

# W7-X OP2 proposals on electrostatic turbulence (w/ lead proponent Stechow)

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## Main hypothesis tested

- OP1.2: NBI-only programs achieved significant core density peaking within half radius
- line-integrated turbulent density fluctuations as measured by phase contrast imaging (PCI) surprisingly showed largely unchanged amplitude and wavenumber spectra
- doppler systems have limited access to core at high densities, but suggest decrease of scattered power far in core
- hypothesis: there is a turbulence limit to achievable core density gradients (by grad-n TEMs?)
- Why is the NBI-induced gradient so localized in the core? Can we identify relevant instabilities at different radii?

## Actuator to test that hypothesis

- NBI fueling (including new sources) for core density gradient control, without “losing” discharge due to P/n limits

## Estimated number of dedicated discharges

- 2x reproduce results from OP1.2 with single NBI source at 2 starting densities
- 2x attempt to extend
- possibly repeat in TEM-unfavorable magnetic configuration (e.g. low mirror)

## Main hypothesis tested

- transiently decreased anomalous transport and ion-scale fluctuations observed after pellet injection in OP1.2
- associated with density peaking and reduced  $\eta_i$  drive of ITGs
- hypothesis 1: this effect is reproducible with the new steady-state pellet injector
- hypothesis 2: this effect can be sustained with continuous pellet injection, or with repeated injection after a pause
- (companion proposal to S. Bozhenkov's in TG profile)

## Actuator to test that hypothesis

- (largely uncontrolled) core density gradient modification by cryogenic pellet injection

## Estimated number of dedicated discharges

- none, since all measurements are done piggyback on the pellet injection scenario development
- interesting findings during campaign (mode activity, strongly reduced fluctuations) can feed back in to pellet injection parameter selection

## ion-scale turbulence characterization in low mirror configuration pellet-fueled discharges

### Main hypothesis tested

- transiently increased confinement and  $T_i$  after pellet injections are postulated to be associated with reduced instability growth rates in the „stability valley“
- hypothesis: magnetic configurations without “stability valley“ are worse at providing improved confinement
  - performance indicators such as  $T_i$  and  $W_{dia}$  do not peak as strongly
  - fluctuation diagnostics see a limited reduction in ion-scale fluctuations

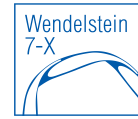
### Actuator to test that hypothesis

- (largely uncontrolled) core density gradient modification by cryogenic pellet injection

### Estimated number of dedicated discharges

- 8? Attempt to repeat “pellet recipe“ in low mirror configuration, vary ECH heating and timing, pellet timing etc. as required to reach highest  $W_{dia}$  and  $T_i$
- If possible, profile matching to pellet experiments in standard or high mirror conf. should be attempted

# turbulence "matching" between pure ECH and pure NBI heating



## Main hypothesis tested

- OP1.2: on switchover from ECH-only to NBI-only, turbulence amplitude and spectra can be very similar before significant peaking begins
- Hypothesis: the ECH power can be tuned to create a near-perfect fluctuation power match between both phases
  - How do the equilibrium and  $E_r$  profiles, as well as the power balance change?
  - Does the resulting ECH power level provide matched ion heating power?
  - How do turbulent fluctuations (including  $T_e$  in the core) change, especially in light of the large change in  $T_e$ ,  $\text{grad}(T_e)$  and  $T_e/T_i$

## Actuator to test that hypothesis

- ECH input power variation

## Estimated number of dedicated discharges

- 3 to converge on optimal ECH power
- 1 repeat at ECH power optimum with multiple switchovers between NBI and ECH