Matthias Hoelzl

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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** (see here) aim to interpret and predict high temperature plasma dynamics. The focus is on studies of **edge localized modes** (ELMs), **disruptions**, vertical displacement events (VDEs), runaway electrons, and respective control techniques.

Curriculum Vitae

- Since 2015: Principal Investigator of two **EUROfusion Enabling Research Projects** with more than 30 project contributors.

- Since 2013: Staff scientist at Max Planck Institute for Plasma Physics.

- 2010 to 2013: Postdoctoral Researcher at Max Planck Institute for Plasma Physics including research stays at CEA/IRFM Cadarache and ITER Organization.

- 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), Huijsmans G.T.A., Atanasiu C.V., Bandaru V.K., Becoulet M., Bhole A., Cathey A., Dvornova A., Franck E., Futatani S., Guillard H., Latu G., Liu F., Nardon E., Nkonga B., Pamela S., Passeron C., Smith S., Strumberger E., van Vugt D. – *Strengthening the non-linear MHD code JOREK for application to key questions of the fusion roadmap.* – **EUROfusion Enabling Research Project** (1/2019–12/2020).

- 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).

Publications

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

- Vanovac B., Wolfrum E., <u>Hoelzl M.</u>, Willensdorfer M., Cavedon M., Harrer G.F., Mink F., Denk S.S., Dunne M., Manz P., Luhmann Jr. N C, and the ASDEX Upgrade Team. – *Characterization of low frequency inter-ELM modes at the pedestal top of H-mode discharge at ASDEX Upgrade* – Nuclear Fusion 58, 112011 (2018)

- Artola F.J., Huijsmans G.T.A., <u>Hoelzl M.</u>, Beyer P., Loarte A., Gribov Y. – *Non-linear magnetohydrodynamic simulations of Edge Localised Modes triggering via vertical oscillations.* – Nuclear Fusion 58, 096018 (2018).

- <u>Hoelzl M.</u>, 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 58, 518 (2018).

- Mink F., <u>Hoelzl M.</u>, 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., <u>Hoelzl M.</u>, 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

- Pamela S., Huijsmans G., Eich T., Saarelma S., Lupelli I., Maggi C., Giroud C., Chapman I., Smith S., Frassineti L., Becoulet M., <u>Hoelzl M.</u>, 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., <u>Hoelzl M.</u>, 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., <u>Hoelzl M.</u>, 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., <u>Hoelzl M.</u>, 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., <u>Hoelzl M.</u>, 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., <u>Hoelzl M.</u>, 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).

- <u>Hoelzl M.</u>, 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., <u>Hoelzl M.</u>, 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

- <u>Hoelzl M.</u>, 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

- <u>Hoelzl M.</u>, 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

- <u>Hoelzl M.</u>, 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. – *Edge localized modes and disruptions – Insights into large-scale plasma instabilities from non-linear MHD simulations.* – Institute Colloquium, Max Planck Institute for Plasma Physics, Garching, Germany (12/2018).

- **Invited Oral**   Orain F., Hoelzl M., Mink F., Willensdorfer M., Dunne M., Viezzer E., Becoulet M., Huijsmans G.T.A., Suttrop W., Pamela S., Günter S., Lackner K., ASDEX Upgrade and EUROfusion MST1 Teams. – *Modeling of the threshold between ELM mitigation and suppression by magnetic perturbations in ASDEX Upgrade.* – 2nd Asia-Pacific Conference on Plasma Physics (AAPPS-DPP 2018), Kanazawa, Japan (10/2018).

- **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, I5.J601 [abstract] (7/2018).

- **Invited Oral**   Artola F.J., Huijsmans G.T.A., Hoelzl M., Beyer P., Loarte A., Gribov Y. – *An in depth look into the physics of ELM triggering via vertical kicks through non-linear MHD simulations.* – 45th European Physical Society Conference on Plasma Physics (EPS), Prague, Czech Republic, I2.109 [abstract] (7/2018). (7/2018).

- **Oral**   Bandaru V., Hoelzl M., Papp G., Aleynikov P., Huijsmans G. – *Implementation of a fluid model for the non-linear interaction between runaway electrons and background plasma.* – 17th European Fusion Theory Conference, Athens, Greece, O.5 (10/2017).

- **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).

- **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).

Teaching and Supervision

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

- Supervison 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

- Since 2018: **Chair of High Performance Computing Committee** and member of IT coordination committee at Max Planck Institute for Plasma Physics

- 2018: **Member of EUROfusion Ad Hoc Group** on *Disruption and Run-away Electron Research & Development Strategy in view of preparing ITER and DEMO operation*

- 2014 to 2018: Member of 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 JOREK website and collaboration platform

- Since 2012: Ombudsperson for several PhD students.

- Referee for: Springer Nature Publishing, Physical Review Letters, Computer Physics Communications, 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. — *Some of the reviews are listed at Publons.*