06/2017).
- **Poster** Krebs I., Jardin S.C., Günter S., Lackner K., Hoelzl M., Ferraro N. – *A self-sustaining mechanism that prevents tokamak plasmas from sawtoothing in non-linear 3D MHD simulations*. – 58th Annual Meeting of the APS Division of Plasma Physics, San Jose, CA, USA (11/2016).
- **Invited Oral** Nardon E., Fil A., Hoelzl M., Kruezi U., Lehnen M., Nkonga B., Pautasso G., Sommariva C., JET Contributors, ASDEX Upgrade Team. – *Modelling of gas penetration, MHD activity and runaway electrons in disruptions mitigated by massive gas injection*. – 43rd European Physical Society Conference on Plasma Physics, Leuven, Belgium, I4.115 (07/2016) |
- **Poster** Hindenlang F., Hoelzl M., Sonnendrücker E. – *A Parallel 3D Discontinuous Galerkin Framework for Nonlinear Resistive MHD Simulations in Tokamak and Stellarator Geometries*. – 43rd European Physical Society Conference on Plasma Physics, Leuven, Belgium, P1.040 (07/2016).
- **Oral** Fil A., Nardon E., Hoelzl M., Huijsmans G., Orain F., Becoulet M., Beyer P., Guirlet R., Koslowski H.R., Lehnen M., Pamela S., Reux C., Saint-Laurent F., Sommariva C., ASDEX Upgrade Team and JET Contributors. – *Modeling of disruption mitigation by massive gas injection in JET with JOREK and IMAGINE*. – 42nd European Physical Society Conference on Plasma Physics, Lisbon, Portugal, O4.135 (25/06/2015).
- **Poster** Hoelzl M., Huijsmans G.T.A., Merkel P., Atanasiu C., Lackner K., Nardon E., Aleynikova K., Liu F., Strumberger E., McAdams R., Chapman I., Fil A. – *Non-Linear Simulations of MHD Instabilities in Tokamaks Including Eddy Current Effects and Perspectives for the Extension to Halo Currents*. – Theory of Fusion Plasmas (Joint Varenna-Lausanne International Workshop), Varenna, Italy, P-10 (09/2014). arxiv:1408.6379 | Journal of Physics: Conference Series 561, 012011 (2014).
- **Invited Oral** Hoelzl M., Krebs I., Lessig A., Lackner K., Günter S., Merkel P., Wenninger R., Huysmans G., Nardon E., Orain F., ASDEX Upgrade Team. – *Non-linear Simulations of Edge Localized Modes and Resistive Walls*. – 15th European Fusion Theory Conference (EFTC), Oxford, UK (09/2013).

Teaching and Supervision

Full list at matthias-hoelzl.org/teaching.html

- Supervision of various Postdoctoral Researchers, PhD, master and bachelor students, as well as many working students. Substitutions for plasma physics lectures at Technical University Munich.

Commitments

- 2018: Member of EUROfusion Ad Hoc Group on Disruption and Run-away Electron Research & Development Strategy in view of preparing ITER and DEMO operation
- Since 2014: Member of the scientists' representative council of Max Planck Institute for Plasma Physics.
- Since 2013: One of the JOREK main developers, organizer of JOREK remote seminar, administrator of website and collaboration platform for the JOREK Code.
- Since 2012: Ombudsperson for several PhD students.
- Referee for: Springer Nature Publishing, Nuclear Fusion, Physics of Plasmas, Plasma Physics and Controlled Fusion, United States Department of Energy, L'Agence nationale de la recherche, Netherlands Organisation for Scientific Research, etc.