

Simulations of turbulence and profile evolution across the edge and scrape-off layer of the ASDEX Upgrade tokamak

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Conclusions and outlook

- ✓ **Global electromagnetic turbulence simulations** across ASDEX Upgrade edge & SOL show
 1. **Transport** dominated by large scale **interchange** modes
 2. **Zonal flows**, driven by drift waves on Larmor radius scale
 3. $\langle E_r \rangle_t^{\text{CR}} = \left\langle \frac{\partial_r p_i}{en} \right\rangle + \frac{m_e}{e} \langle \mathbf{u} \cdot \nabla \mathbf{u} \rangle \cdot \mathbf{e}_r + \langle u_{\parallel} B_{\theta} \rangle$
 4. $\mathbf{E} \times \mathbf{B}$ **shear** peaks at separatrix, driving both vortex breaking and zonal flows
 5. **Neutral gas** recycling is crucial in setting the profiles
- ✓ Simulations are **validated** against attached L-mode AUG and TCV experiments
- ❖ A lot of work remains **towards predictive, high performance reactor simulations**:
 1. Code scalability / speed-up
 2. Refining the neutral gas and impurity model
 3. Low collisionality and neoclassical corrections to the fluid model
- ❖ Tackled in a European effort: see P6 Posters 6 by Patrick Tamain
- ❖ Gyrokinetic FCI simulations are on their way: Dominik Michels *et al*, accepted by CPC (2021)