Modelling of plasma background plasmas							
Year	Deliverable ID	Deliverable Title	Deliverable Owner	BEN	PM @ 50%	PM @ 70% (if applicable)	PM @ 0% AR (if applicable)
2021	PWIE-SP D.D1.T-T001-D004	Plasma background parameters of W7-X for modelling of impurity migration experiments as well as PSI-2 (FZJ)	Xu, Shuai (s.xu@fz-juelich.de)	FZJ	4		

Modeling Tools: EMC3-EIRENE, HINT

Exploitation Plan:

1. Set-up set of numerical plasma backgrounds of impurity migration experiments on W7-X.
2. Set-up set of predict plasmas backgrounds of OP2 high performance discharges with beta effects being considered in the standard configuration on W7-X
3. Modelling of plasma backgrounds of PSI-II

Input and remarks:

- Reference discharges from OP1
- Multiple SOL/edge diagnostics for Te, ne, Ti, Mach number and the impurity radiation are required for conditioning the numerical plasma background, e.g. Langmuir probes, Thomson scattering, IR camera, 2D coherence imaging spectroscopy, bolometer cameras, …

Current status:

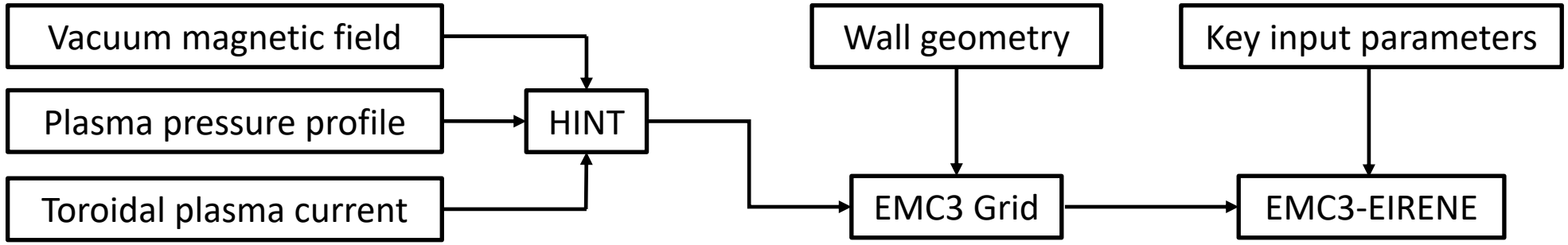
- Set of numerical plasma backgrounds with vacuum magnetic field in low-iota, standard, high-mirror configurations on W7-X
- EMC3-EIRENE simulations with finite beta effects in the standard configuration on W7-X

Motivation:

- W7-X aims to achieve high-performance plasmas with <β> of up to 5%.
- In OP1, <β> ~ 1.2% and β_{axis} ~3.5% have been achieved. In OP2, β_{axis} will be higher.
- Magnetic field distributions are modified by finite beta effects and toroidal plasma currents.

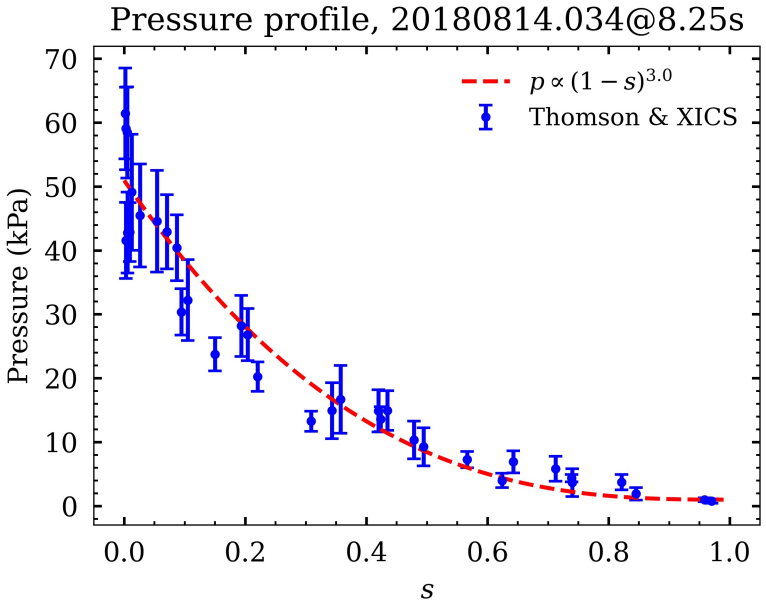
A. Knieps et al., submitted to NF, 2021
Y. Gao et al., NF 59 106015, 2019

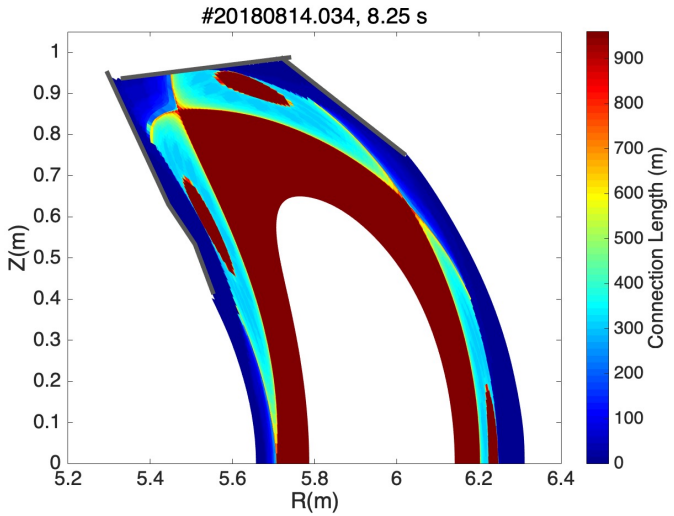
Modeling strategy:

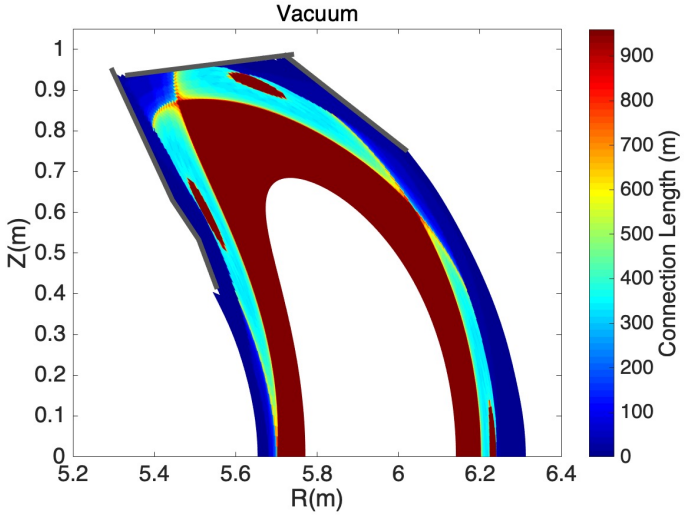


EMC3-EIRENE simulations with finite beta effects in the standard configuration

#20180814.034: β_{axis} ~ 1.9% I_p = 4.662 kA







Plasma pressure profile:

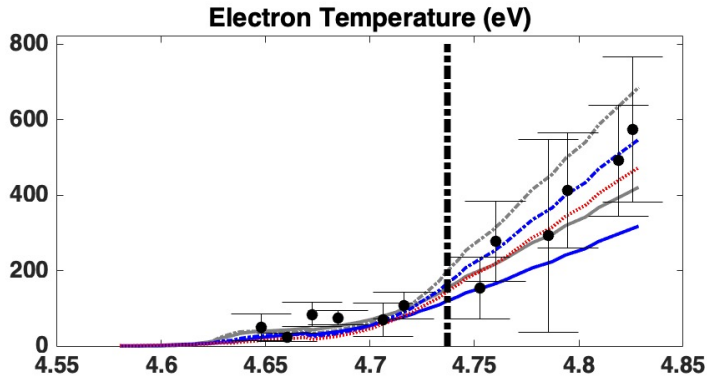
Measurement: Thomson scattering, XICS

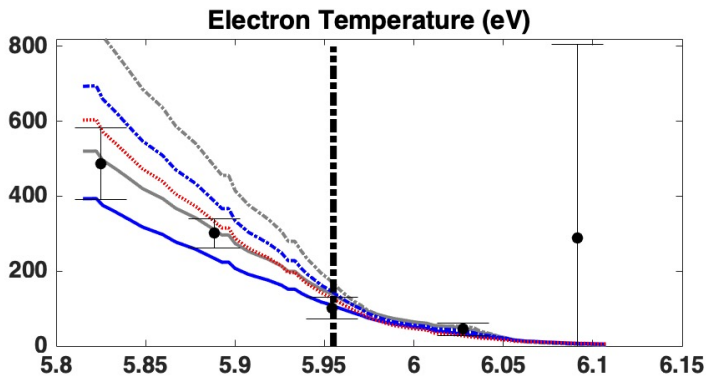
$p = p_e + p_i = n_e T_e + n_i T_i$, $n_i \sim n_e$

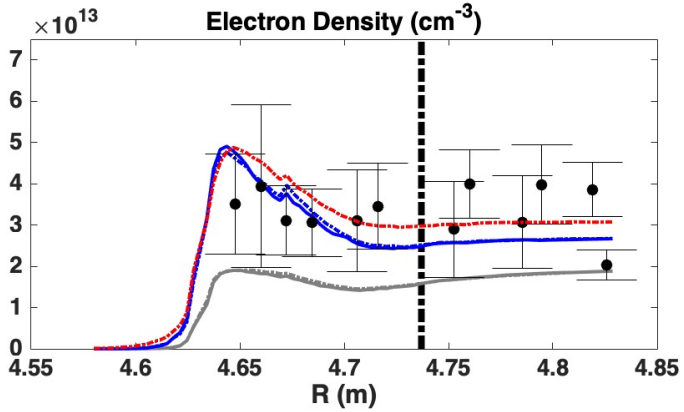
Fitting: $p = p_0 * (1-s)^{\alpha}$ （used in HINT）

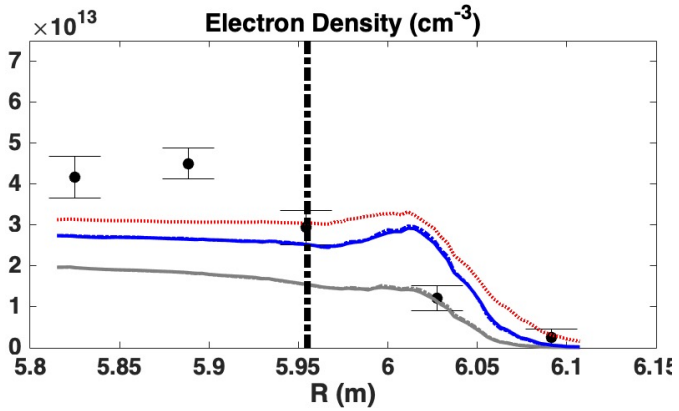
- Magnetic field distributions are modified by plasma beta and toroidal current effects

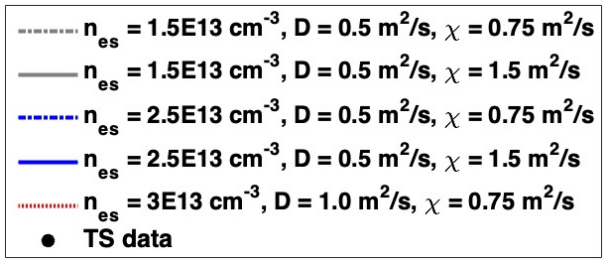
Comparison between the modeling and TS diagnostics:

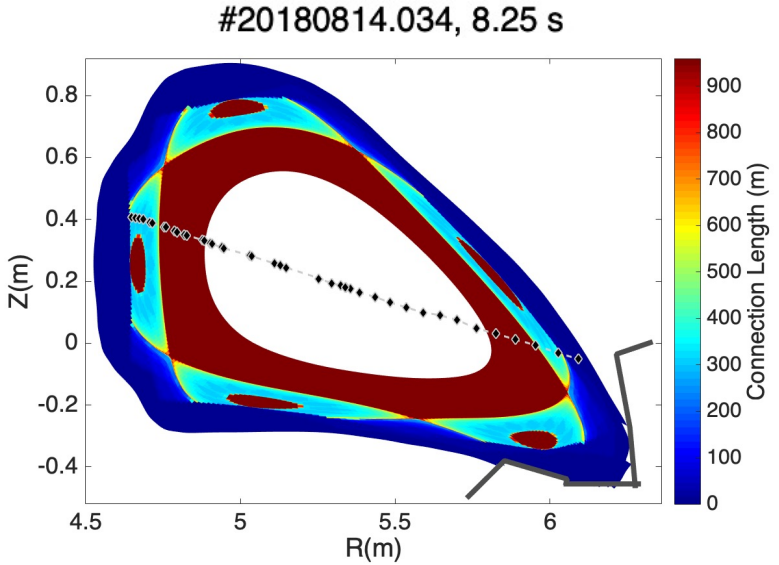


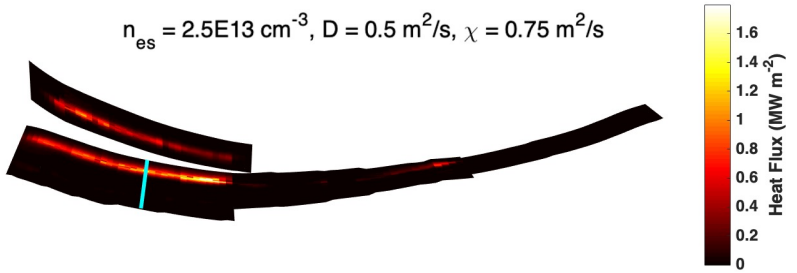












Thank you!