



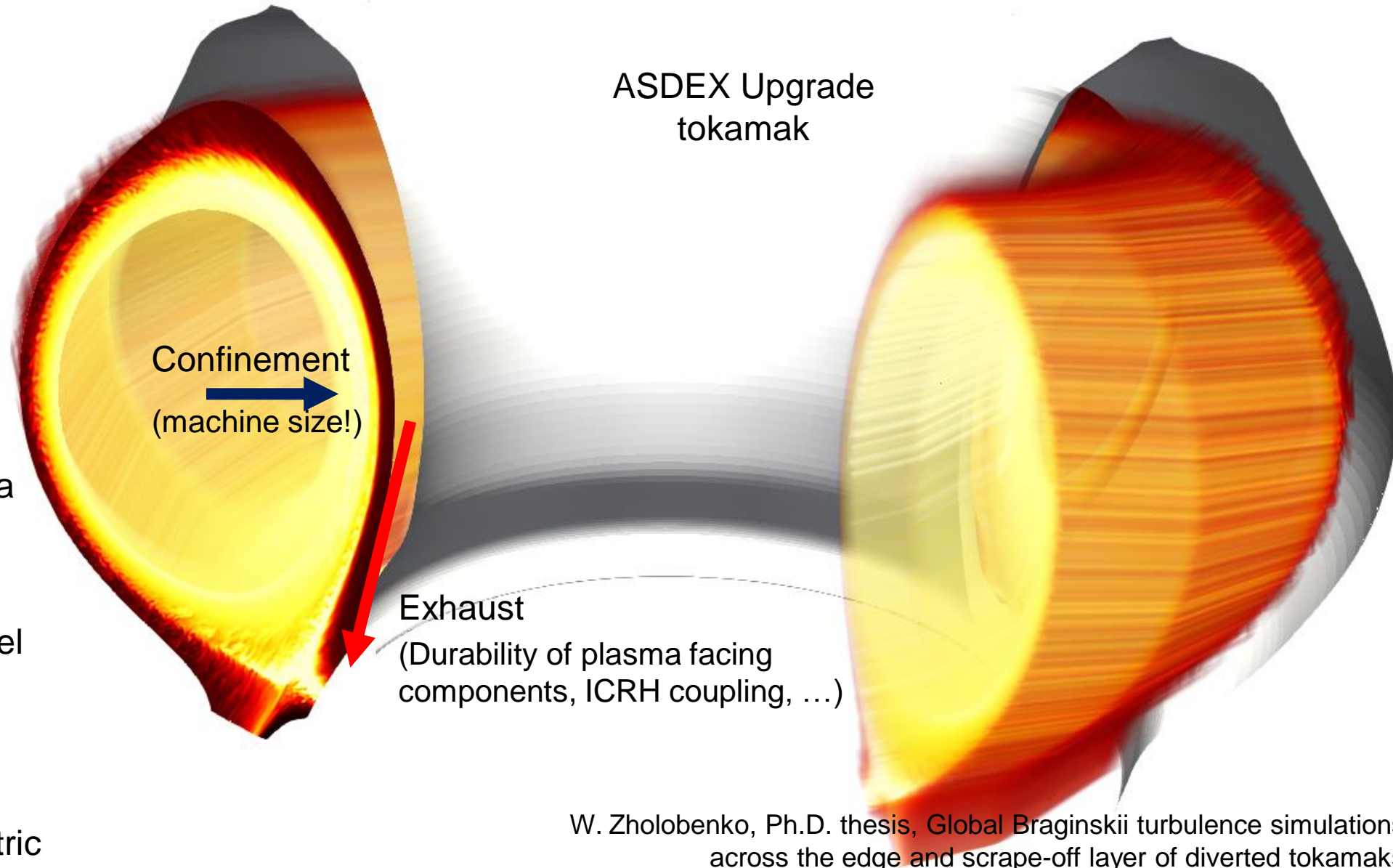
Edge-SOL turbulent transport in ELM-free scenarios with GRILLIX



Dr. Wladimir Zholobenko



Transport in a tokamak is turbulent



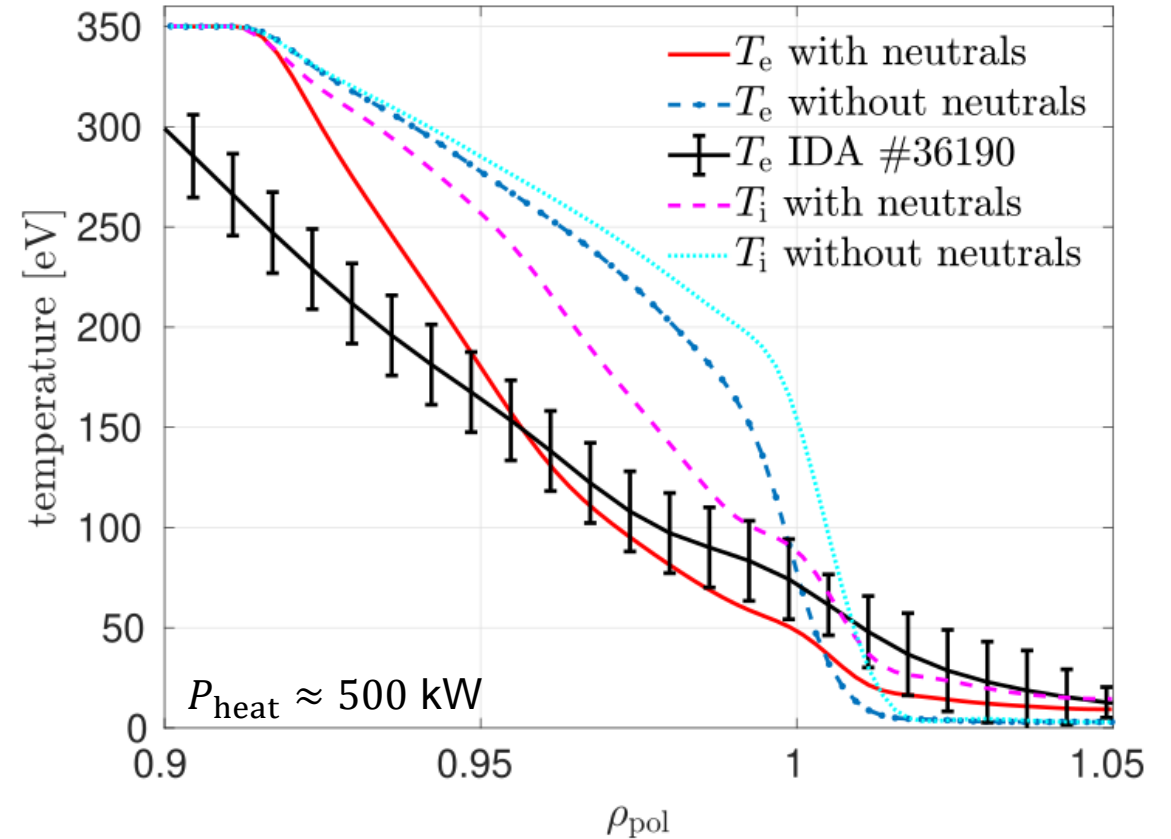
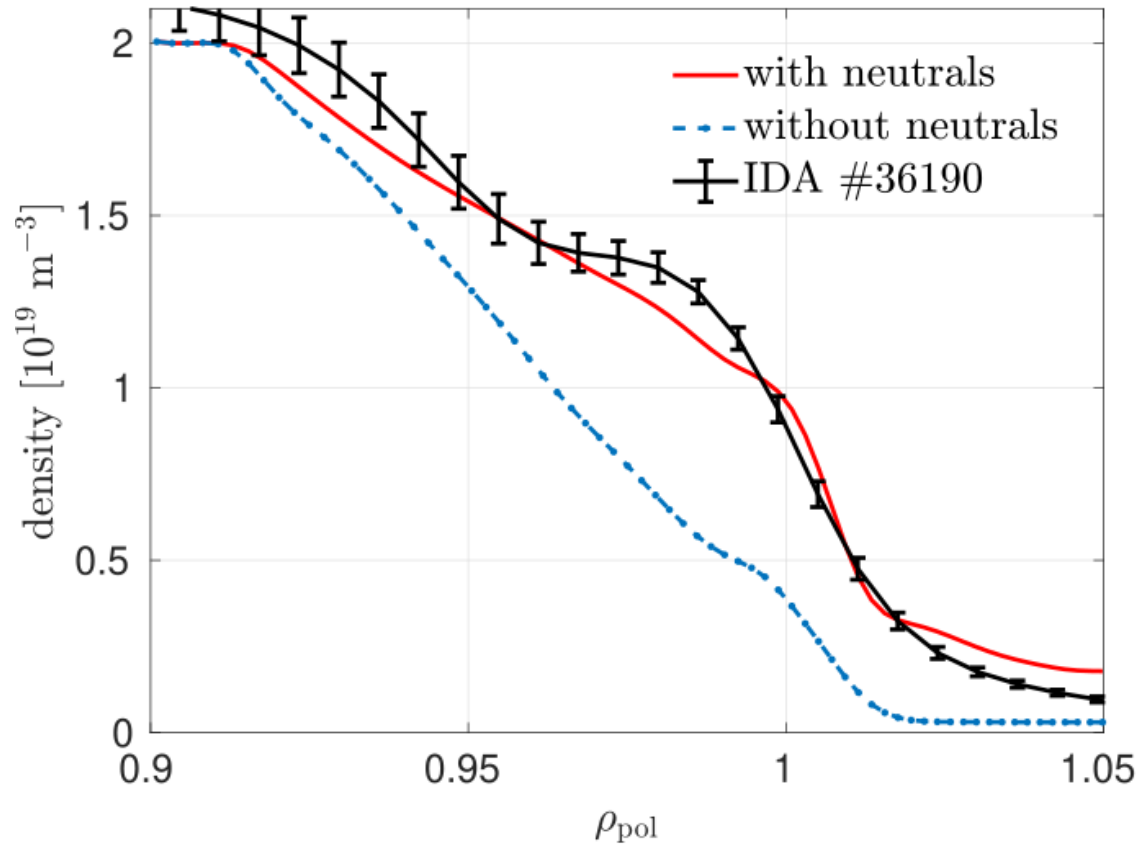
- Global (,full-f') fluid plasma model (extended drift-reduced Braginskii)
- Diffusive neutral gas model
- FCI discretisation: locally field-aligned (sparse toroidally), but does not require B_{pol} for global metric

W. Zholobenko, Ph.D. thesis, Global Braginskii turbulence simulations across the edge and scrape-off layer of diverted tokamaks

Validation vs AUG #36190 attached L-mode

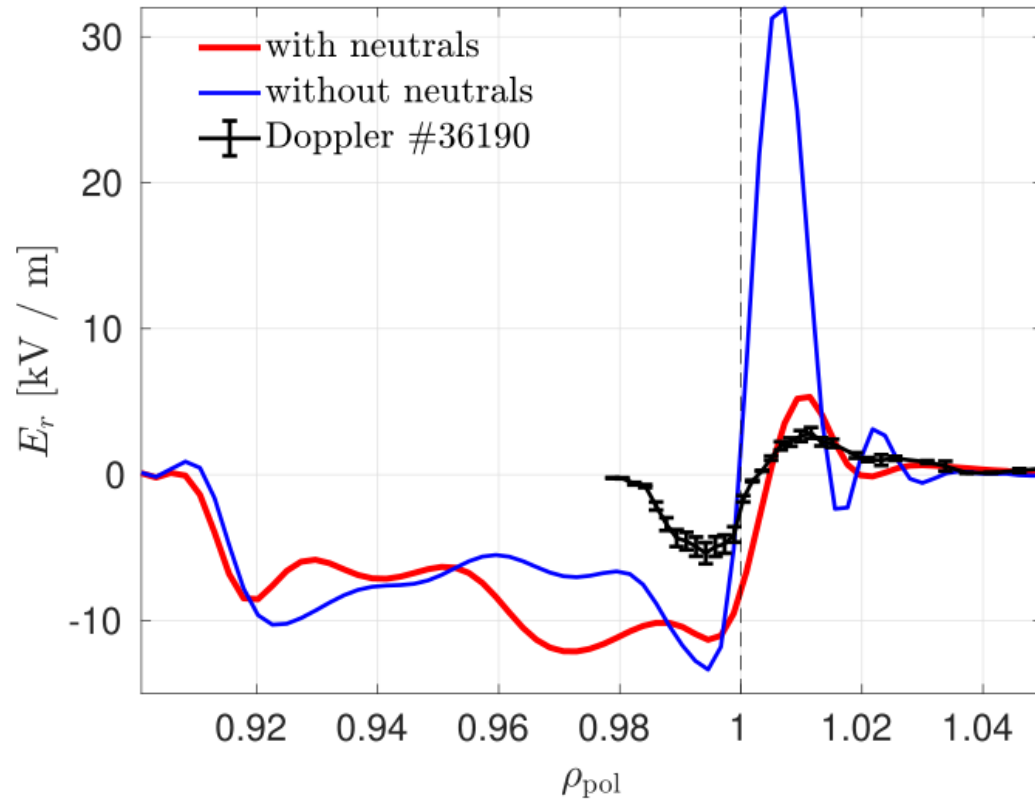


outboard mid-plane profiles



W. Zholobenko et al 2021 Nucl. Fusion 61 116015

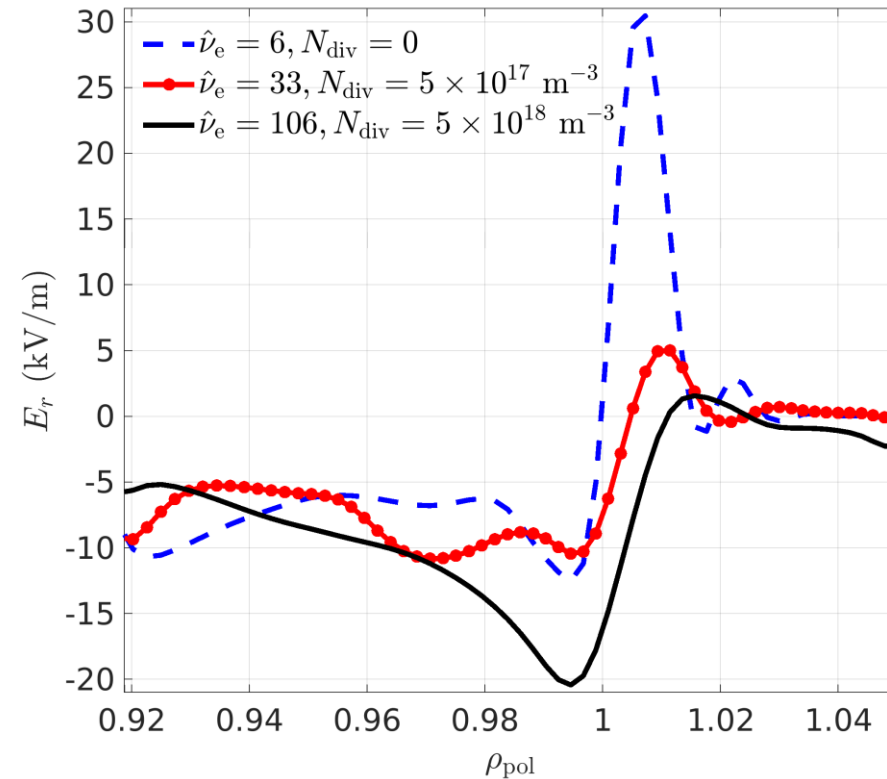
AUG radial electric field validation



- Shape not bad, but too larger by factor ~2
- **SOL:** $e\langle E_r \rangle_t \approx -3\partial_r \langle T_e \rangle_t$
- **CR:** $\langle E_r \rangle_t = \left\langle \frac{\partial_r p_i}{en} \right\rangle + \langle u_{\parallel} B_{\theta} \rangle + \frac{m_i}{e} \langle \mathbf{u} \cdot \nabla \mathbf{u} \rangle \cdot \mathbf{e}_r$

W Zholobenko et al 2021 *Plasma Phys. Control. Fusion* **63** 034001

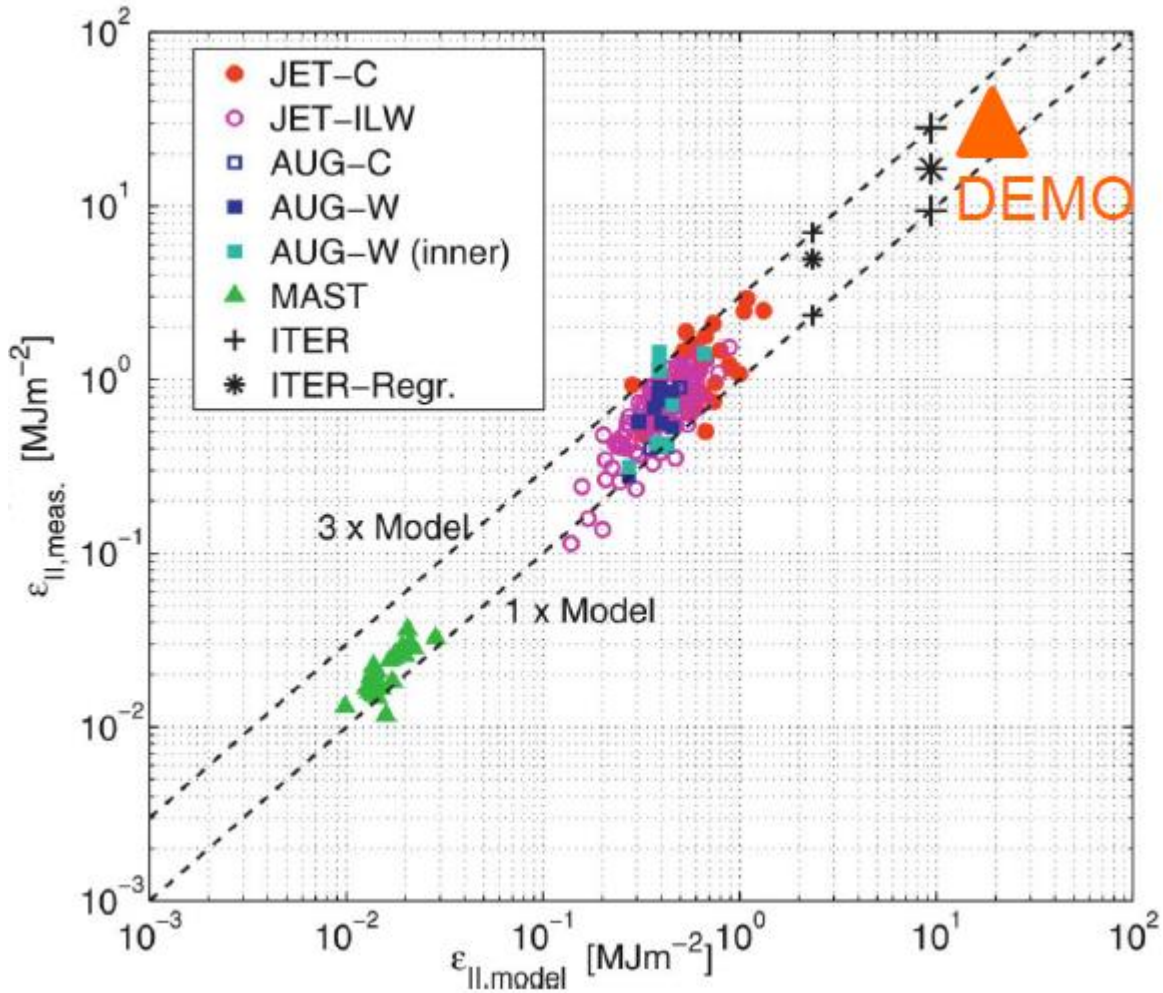
collisionality scan



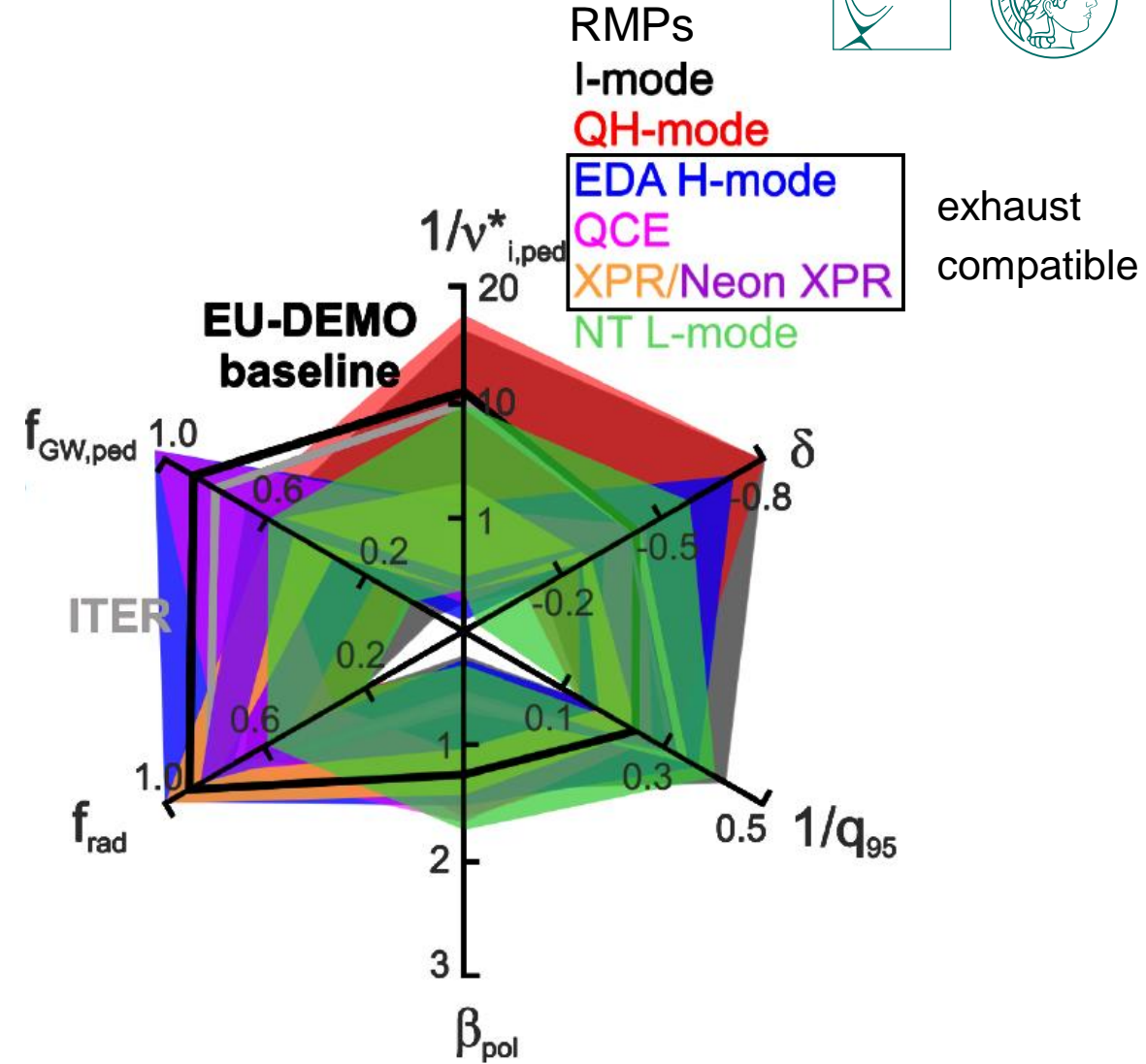
- **Strong dependence on collisionality in edge and SOL**
- **SOL E_r reduces as divertor cools down**
- **near SOL $E_r \times B$ shear remains, but vanishes in far SOL**

W. Zholobenko et al 2022, „Filamentary transport in global edge-SOL simulations of ASDEX Upgrade”, NME 2023

H-modes: ELMs must (and can) be avoided in reactors

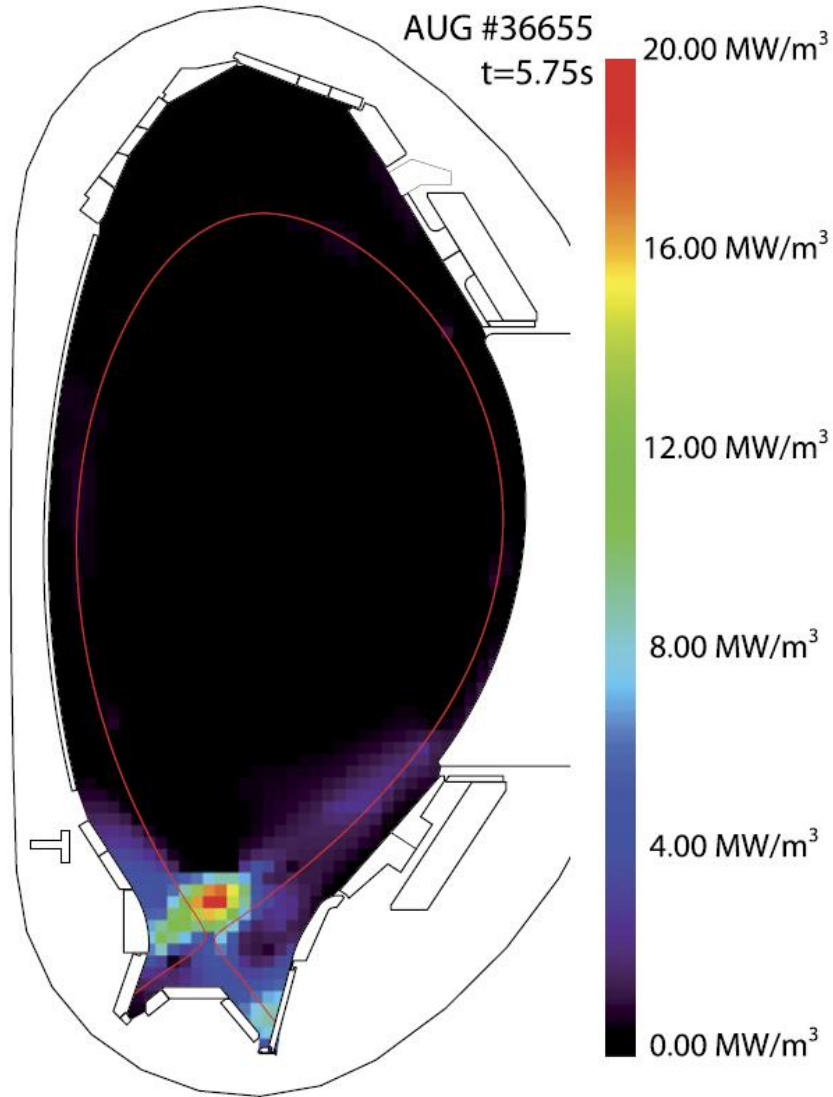


T. Eich *et al* NME 12 84 (2017)



E. Viezzer *et al* NME (2022), submitted

GRILLIX offers high resolution of turbulence across the X-point



GRILLIX simulations of attached L-mode ASDEX Upgrade

The high resolution of turbulence around the X-point is particularly promising for investigating the X-point radiator scenario.

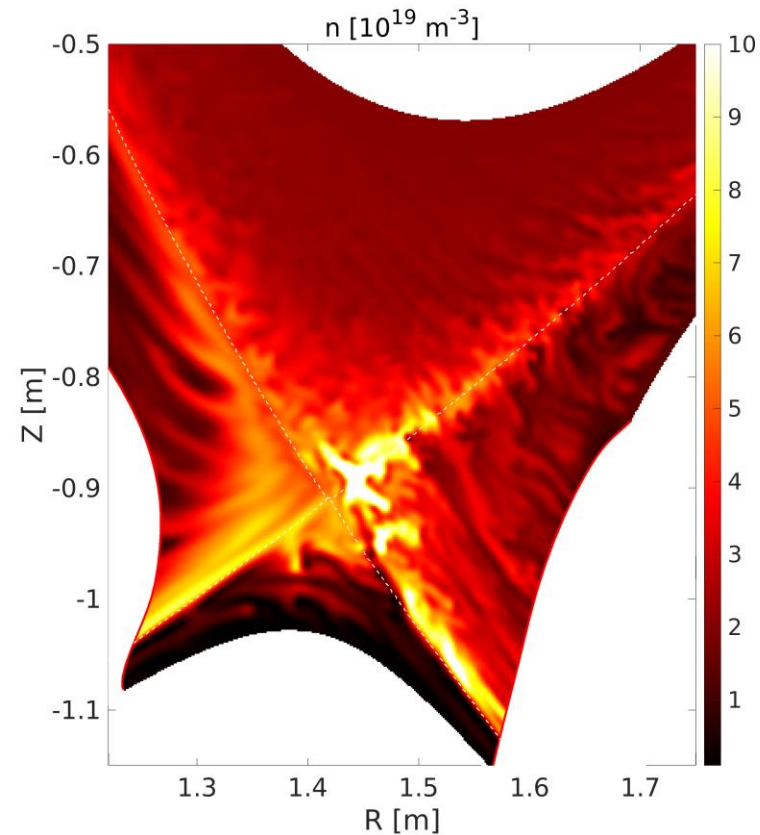


Figure 1. Tomographic reconstruction of the radiated power for AUG #36655, the XPR is present.

M. Bernert *et al* 2021 *Nucl. Fusion* **61** 024001

W. Zholobenko *et al* 2021 *Nucl. Fusion* **61** 116015