# Main Objectives Task Force I: *High Performance Scenarios*

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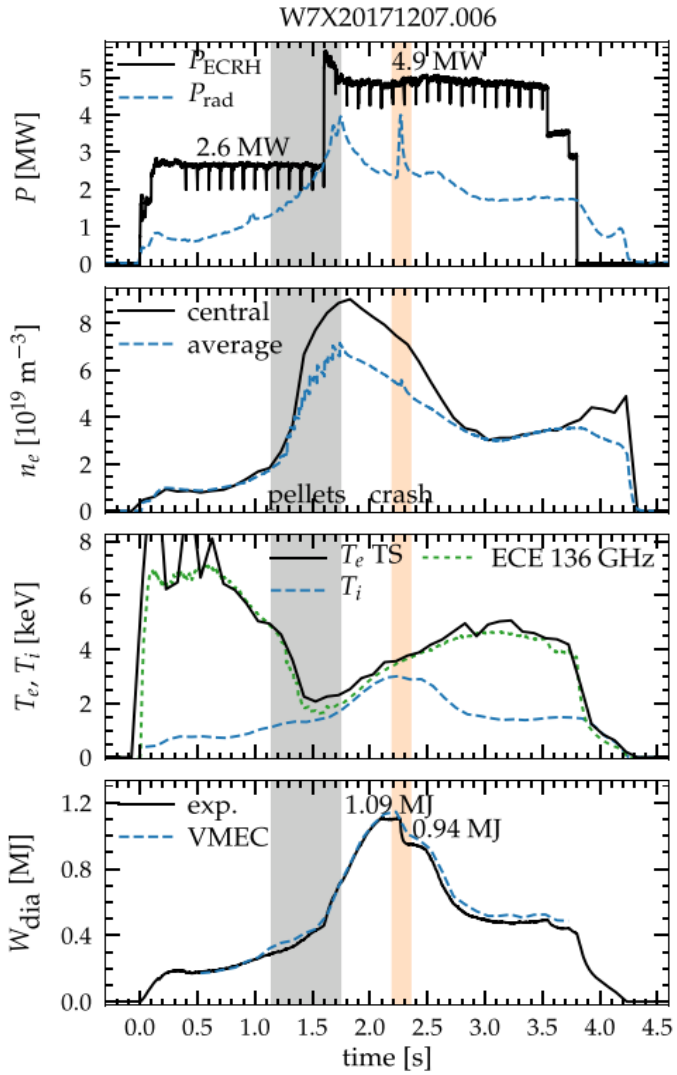
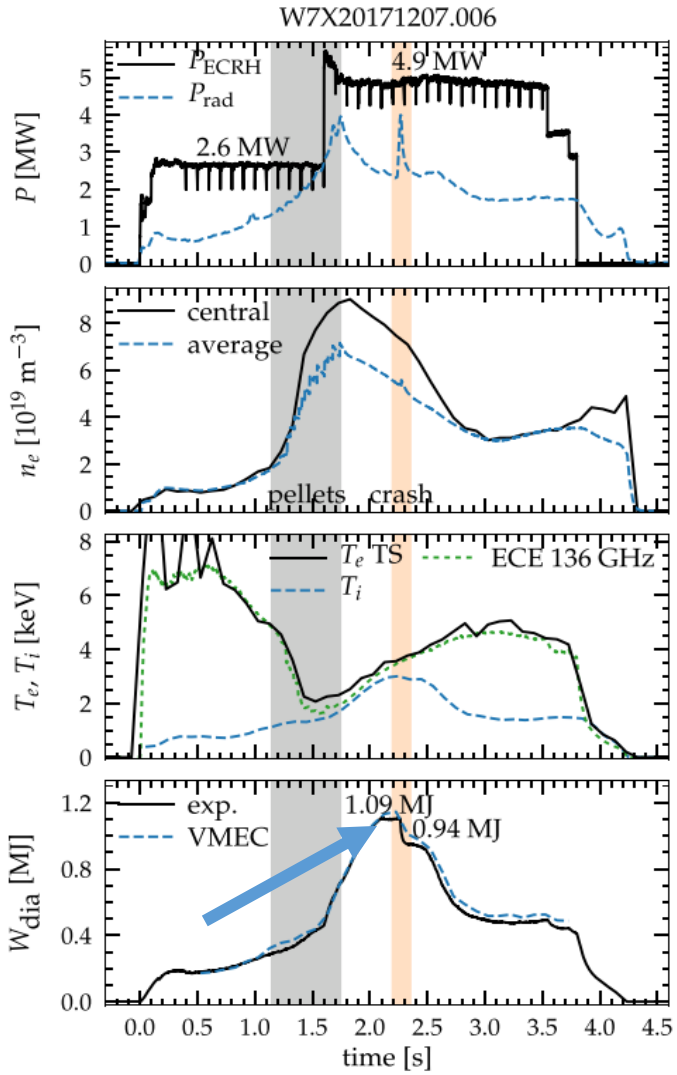



***Transient phases of high performance:***

# Main Objectives Task Force I: *High Performance Scenarios*




***Transient phases of high performance:***

- $W_{DIA}$ ~ 1.1 MJ

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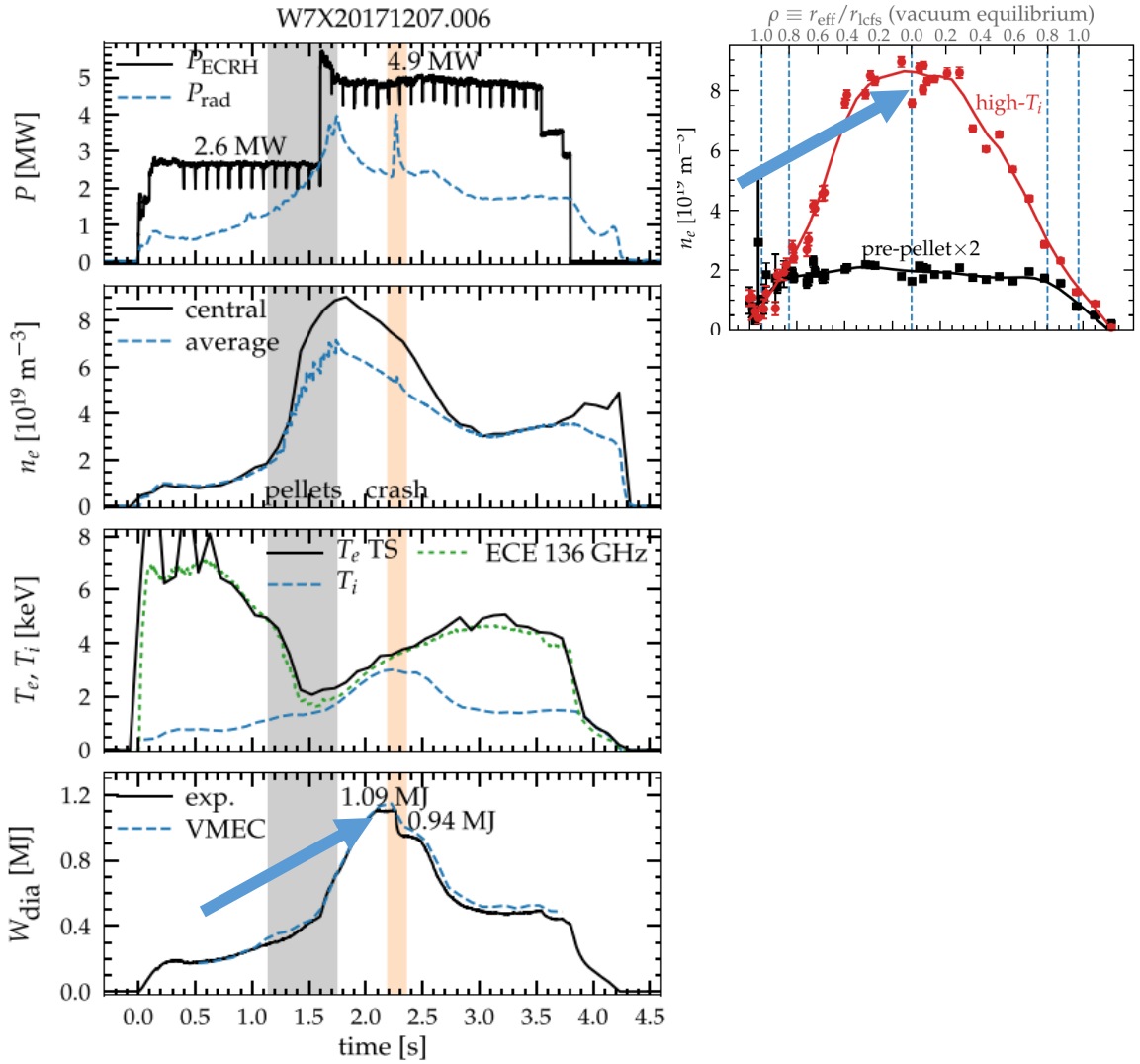





***Transient phases of high performance:***

- $W_{DIA}$ ~ 1.1 MJ
- $n_e$ *profile peaking*

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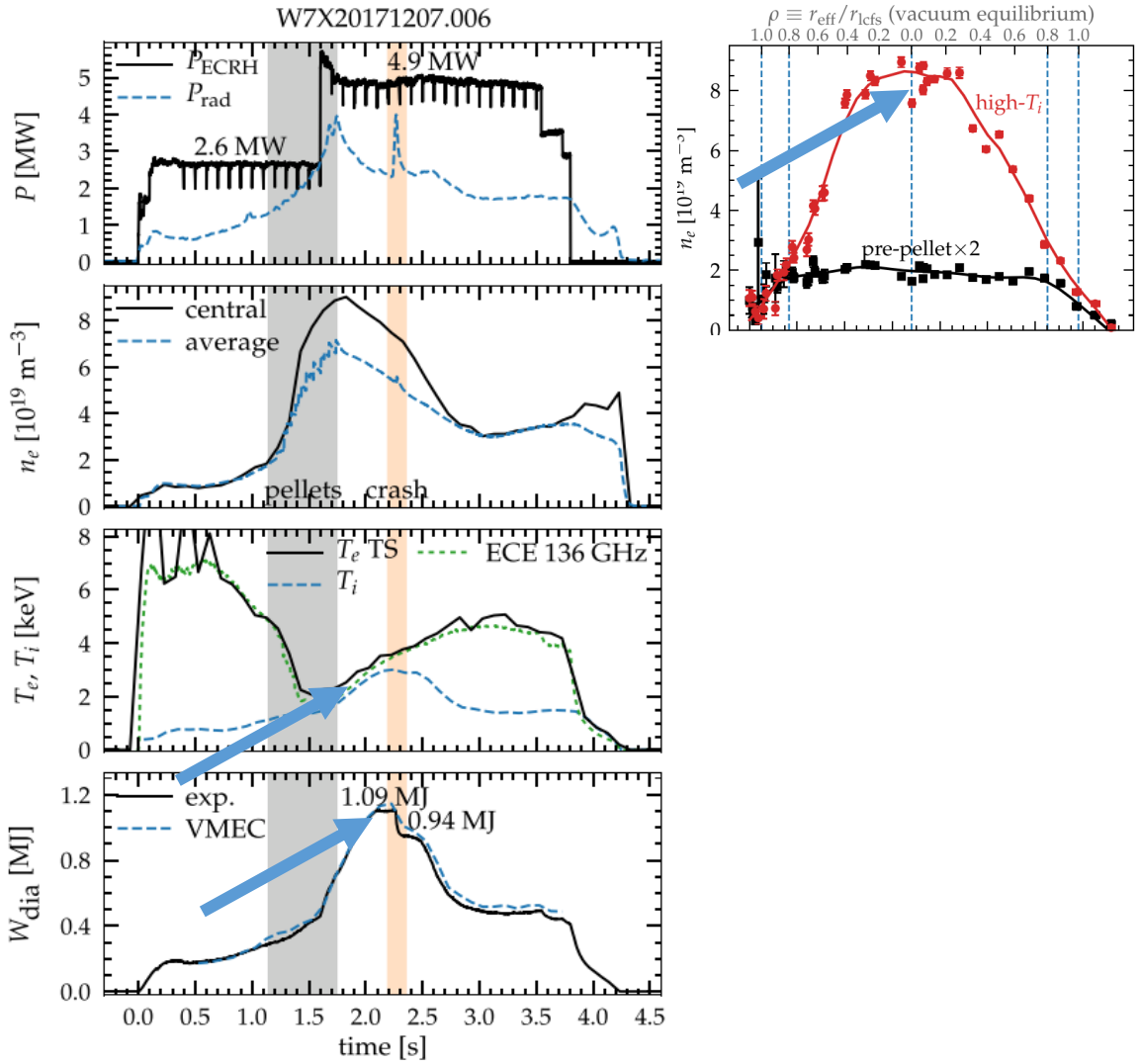


***Transient phases of high performance:***

- $W_{DIA}$ ~ 1.1 MJ
- $n_e$ *profile peaking*
- $T_i$ ~ $T_e$

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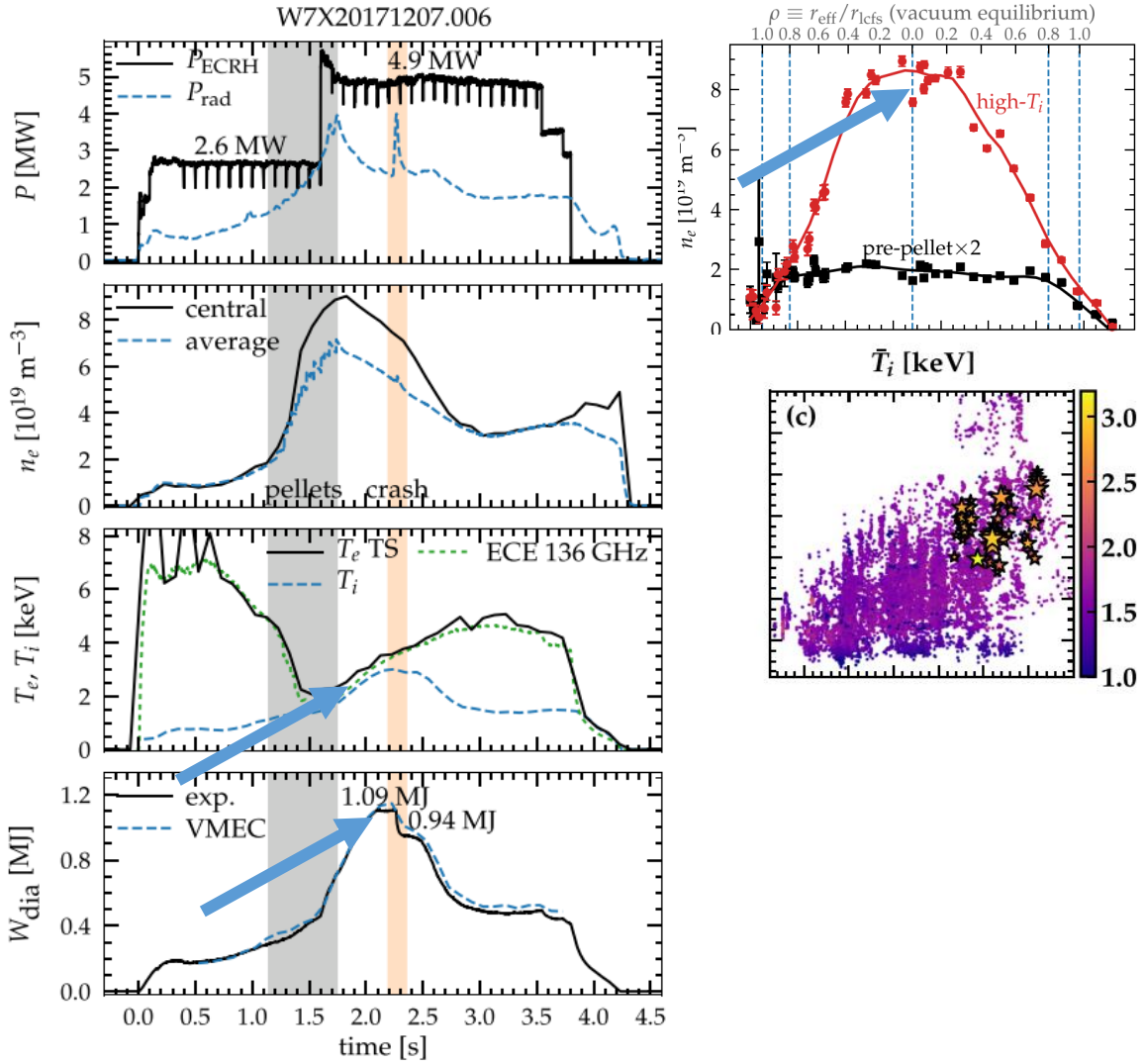


***Transient phases of high performance:***

- $W_{DIA}$ ~ 1.1 MJ
- $n_e$ *profile peaking*
- $T_i \sim T_e$
- $T_i > 1.5$ keV

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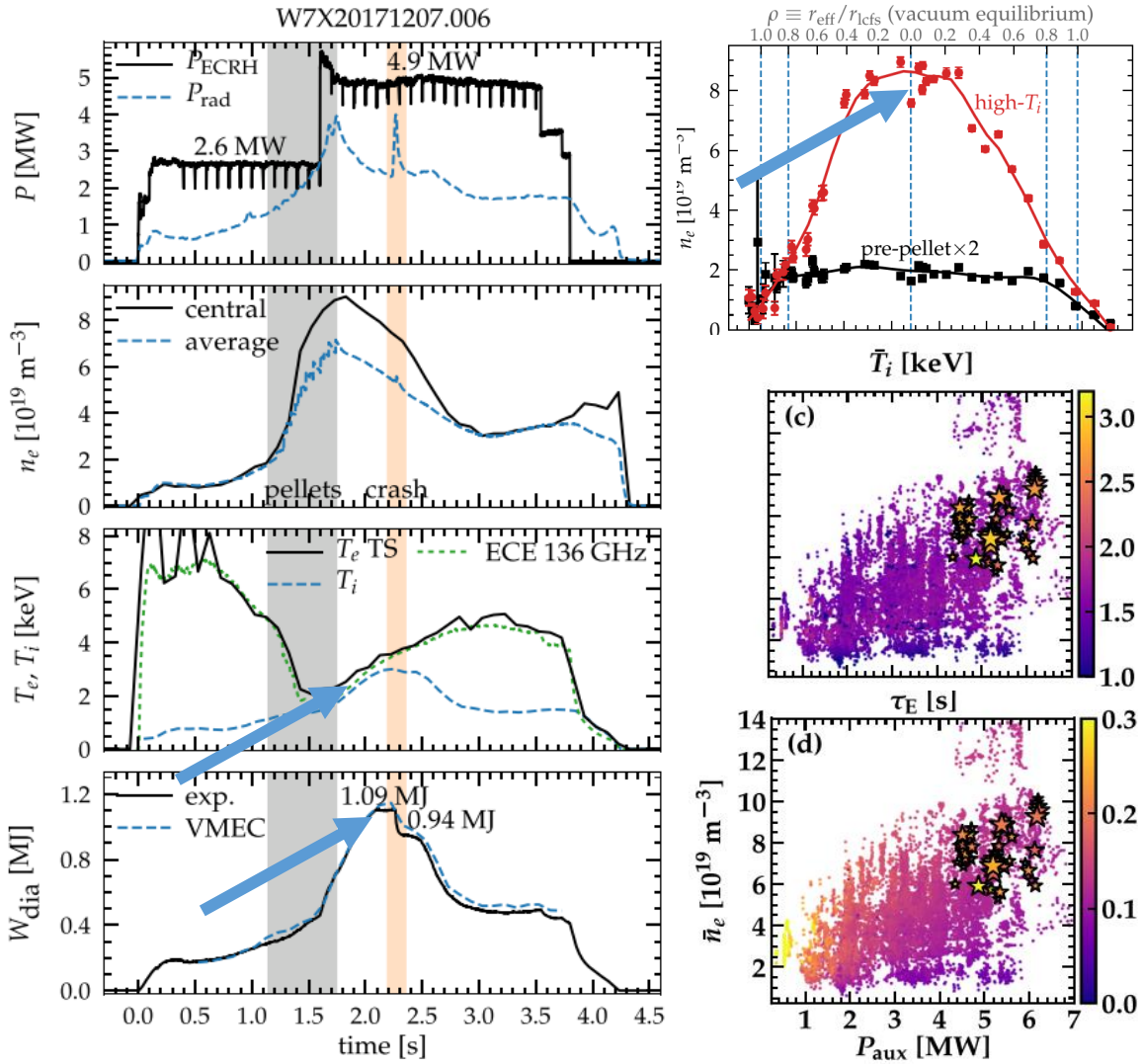


***Transient phases of high performance:***

- $W_{DIA}$ ~ 1.1 MJ
- *$n_e$ profile peaking*
- $T_i \sim T_e$
- $T_i$ > 1.5 keV
- $\tau_E \geq$ ISS04, increased $\tau_I$

*-> reduced turbulent tansport in post pellet phase*

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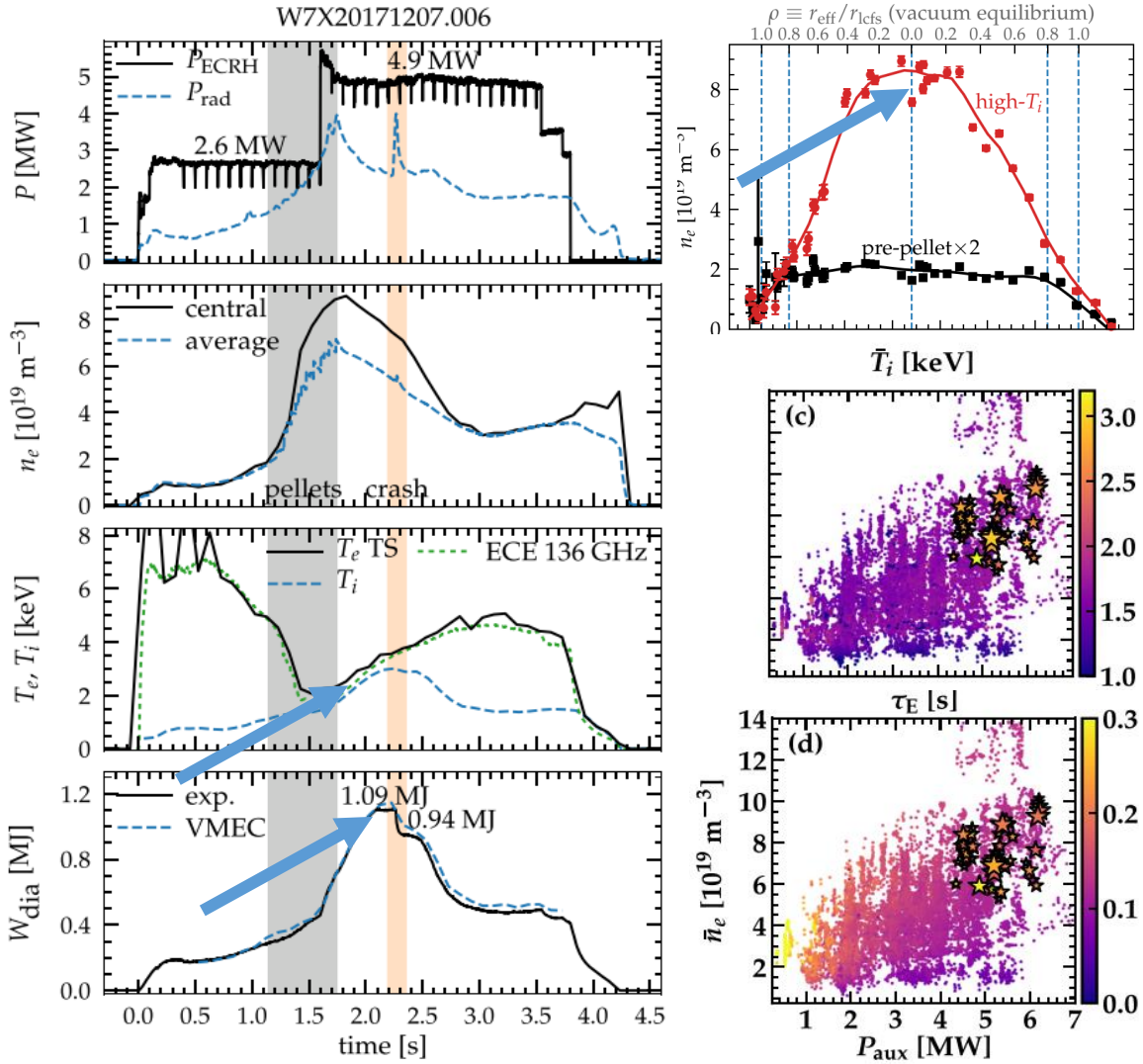


***Transient* phases of high performance:**

- $W_{DIA}$ ~ 1.1 MJ
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- $T_i \sim T_e$
- $T_i$ > 1.5 keV
- $\tau_E \geq$ ISS04, increased $\tau_I$

*-> reduced turbulent tansport in post pellet phase*

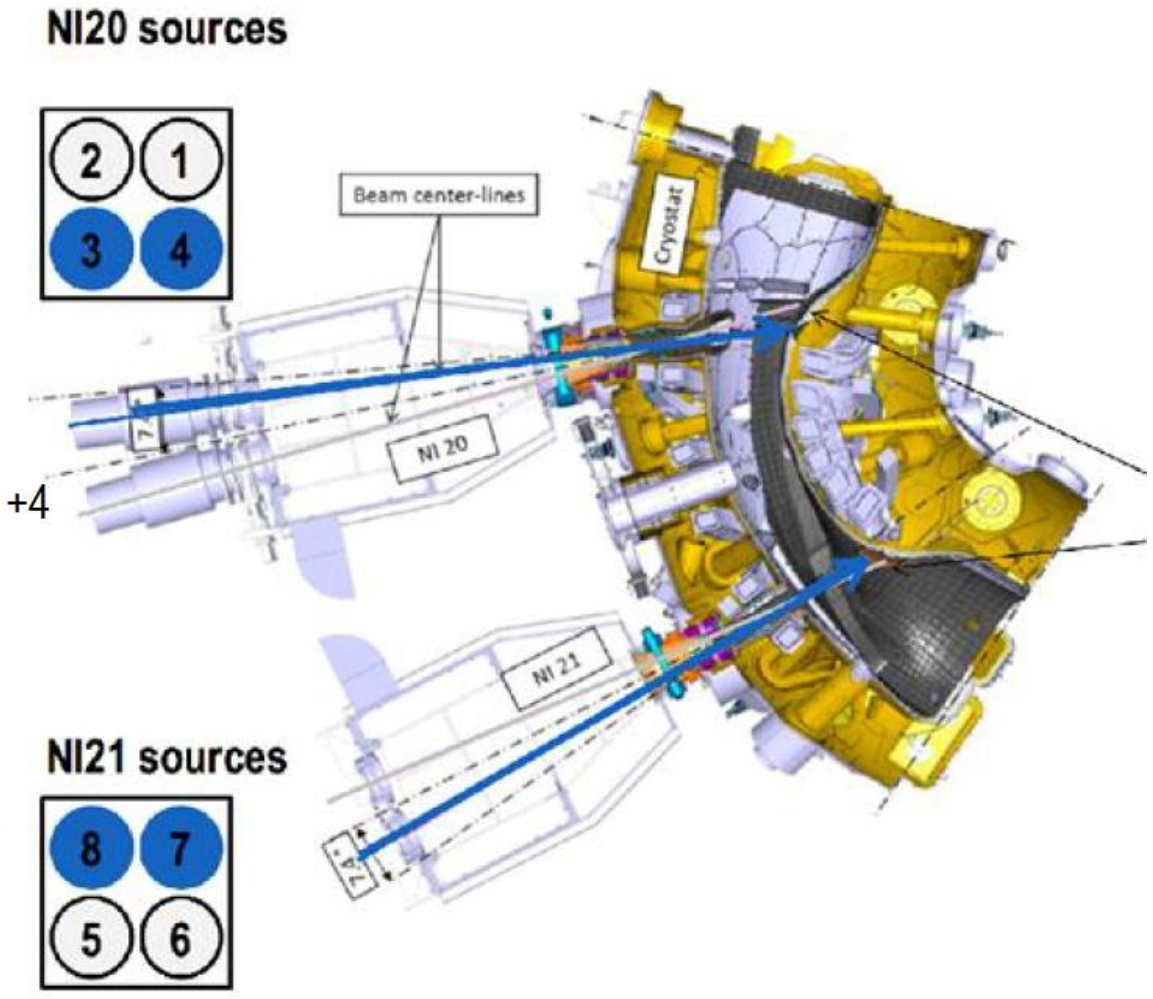
*Similar high performance observed in:*

- NBI / low ECRH power scenarios
- massive impurity injections (B dropper, LBO TESPEL)

# Main Objectives Task Force I

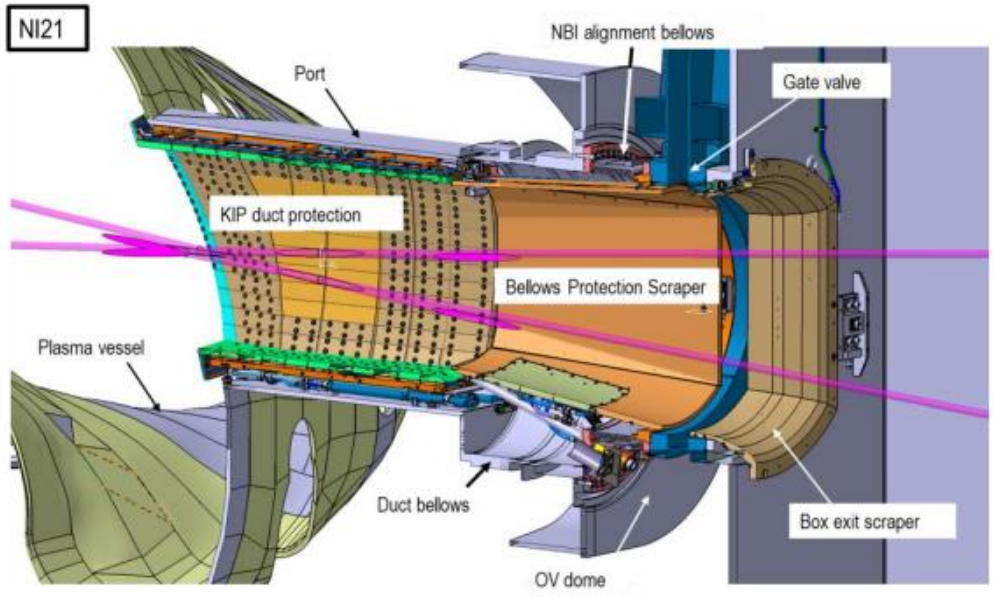
| Main Objective | Scientific Goal | Measures of success / deliverables |
|---|---|---|
| Exploration of reduced turbulence / high performance scenarios w.r.t. stationary plasma conditions, kinetic-, density-, and impurity-profile control | ▪ Demonstrate steady-state viability of increased performance scenarios after pellet / impurity injections as well as low ECRH/NBI heated plasmas<br>▪ Qualify actuators for the control of profiles and impurities | ▪ High plasma performance in the order of seconds, including<br>• $T_i$ above clamping limit (1.5 keV)<br>• $\tau_E$ equal or better to ISS04 scaling<br>▪ Avoidance of impurity accumulation<br>▪ Assess density profile control |

# Main Objectives Task Force I: *Upgraded NBI System*




***NBI System:***

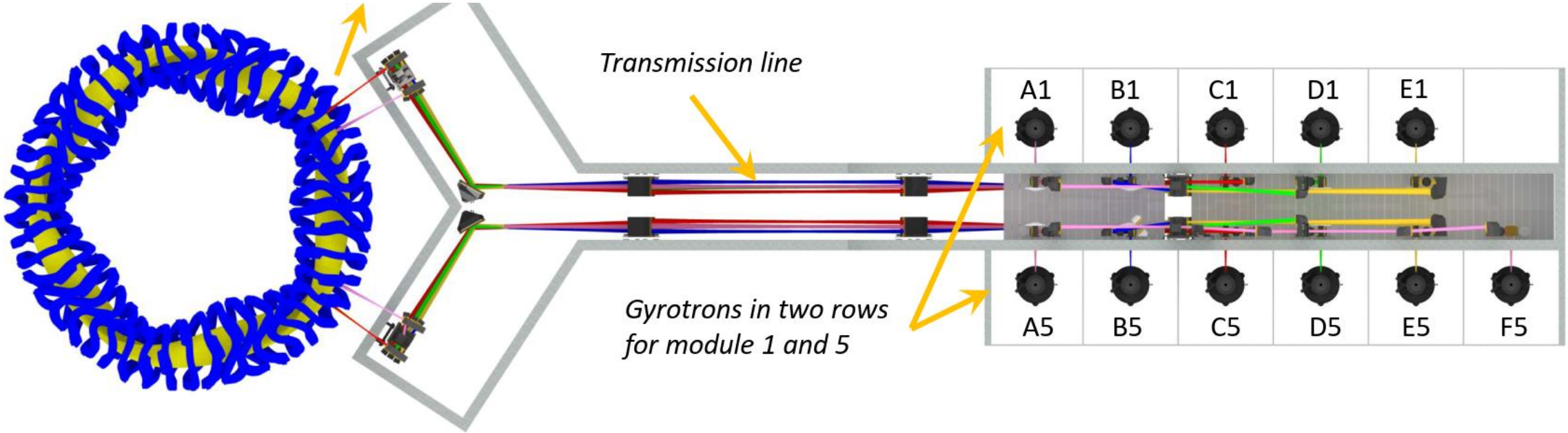
- 2nd NBI box in operation during OP2.1
- Power: 4.5 MW per box
- Pulse length: 5 seconds



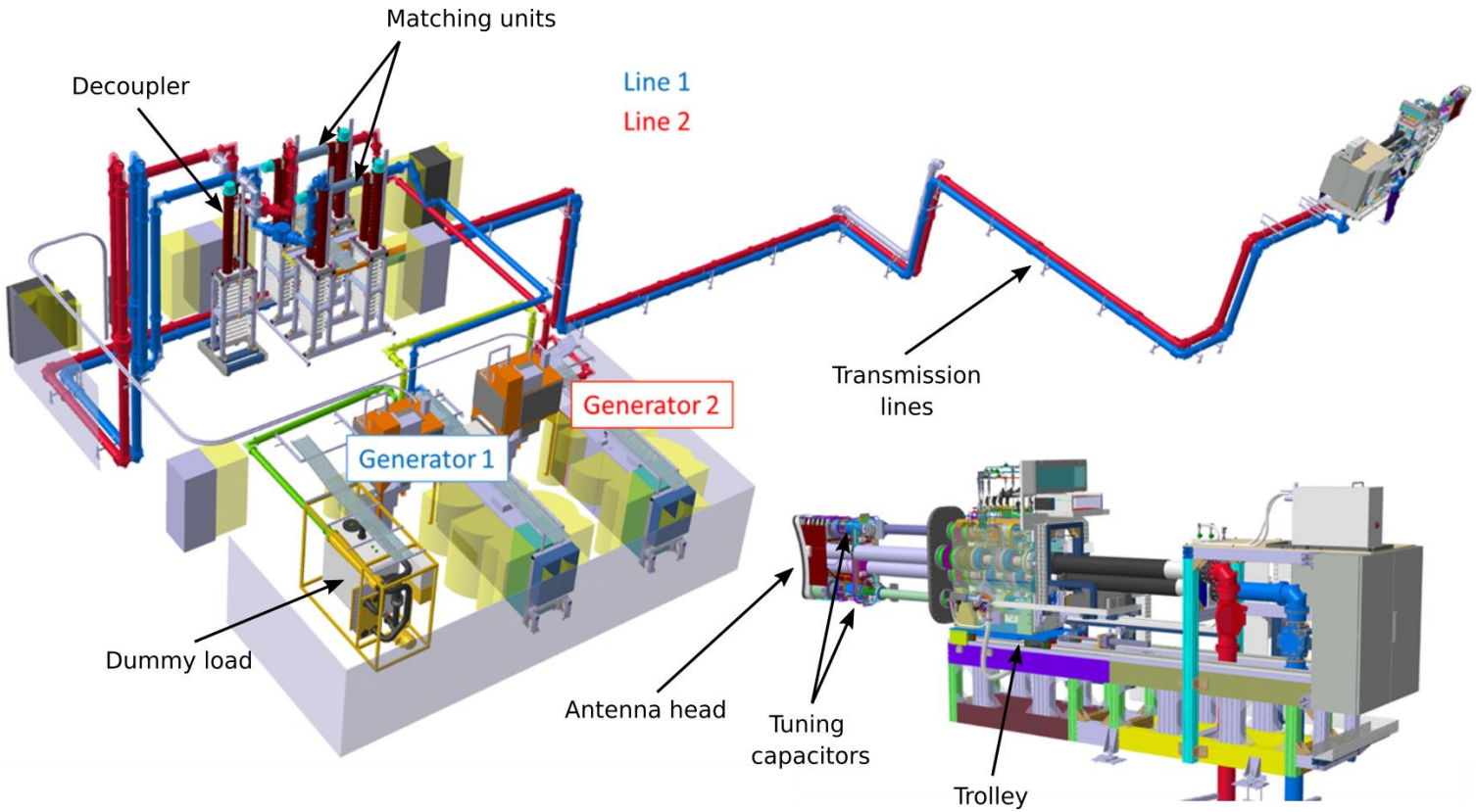
# Main Objectives Task Force I: *Upgraded ECRH System*

***ECRH System:***

- New 1.5 MW gyrotron for OP2.1
- Power: 6.5 + 1 MW in plasma



# Main Objectives Task Force I: *Upgraded ICRH System*




***ICRH System:***

- Currently being installed at W7-X
- Max coupled RF power: 1 – 1.5 MW
- Heating scenarios:
  - 4He/H, 4He/3He, 3 ion-scheme
  - plasma start-up with ICRH?

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| Exploration of heating scenarios using upgraded plasma heating capabilities (ECRH, NBI, ICRH) | ▪ Extension of NBI operation space and preparation of fast ion diagnostics<br>▪ Observation and prediction of fast ion losses for machine safety and validation of simulations tools | ▪ Demonstrate effective ion heating<br>▪ Exhaustive operational map of the W7-X configuration space incl. operation limits<br>▪ Safe operation w.r.t. NBI/ICRH induced fast ion losses<br>▪ Validation of fast ion loss simulation tools |

# Main Objectives Task Force I

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| Develop high beta plasma scenario by means of low field operation | ▪ Development of a plasma startup scenario @ B=1.7 T employing X3 / ICRH / NBI heating<br>▪ Fast ion confinement at high plasma-beta | ▪ Reliable plasma startup scenario @ 1.7 T<br>▪ Demonstration of improved fast ion confinement of W7-X at high beta<br>▪ Develop capability to extrapolate B-field dependency to high-field reactor operation |