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# CWGM adjourn 2017



IPP

## Overview CERC experiments / collaborations

Felix Warmer  
For the collaborators

06. October 2017

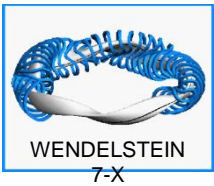
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Max-Planck-Institut  
für Plasmaphysik  
EURATOM Assoziation



EUROfusion



## S. Satake (NIFS), J. L. Velasco (CIEMAT), et al.

- **Gather CERC plasma experiment data in D-discharges of LHD**
  - To expand ISHPDB (International Stellarator/Heliotron Profile Database)
    - (Heliotron-J data recently registered)
- **Benchmark bootstrap current calculation by neoclassical transport codes**
  - FORTEC-3D (global, local) , DKES/PENTA
  - Comparison BSC in e-root and i-root conditions, as well as H vs. D
  - Balanced ECCD, very weak tangential NBI for MSE measurement
  - However, perp. NBI drove negative toroidal current which was comparable to positive bootstrap current. Need to include the NBI driven current for analysis.
  - CERC threshold + (analytic) scaling
- Experiments scheduled for W7X (BSC very important for island divertor operation)



N. Pablant (PPPL), A. Alonso (CIEMAT), M. Yokoyama (NIFS), F. Warmer (IPP),  
H. Takahashi (NIFS), K. Tanaka (NIFS), N. Tamura (NIFS), et al.

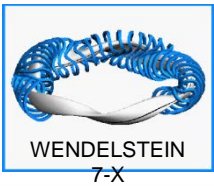
- **CERC features / comparison in LHD and W7X**

- Systematic power and density scans (done in LHD H and D)
- Scheduled for W7X (this / next week)
- Energy confinement, transport, impurity transport, (isotope effect)
- Power Balance
- Radial electric field (XICS, CXRS, HIBP)
- Neoclassical transport simulations

P. Xanthopoulos (IPP), M. Nakata (NIFS), J. Prohl (IPP), Nunami (NIFS), et al.

- **Turbulence understanding**

- Benchmark of GKV and GENE
- Linear and non-linear simulations for TEM dominated regime / isotope
- Dedicated experiment support (!) (also neoclassic experts)
- PCI measurements (K. Tanaka, et al.)
- Theory prediction (NC/turb.) for experimental planning



## A. Dinklage (IPP), W7X Team, et al.

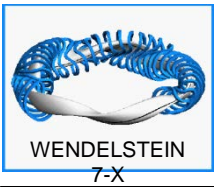
- **Configuration effects**

- Use configuration (coil) flexibility of W7X
- Mirror ratio,  $\epsilon_{\text{eff}}$ , polarity, iota
- Bootstrap current, edge topology
- NC transport  $\leftrightarrow$  anomalous transport (configuration optimization!)
- [Link to NIFS \(?\)](#), configuration dependence  $R_{\text{ax}}=3.6 \rightarrow 3.9\text{m}$  known

## K. Tanaka (NIFS), F. Warmer (IPP), et al.

- **Particle Transport**

- Density modulation experiments
- Carried out for LHD, H and D
- [Scheduled for W7X](#)

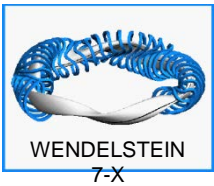


**Minami (Kyoto), Kenmochi (Kyoto), J.L. Velasco (CIEMAT), Kumar (HSX), et al.**

- **CERC in small-medium sized stellarators (H-J, TJII, HSX)**
  - CERC observation in Heliotron J
  - Core island on CERC threshold / formation
  - Discussion CERC  $\leftrightarrow$  eITB
- Join CERC collaborations (!?)

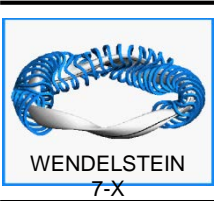
**???**

- **Bifurcation / transition e-root to i-root**
  - Neoclassical simulations / prediction



## Paper reference

- **A. Alonso, et al., “Ion heat transport in low-density W7-X plasmas”**
- **A. Dinklage, et al., “Effects of first magnetic configuration changes on W7-X”**
- **J.L. Valesco, et al., “Large tangential electric fields in plasmas close to temperature screening”**
- **S. Satake, et al., “Benchmark of bootstrap current calculations in multi-ion species helical plasmas”**
- **F. Warmer, et al., “Energy confinement in hydrogen and deuterium electron-root plasmas in the Large Helical Device”**
- **... etc....**
- **...**



## **Summary / Outlook**

- **CERC experiments done in LHD in 19<sup>th</sup> campaign (H and D)**
- **W7X: experiments are scheduled (next weeks)**
- **Data analysis / theory support throughout next year**
  - **Many collaborations ongoing**
- **Well documented experiments for database (including simulations / theory)**
- **Contribution of smaller devices? (e.g. zonal flows in TJII, CERC formation)**