ASTRA/TGLF simulations of full power single null DTT scenarios comparing positive and negative triangularity

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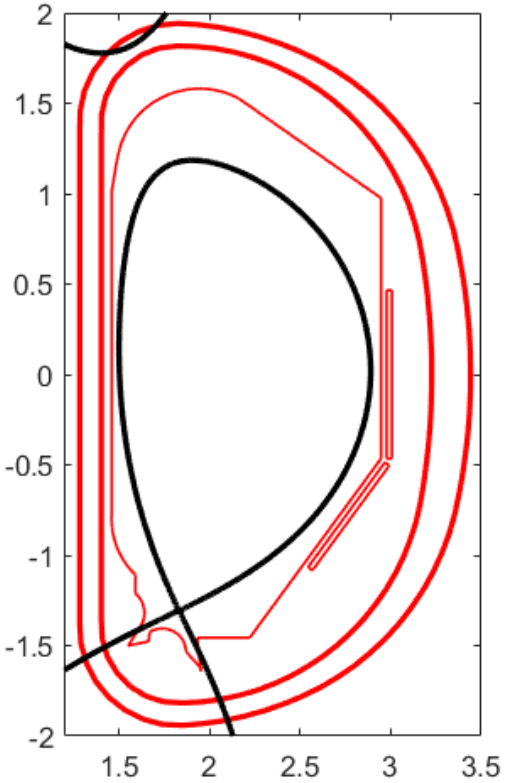
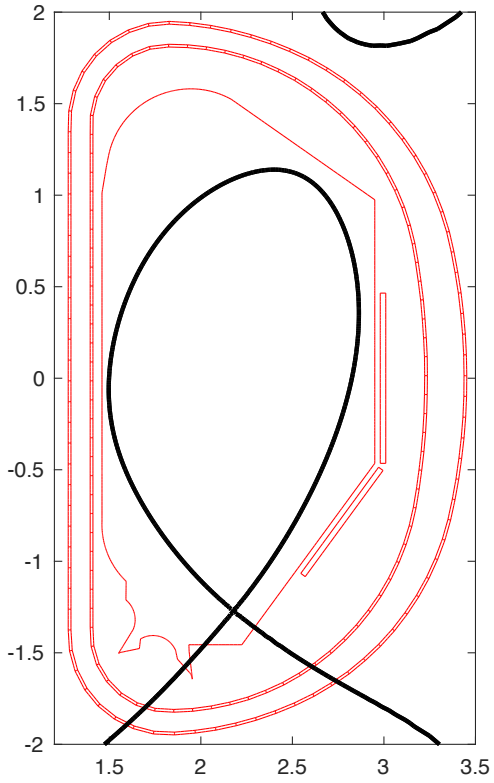
DTT configurations with negative triangularity



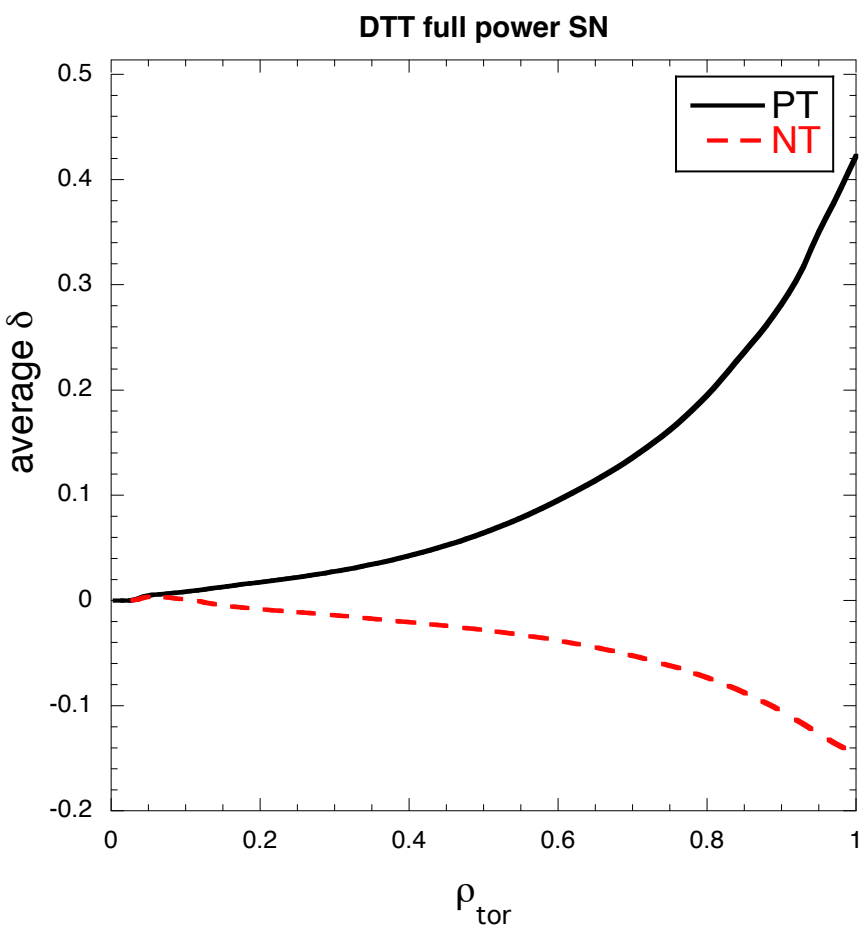


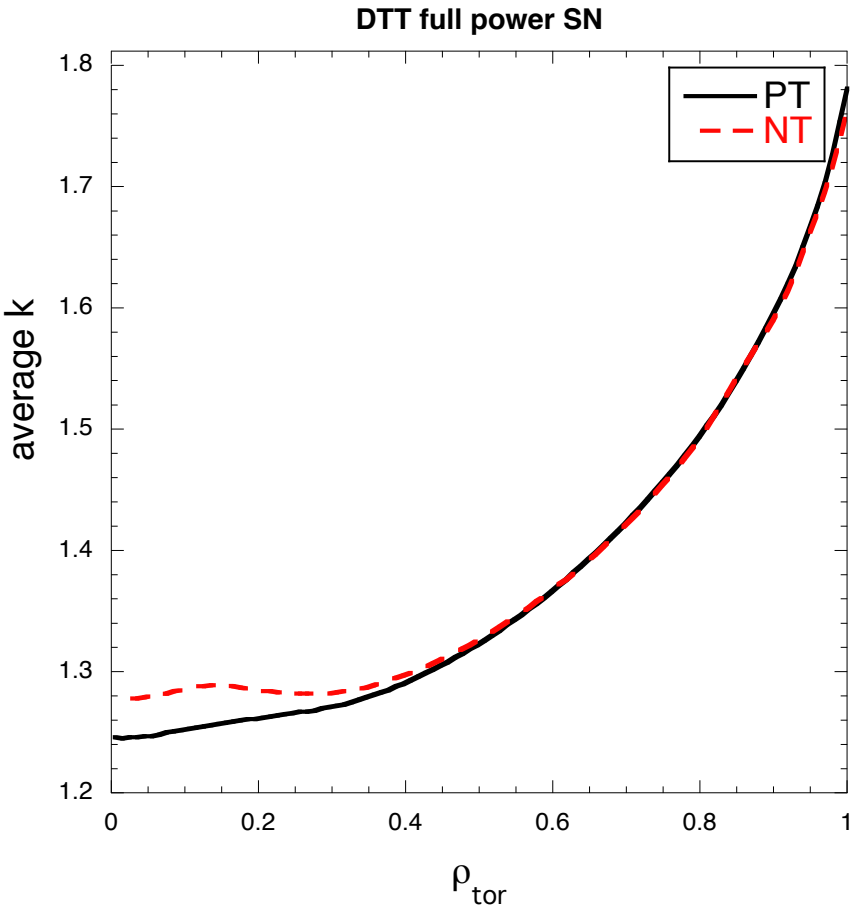
Similar to AUG

R=2.19 m / a =0.70 m
6 T / 5.5 MA
upper δ=0.33
Lower δ = 0.35

R=2.19 m / a =0.70 m
6 T / 4 MA
upper δ=-0.3
Lower δ = 0.05

DTT triangularity profiles





Poloidally averaged triangularity is lower in NT, ellipticity similar

ASTRA simulation settings

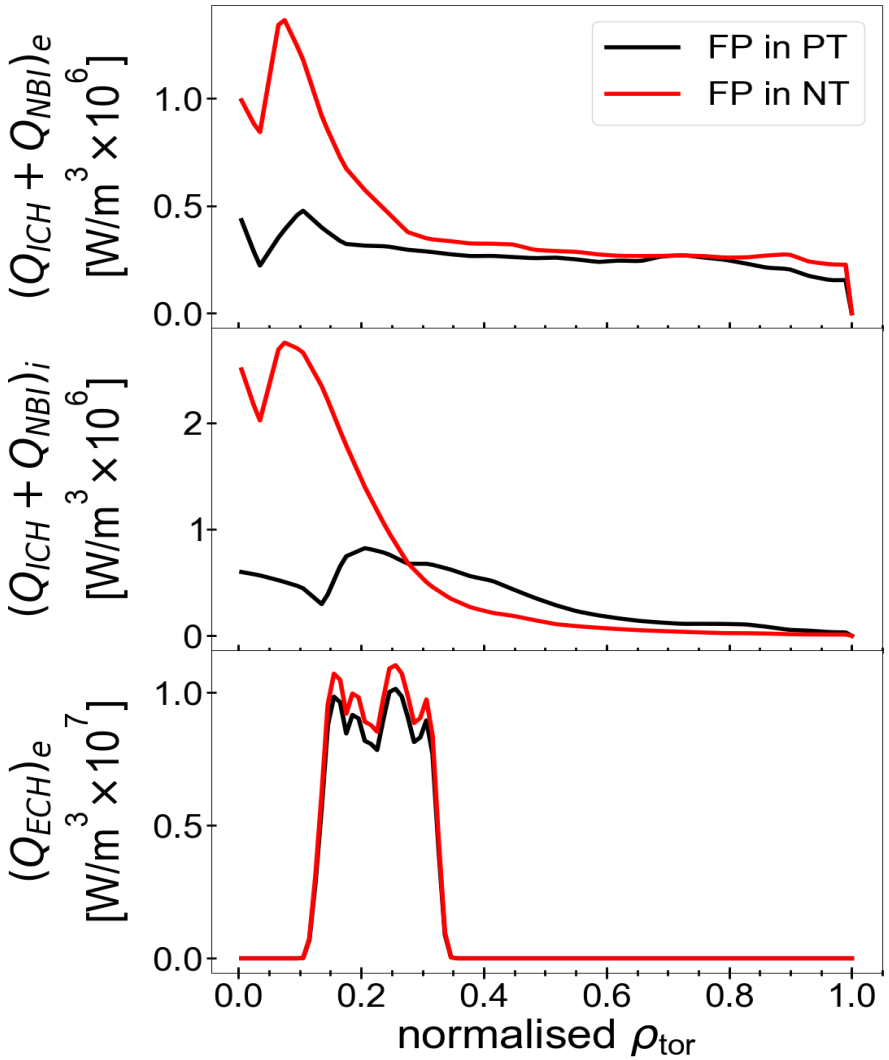
- Simulations for the moment are for steady-state at flat-top
- Fixed boundary from CREATE-NL code, equilibrium evolved self-consistently with SPIDER
- TGLF SAT2 used for turbulent transport
- Predict: ne, Te, Ti, J, 2 impurities (Ne, W). Rotation has neglibigle impact. Ne is used as seeding gas in both cases.
- Impurities charge profiles are predicted with JINTRAC/SANCO and fed into ASTRA. Impurity densities are calculated by ASTRA/TGLF under prescription of initial Zeff and nW/nNe=0.004.
- Boundary conditions to be compatible with SOL and detachment:

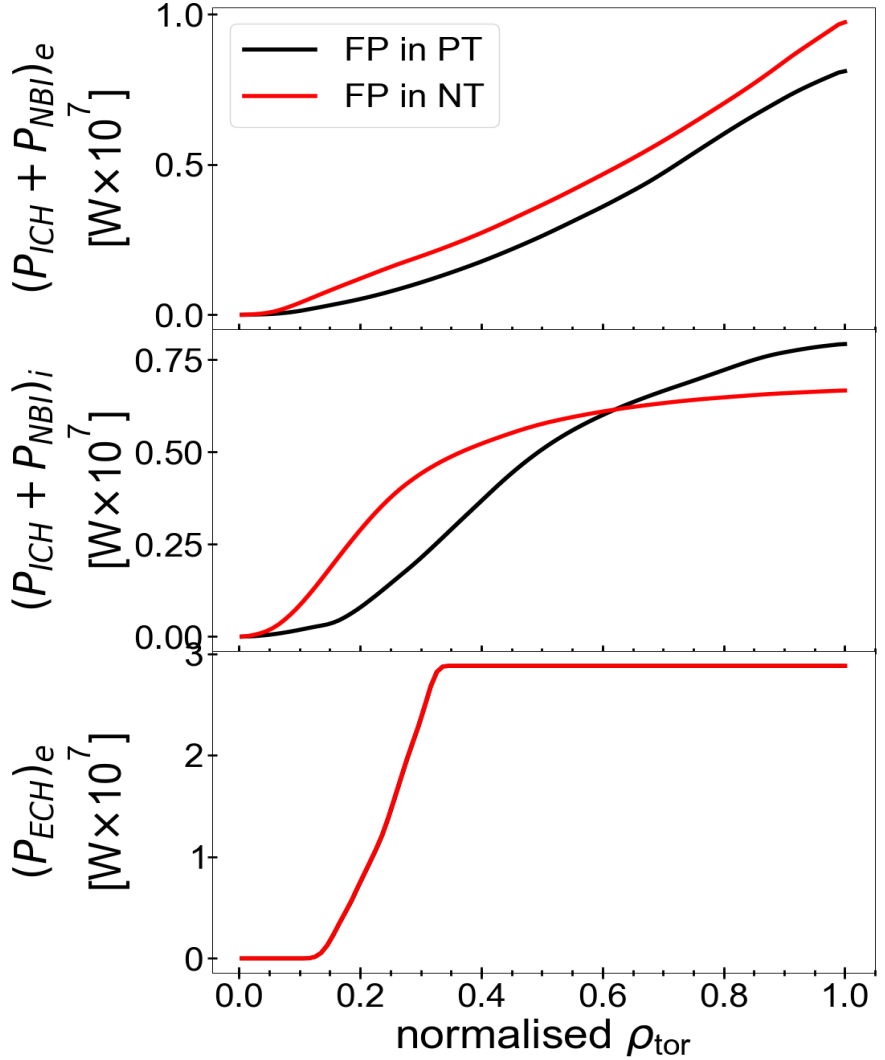
	PT	NT
ne sep	8.27 E19 m-3	7.63 E19 m-3
Te-Ti sep	130	60 eV

- For PT : pedestal from EFIT, simulation inside ρ_{tor}=0.94
- For NT: L mode, simulation inside ρ_{tor}=1

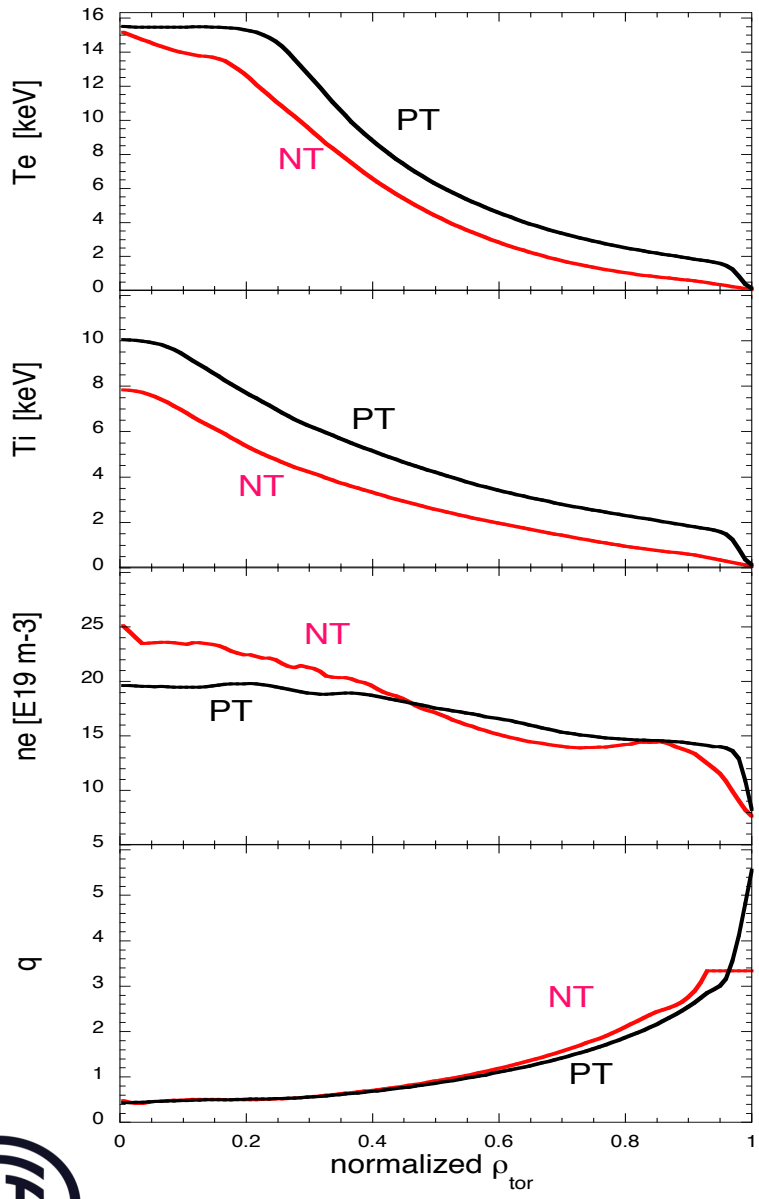
Heating profiles

- ECRH 170 GHz 29 MW on plasma
- NBI 510 keV 10 MW on plasma
- ICRH 60-90 MHz 6 MW on plasma



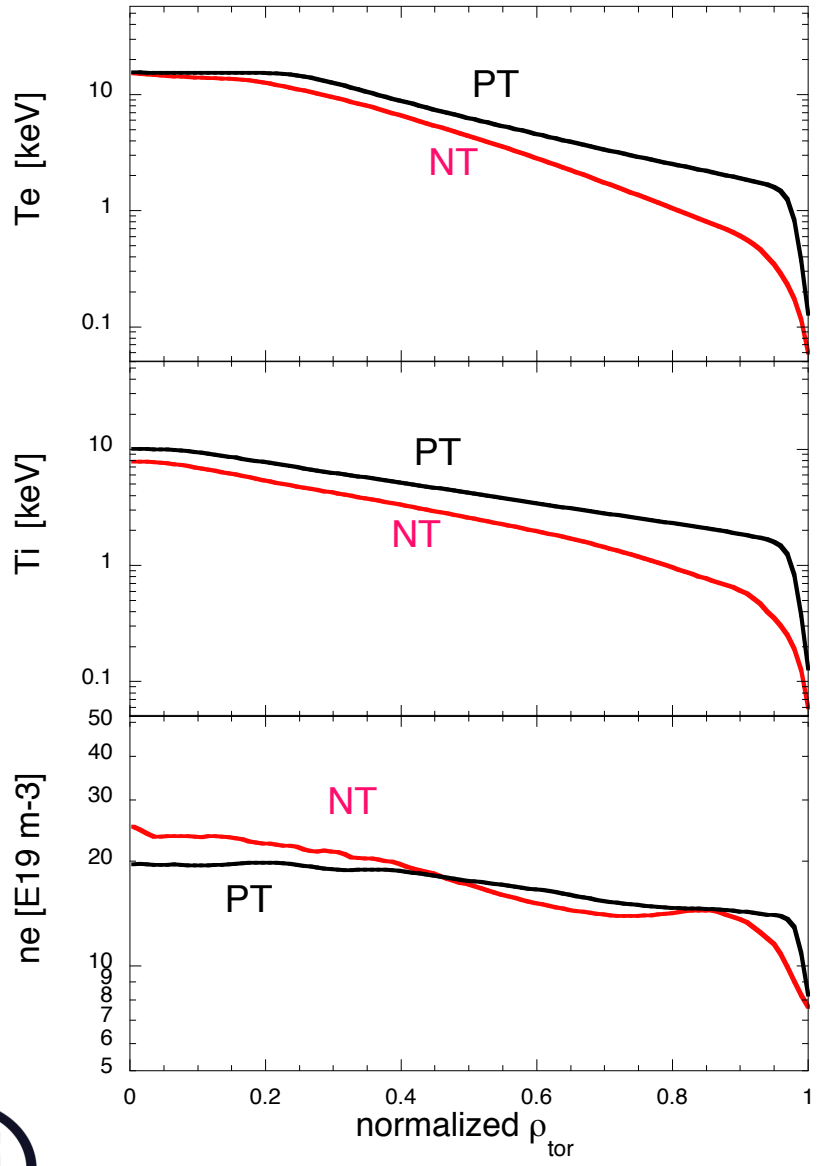


Temperature, density, q profiles



- Loss of pedestal leads to a constant delta in temperatures
- It is not an exponentially growing deficit in NT, as it would be for constant R/LT
- Density is similar. Can be further improved playing with gas puff.
- q is similar apart from very edge

Log scale

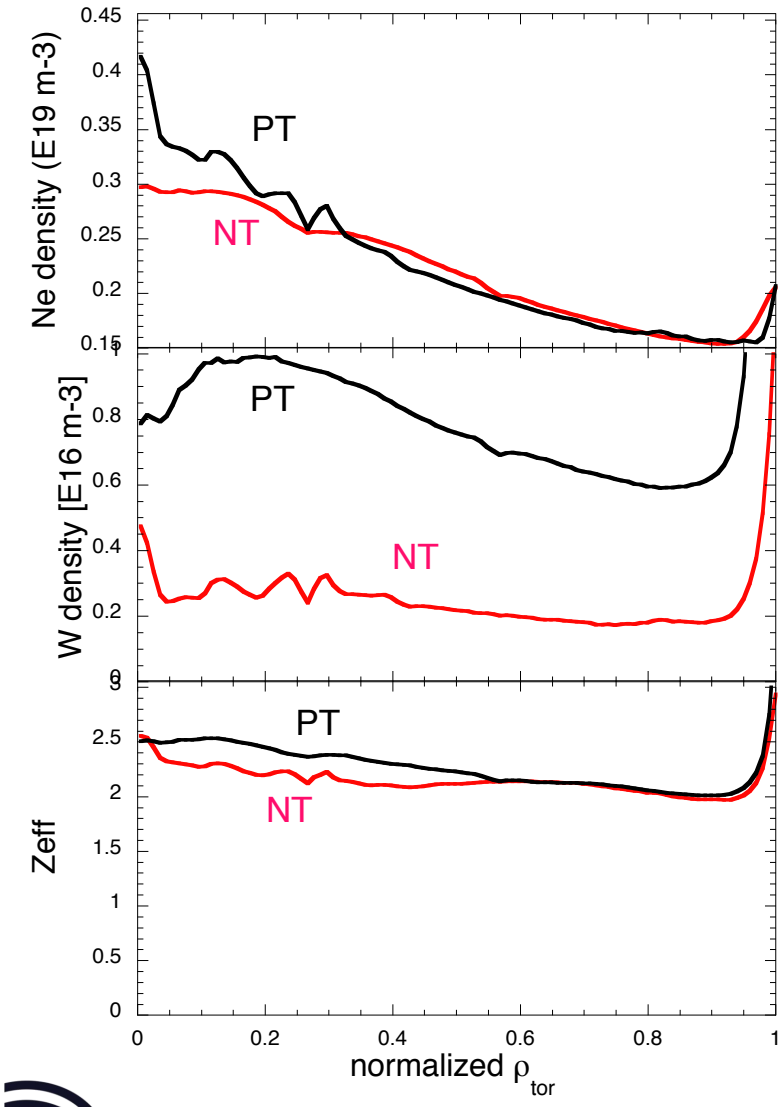


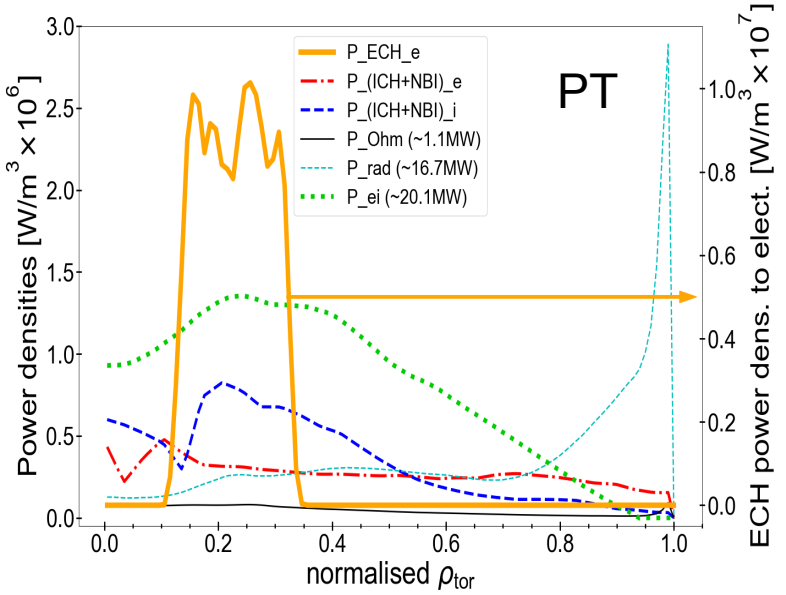
There is an increase in R/LT in NT which partly alleviates the effect of pedestal loss

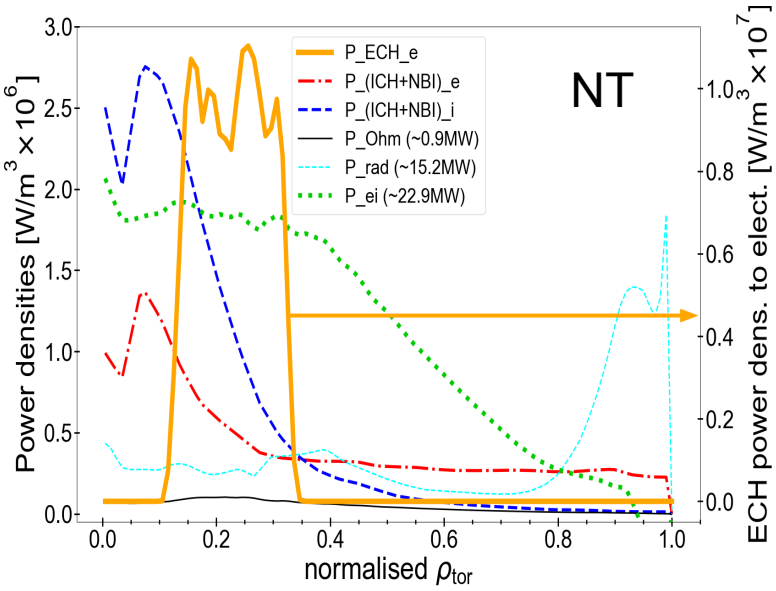
Possibly simply due to having higher normalized fluxes due to lower T

The increase in R/LT is not enough to recover same core temperatures

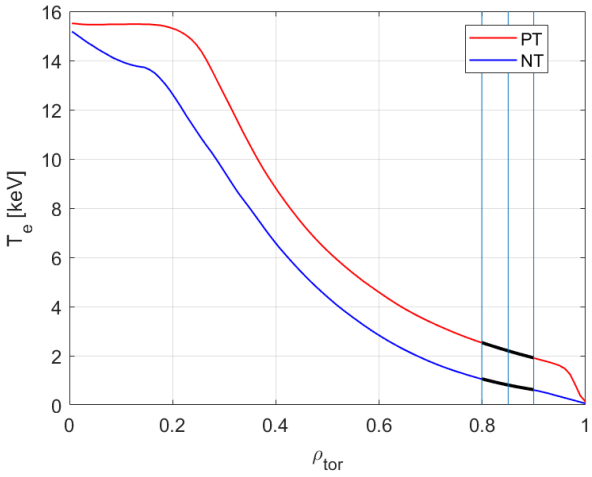
Impurities and powers

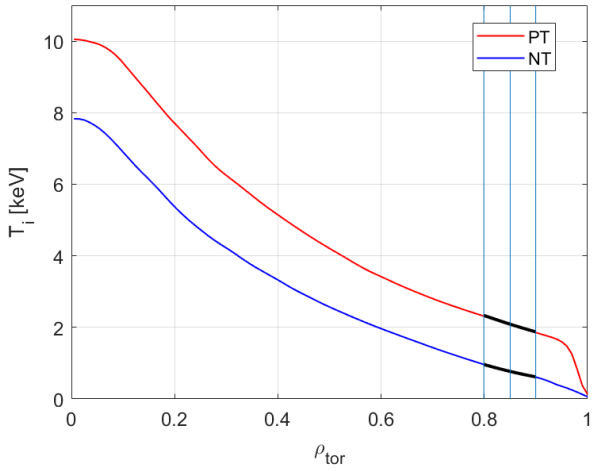


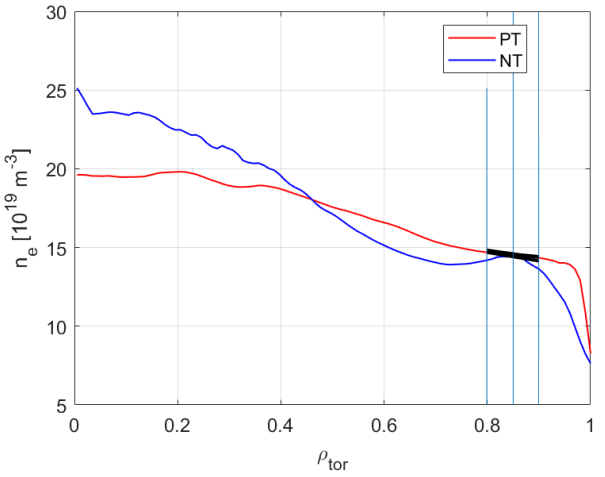


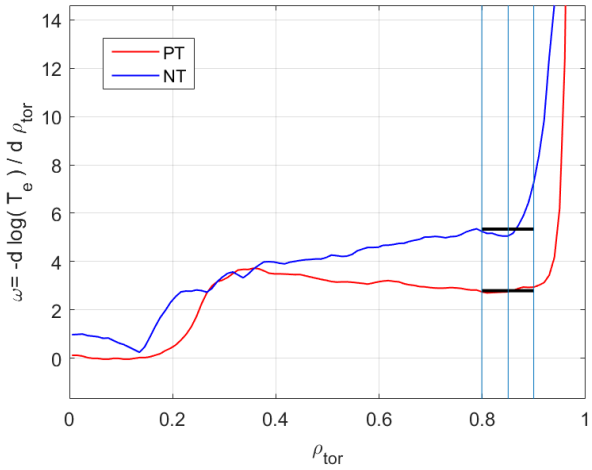


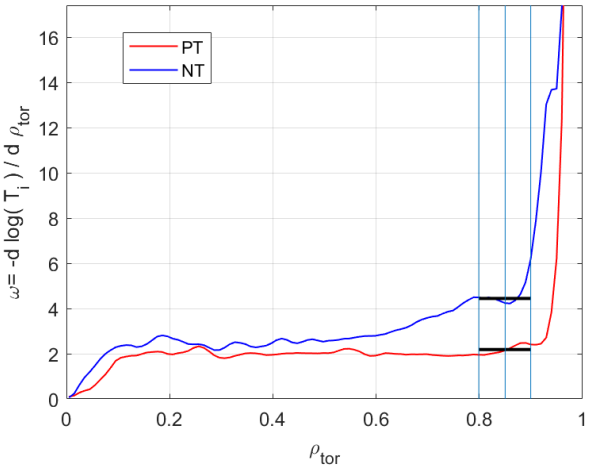
R/L_T and R/L_n and GENE input at ρ_{tor}=0.85

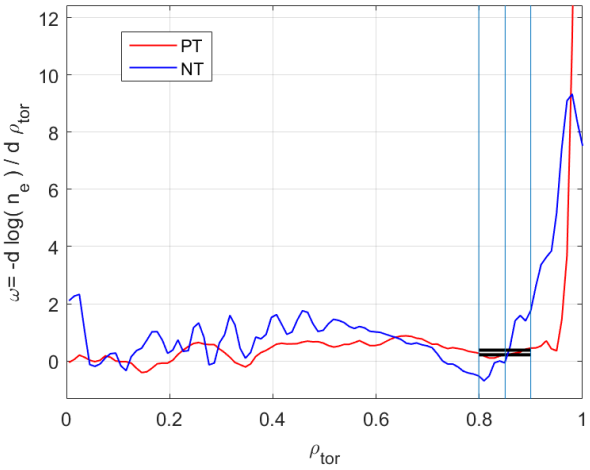






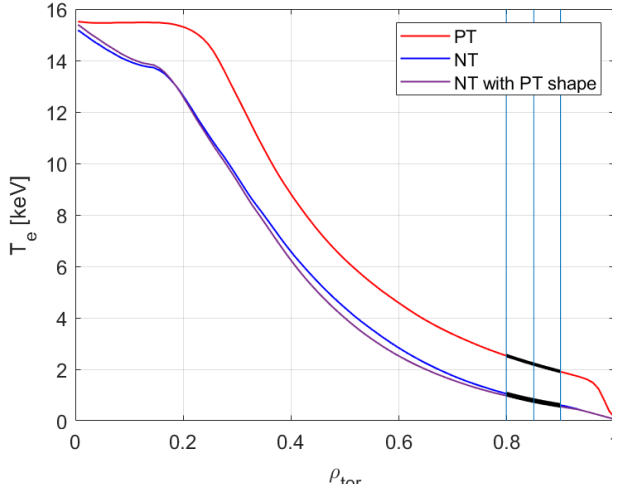


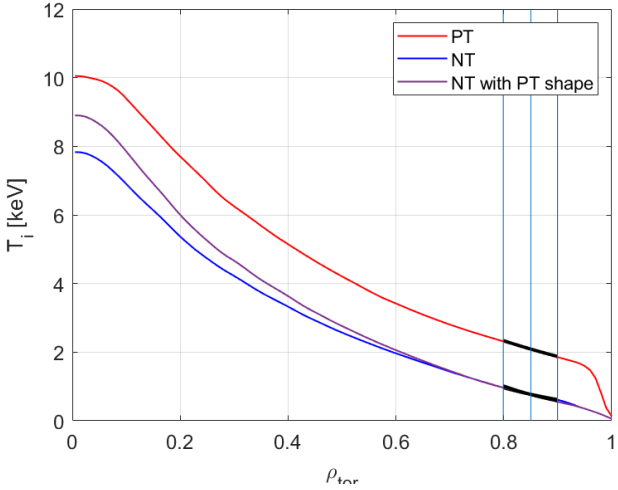


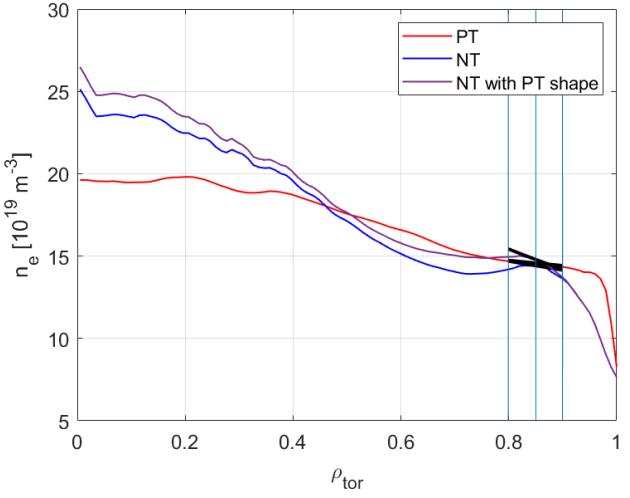


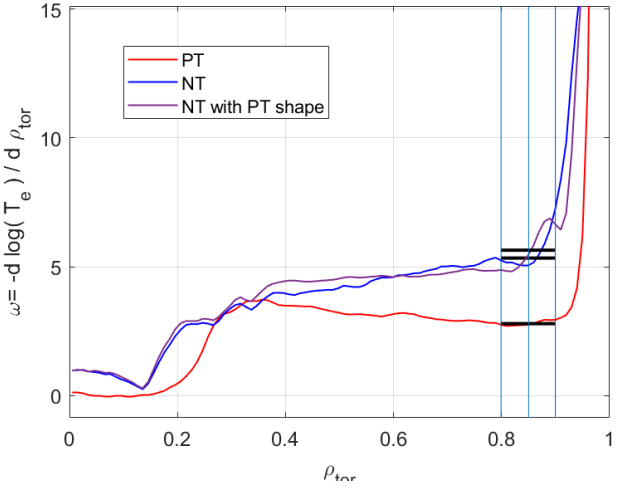
Comparison with PT shape but with all the rest from NT

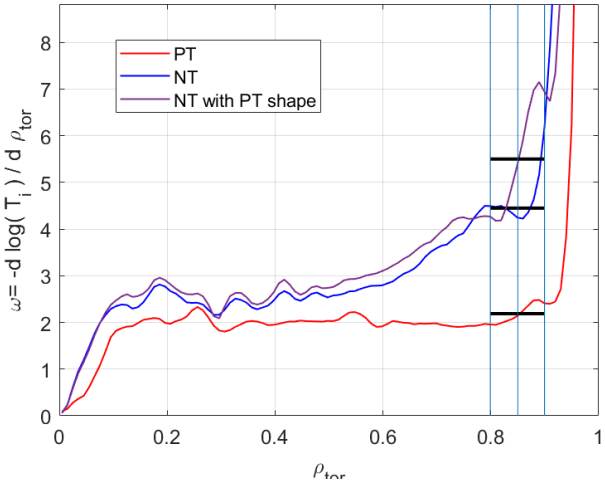
Only shape changed to PT, boundary conditions, heating, q

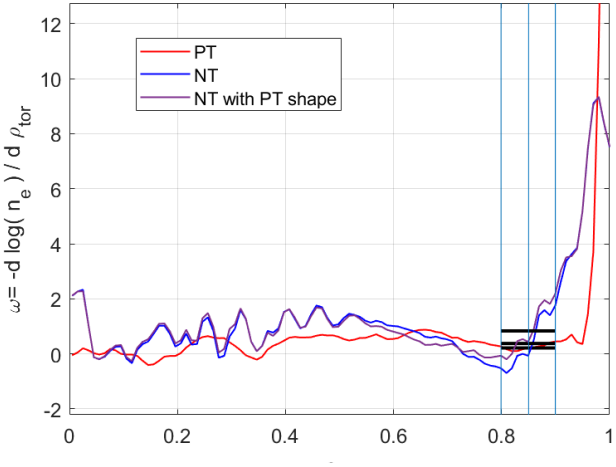












Surprise! Geometry does not do much, changes are mainly due to having pedestal or not

Conclusions

- ASTRA/TGLF SAT2 first simulations of a pair of full power SN DTT plasmas with positive and negative triangularity are now available
- Plasma settings are taken realistically and simulations are self-consistent so there are changes in boundary conditions, plasma current (to keep same q), heating depositions and impurity profiles
- Loss of pedestal is only partiallly compensated by higher R/LT in the outer region
- However, similar profiles and R/LT values are obtained with PT geometry and boundary conditions, heating, q profile from NT simulations➔ **changes are mainly due to different boundary and not to geometry!**
- Stand-alone TGLF simulations will be made to assess stiffness and parametric dependences