EUROfusion

18th November 2024

RT-02 "Physics understanding of alternatives to Type-I ELM regime"
Discussion about proposals and allocated priorities

B. Labit

On behalf of WPTE TFLs
E. Tsitrone, N. Vianello, M. Baruzzo, V. Igochine, D. Keeling, A. Hakola, B. Labit

Research Topic Coordinators
E. Viezzer, M. Dunne, M. Faitsch, O. Sauter

This work has been carried out within the framework of the EUROfusion Consortium, funded by the European Union via the Euratom Research and Training Programme (Grant Agreement No 101052200 — EUROfusion). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them.

Introduction

ITER

RT01: Core-Edge-SOL integrated H-mode

DEMO

RT02: Alternative to type-I ELM regimes

Physics & Control integration

RT03: Disruption & RE mitigation strategies

RT04: Machine generic integrated control

RT05: Physics of divertor detachment

RT08: Physics of high β long pulse scenario

RT09: Physics of energetic particles

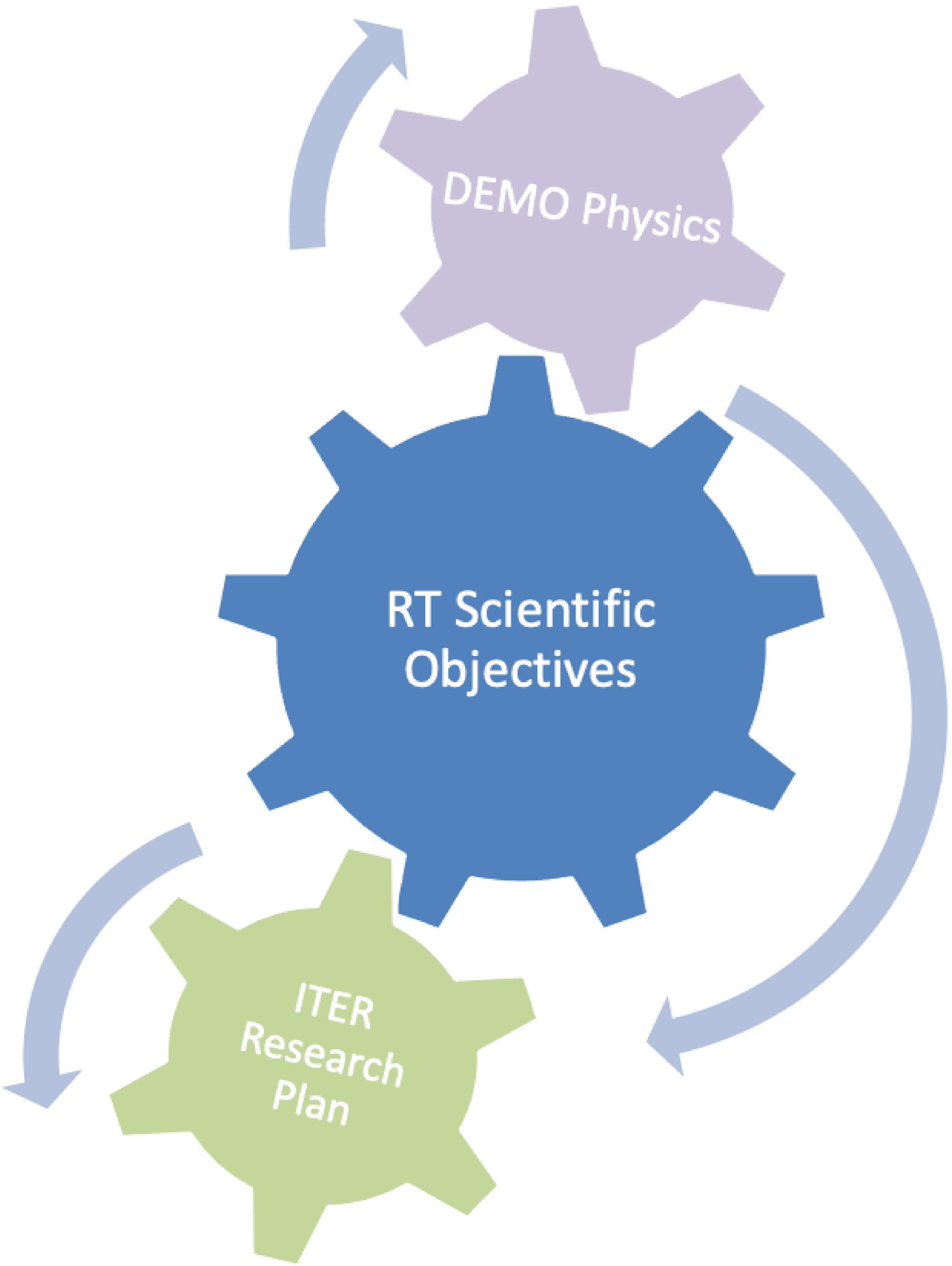
RT06: preparation of efficient PFC operation

RT07: Alternative divertor configuration

PEX

Mission 1	Mission 2

Prioritization scheme and criteria



Proposal Evaluated according to the criteria:

Adherence to the Scientific Objectives

Team effort

Size and feasibility

All these aspects were considered by the TFLs when setting the priorities – according to the following scheme

P1: experimental priority for 2025: machine time granted but pulse budget might need reduction

P2: will be done if time allows after Prio 1 experiments are completed

P3: back-up programme

PB: piggy-back experiment/pure analysis proposal

Summary of proposals (26)

No	RT	Proposal name	Proposer	
17	RT02	Characterization of edge fluctuations for NT plasmas with ballooning modes	Margherita Ugoletti et al.	
18	RT02	Turbulent Edge/SOL Transport in EDA Regimes in TCV	Miriam La Matina et al.	
19	RT02	Turbulence Properties in the Edge of NT Plasmas	Thomas Pütterich	
20	RT02	Continued development of RMP ELM suppression scenario in tight aspect ratio geometry	David Ryan	
21	RT02	Exploration of the QCE regime in ASDEX Upgrade	Michael Faitsch,Mike Dunne	
22	RT02	Exploration of the QCE regime in MAST-U	Jessica Stobbs,Mike Dunne	
23	RT02	EDA H-mode in AUG and TCV	Luís Gil	
24	RT02	Impact of resonant field amplification (RFA) on edge magnetic structure and ELM control in high-beta plasmas	Yunfeng Liang	
25	RT02	Investigating possible reasons of different NT performance in AUG and TCV in view of iDTT NT scenarios	P.Mantica	
26	RT02	I-mode access in alternative divertor configurations in ASDEX Upgrade	Davide Silvagni, et al.	→ moved to RT07
27	RT02	High-radiative and detached I-mode in alternative divertor configuration in ASDEX Upgrade	Davide Silvagni, et al.	→ moved to RT07
28	RT02	The role of the QCM in EDA H mode and its relation to the QCE regime in AUG	Gustavo Grenfell, et al.	
29	RT02	I-mode access, power thresholds and confinement on WEST	Amanda Hubbard, Laure Vermare, et al.	
30	RT02	Investigations of the first wall power loads at different midplane separatrix positions in AUG	Andreas Redl	
31	RT02	Detachment in high-power L-mode NT plasmas and comparison with H-mode PT plasmas	Garance Durr-Legoupil-Nicoud, et al.	
32	RT02	Development of a stationary QH-mode scenario	Eleonora Viezzer, Samuli Saarelma	
33	RT02	Negative triangularity in conventional vs spherical tokamaks	Diego Jose Cruz Zabala, et al.	
34	RT02	Impurity transport in ELM-free scenarios in AUG	Mike Dunne, et al.	
35	RT02	Power threshold density minimum in I-mode and edge ion heat flux scaling	Jan Cecrdle et al.	
36	RT02	Advanced scenarios in negative triangularity	Antonia Frank	
37	RT02	Study of supershot-like scenario confinement on a ST	Francesco Paolo Orsitto	
38	RT02	Expansion of the stable beta_N negative-triangularity L-mode existence domain	Stefano Coda	
39	RT02	Using strongly negative triangularities on ASDEX Upgrade	Jörg Hobirk	
40	RT02	Development of NT on WEST and comparison with TCV	Olivier Sauter	
41	RT02	Similarity experiments of NT plasmas on TCV towards DEMO	Olivier Sauter	
42	RT02	Heating mix effect on RMP ELM suppression	Wolfgang Suttrop, et al.	
43	RT02	Why it is difficult to have a QCE at q95<4.5?	Benoit Labit, O. Sauter, et al	
185	RT09	Fast-ion transport in negative triangularity	J. Rasmussen	← coming from RT09

Summary of proposals

NT (11) | QCE (5) | EDA (3) | QH (1) | RMP (3) | I-mode (2) | Others (1)

No	RT	Proposal name	Proposer
17	RT02	Characterization of edge fluctuations for NT plasmas with ballooning modes	Margherita Ugoletti et al.
18	RT02	Turbulent Edge/SOL Transport in EDA Regimes in TCV	Miriam La Matina et al.
19	RT02	Turbulence Properties in the Edge of NT Plasmas	Thomas Pütterich
20	RT02	Continued development of RMP ELM suppression scenario in tight aspect ratio geometry	David Ryan
21	RT02	Exploration of the QCE regime in ASDEX Upgrade	Michael Faitsch, Mike Dunne
22	RT02	Exploration of the QCE regime in MAST-U	Jessica Stobbs,Mike Dunne
23	RT02	EDA H-mode in AUG and TCV	Luís Gil
24	RT02	Impact of resonant field amplification (RFA) on edge magnetic structure and ELM control in high-beta plasmas	Yunfeng Liang
25	RT02	Investigating possible reasons of different NT performance in AUG and TCV in view of iDTT NT scenarios	P.Mantica
28	RT02	The role of the QCM in EDA H mode and its relation to the QCE regime in AUG	Gustavo Grenfell, et al.
29	RT02	I-mode access, power thresholds and confinement on WEST	Amanda Hubbard, Laure Vermare, et al.
30	RT02	Investigations of the first wall power loads at different midplane separatrix positions in AUG	Andreas Redl
31	RT02	Detachment in high-power L-mode NT plasmas and comparison with H-mode PT plasmas	Garance Durr-Legoupil-Nicoud, et al.
32	RT02	Development of a stationary QH-mode scenario	Eleonora Viezzer, Samuli Saarelma
33	RT02	Negative triangularity in conventional vs spherical tokamaks	Diego Jose Cruz Zabala, et al.
34	RT02	Impurity transport in ELM-free scenarios in AUG	Mike Dunne, et al.
35	RT02	Power threshold density minimum in I-mode and edge ion heat flux scaling	Jan Cecrdle et al.
36	RT02	Advanced scenarios in negative triangularity	Antonia Frank
37	RT02	Study of supershot-like scenario confinement on a ST	Francesco Paolo Orsitto
38	RT02	Expansion of the stable beta_N negative-triangularity L-mode existence domain	Stefano Coda
39	RT02	Using strongly negative triangularities on ASDEX Upgrade	Jörg Hobirk
40	RT02	Development of NT on WEST and comparison with TCV	Olivier Sauter
41	RT02	Similarity experiments of NT plasmas on TCV towards DEMO	Olivier Sauter
42	RT02	Heating mix effect on RMP ELM suppression	Wolfgang Suttrop, et al.
43	RT02	Why it is difficult to have a QCE at q95<4.5?	Benoit Labit, O. Sauter, et al.
185	RT09	Fast-ion transport in negative triangularity	Jesper Rasmussen

Scientific Objectives and Machine Time

#	
D1	Quantify turbulent and MHD driven transport in the vicinity of the separatrix and implications for predictions for ITER and DEMO
D2	Quantify first wall load in no-ELM scenarios and provide model for SOL transport extrapolation
D3	Extend the parameters space of no-ELM scenarios to large Psep/R and/or pedestal top collisionallities relevant for ITER and DEMO
D4	Determine the key physics mechanisms regulating edge transport in order to access no-ELM regimes
D5	Quantify the overall performance of negative triangularity plasmas in view of DEMO

2025	AUG	TCV	MAST-U	WEST
Tentative allocation	45	120	48	15
Total proposed	207	375	169	50
Scientific/dev.	171/36	221/154	149/20	40/10

#17 Characterization of edge fluctuations for NT plasmas with ballooning modes

- **Proponents and contact person:**
- margherita.ugoletti@igi.cnr.it, M. Agostini, M. La Matina, T. Bolzonella, L. Pigatto, B. Labit, P. Hennequin, S. Rienaecker, M. van Rossem, W. Yinghan

- **Scientific Background & Objectives**

  Negative triangularity (NT) achieves H-mode level core performance with L-mode edge, making it attractive for future fusion reactors

- *Ballooning mode instability in NT:* In NT configurations, ideal ballooning modes destabilize at lower pressure gradients compared to PT, preventing the formation of the edge transport barrier (ETB) and suppressing H-mode.
- **Diagnostics and goals:** The Thermal Helium Beam (THB) diagnostics at TCV will be used to measure electron density, temperature, and filamentary structures, aiming to understand how plasma fluctuations change with plasma shaping

- **Experimental Strategy/Machine Constraints and essential diagnostic**
- Perform a scan in δ top in LSN on a shot-to-shot basis. Repeat the scan in δ bottom in USN to observe any differences. If there are no significant differences, prefer USN for compatibility with DBS and SPR. (5 shots)
- For each shot, apply a discrete ramp of NBI-1. Repeat the THB measurements during the various NBI-1 steps. (10 shots)
- Repeat most interesting shape with GPI mid-plane and SPR/DBS (10 shots).
- Note that the modification of δ is limited by the THB coverage.

THB is an essential diagnostic.

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	25	10
WEST		

#17 Characterization of edge fluctuations for NT plasmas with ballooning modes

- TFL assessment: **PB/P1**
- Should help to better understand specificities of NT edge

- **Proponents and contact person:**
- margherita.ugoletti@igi.cnr.it, M. Agostini, M. La Matina, T. Bolzonella, L. Pigatto, B. Labit, P. Hennequin, S. Rienaecker, M. van Rossem, W. Yinghan

- **Scientific Background & Objectives**

  Negative triangularity (NT) achieves H-mode level core performance with L-mode edge, making it attractive for future fusion reactors

- *Ballooning mode instability in NT:* In NT configurations, ideal ballooning modes destabilize at lower pressure gradients compared to PT, preventing the formation of the edge transport barrier (ETB) and suppressing H-mode.
- **Diagnostics and goals:** The Thermal Helium Beam (THB) diagnostics at TCV will be used to measure electron density, temperature, and filamentary structures, aiming to understand how plasma fluctuations change with plasma shaping

- **Experimental Strategy/Machine Constraints and essential diagnostic**
- Perform a scan in δ top in LSN on a shot-to-shot basis. Repeat the scan in δ bottom in USN to observe any differences. If there are no significant differences, prefer USN for compatibility with DBS and SPR. (5 shots)
- For each shot, apply a discrete ramp of NBI-1. Repeat the THB measurements during the various NBI-1 steps. (10 shots)
- Repeat most interesting shape with GPI mid-plane and SPR/DBS (10 shots).
- Note that the modification of δ is limited by the THB coverage.

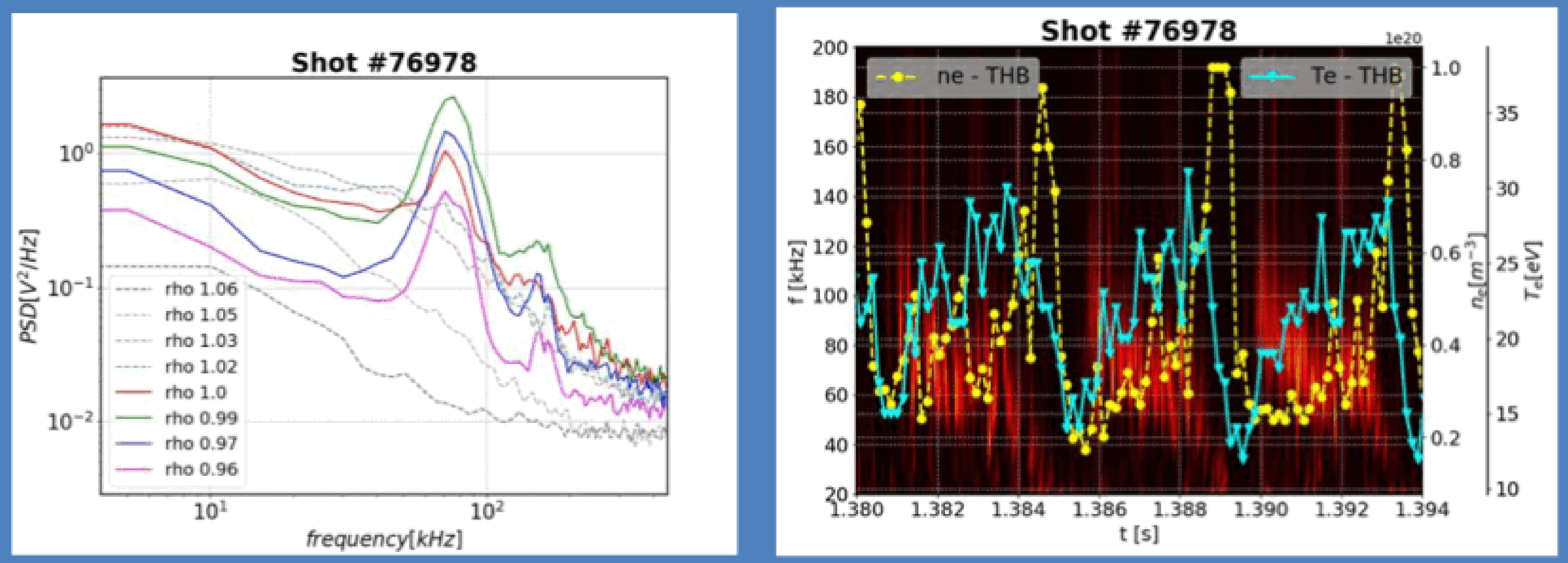
THB is an essential diagnostic.

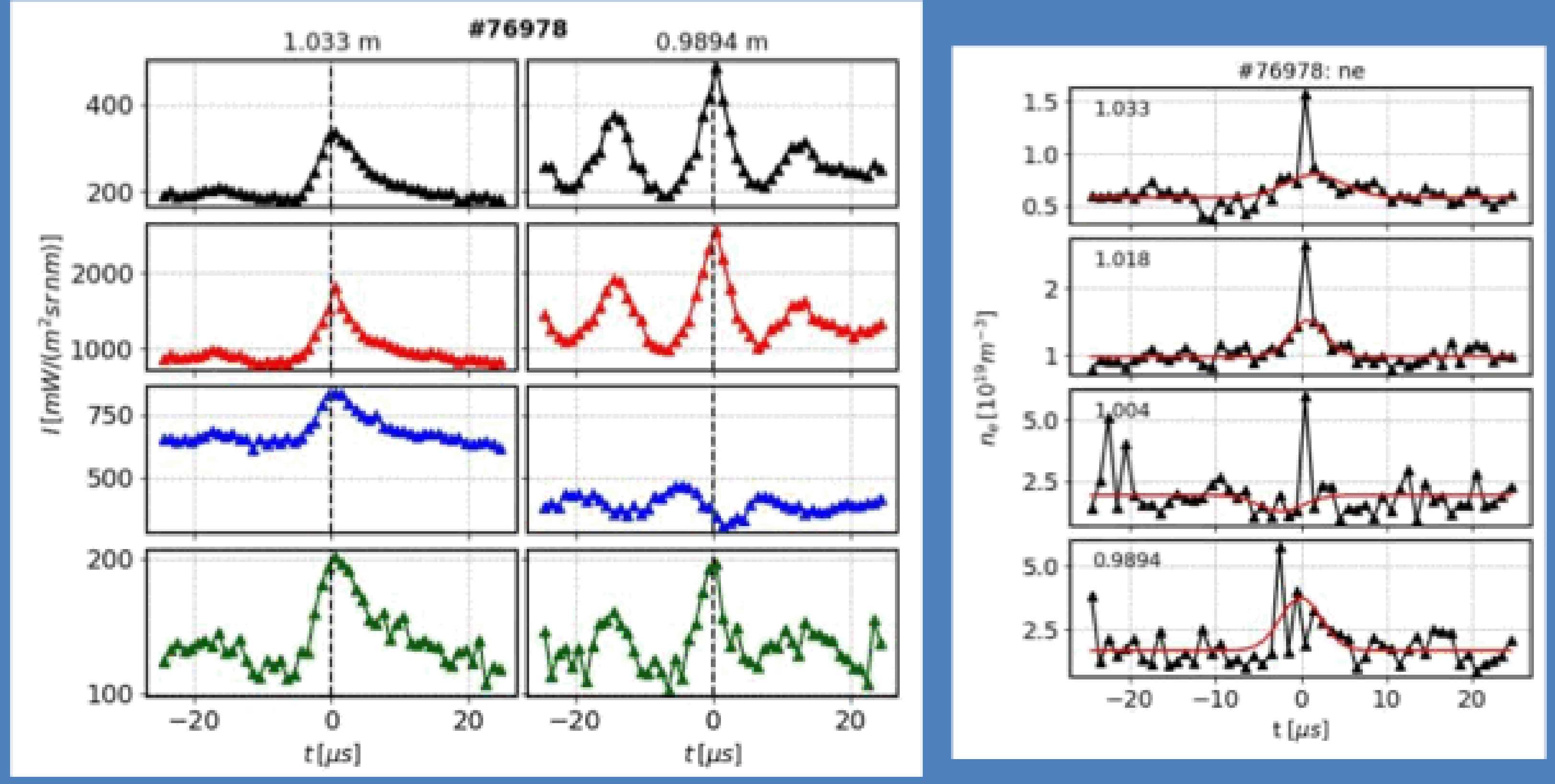
Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	25	10
WEST		

#18 Turbulent edge/SOL transport in EDA regimes in TCV

- **Proponents and contact person:**
  - Miriam La Matina (miriam.lamatina@igi.cnr.it)
  - Matteo Agostini
  - Margherita Ugoletti
  - Benoît Labit
  - Mack Van Rossem
  - Pascale Hennequin
  - Sascha Rienäcker





- **Scientific Background & Objectives**

Investigate turbulence activity and transport to identify their key characteristics and understand their role in determining the shape and stability properties of the pedestal in the EDA regime, specifically detecting and characterizing modes localized in the edge region, like the QCM using as primary diagnostic the Thermal Helium Beam (THB) diagnostic, together with SPR diagnostic and DBS diagnostic that will be used to:

  - Characterize the fluctuation activity across the pedestal and the separatrix to better identify/discriminate instability regimes, reconstructing the electron temperature and density fluctuations;
  - Characterize of edge instabilities, including QCM modes;
  - Characterize the SOL filaments;

- **Experimental Strategy/Machine Constraints and essential diagnostic**

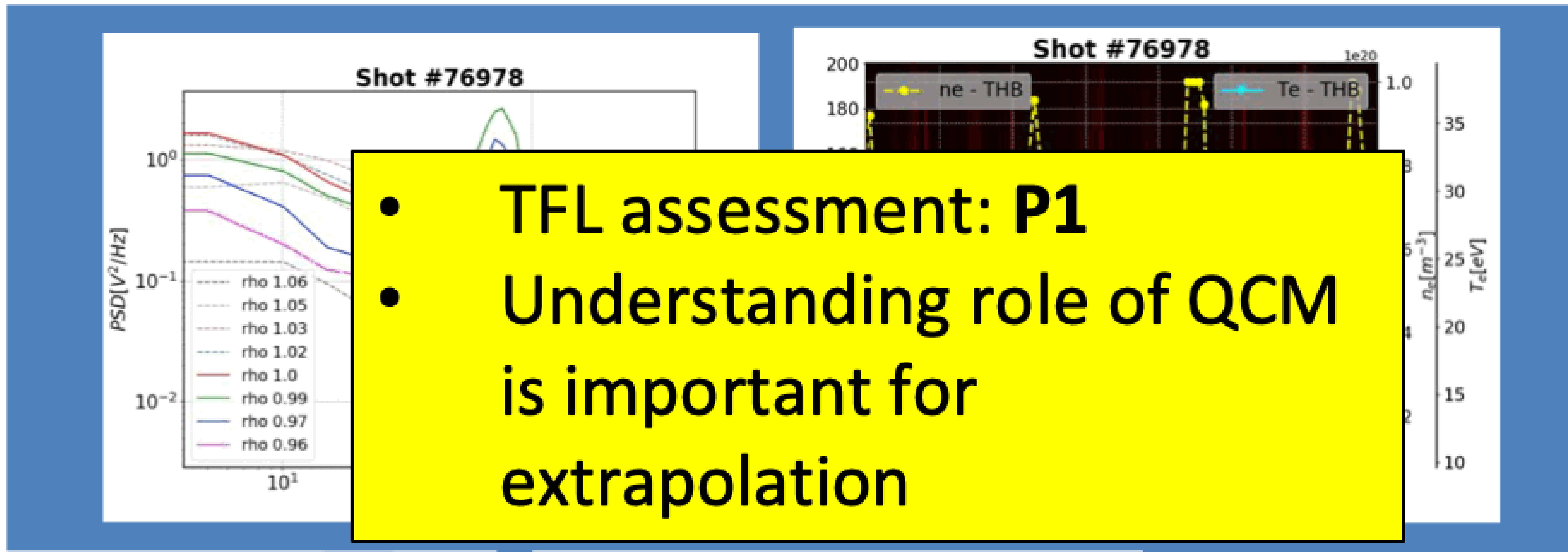
  - Perform parameter scans: heating power, plasma density) (around 4 pulses for each scan)
  - Vary the plasma shape and study its influence on the regime and ELM avoidance (4 pulses)
  - Execute stationary discharges with optimized diagnostic settings for detailed characterization of plasma (4 pulses)

Required non-standard diagnostics: THB, SPR and DBS

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	20	0
WEST		

#18 Turbulent edge/SOL transport in EDA regimes in TCV



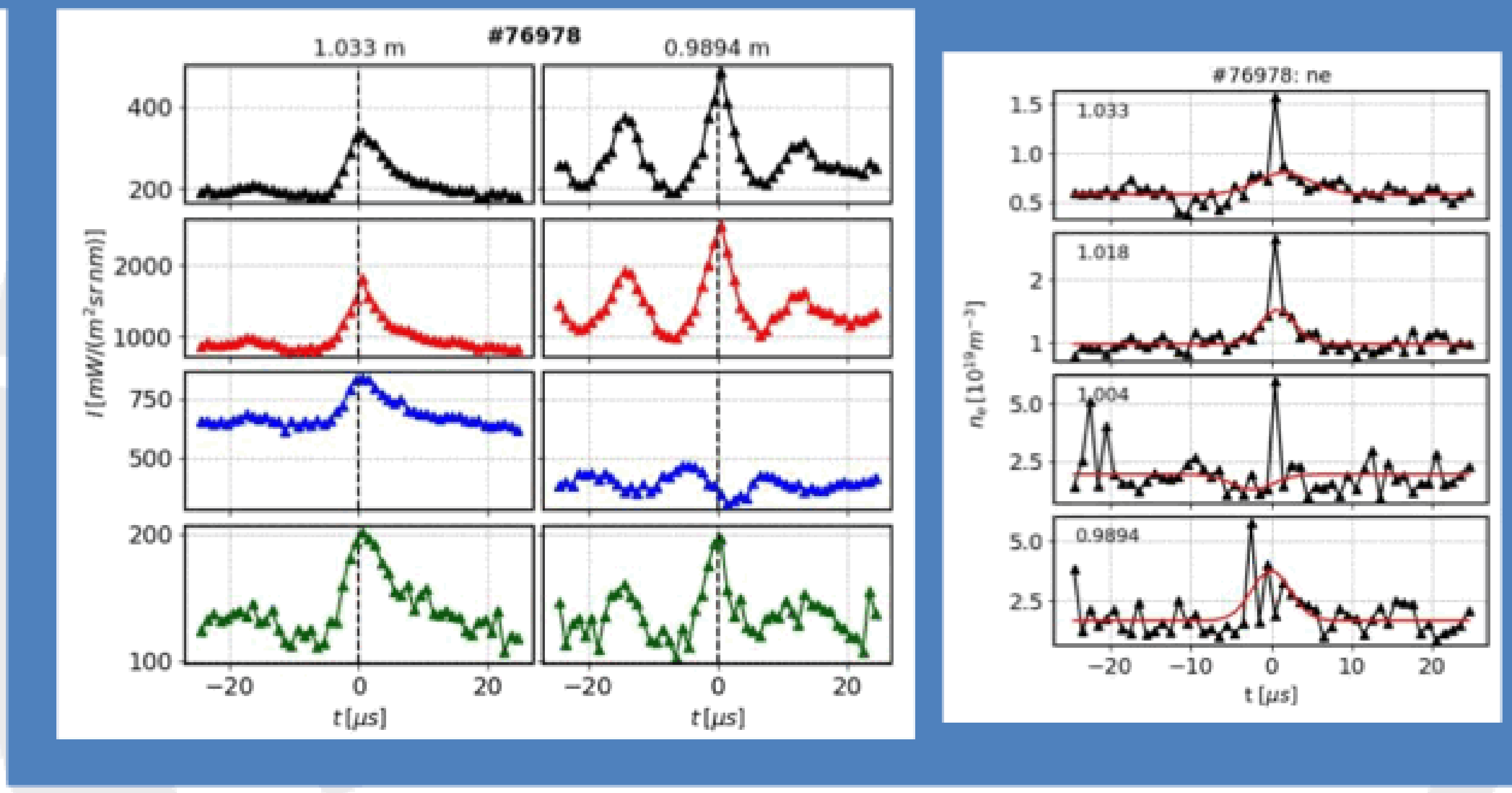
- TFL assessment: **P1**
- Understanding role of QCM is important for extrapolation

- **Proponents and contact person:**
  - Miriam La Matina (miriam.lamatina@igi.cnr.it)
  - Matteo Agostini
  - Margherita Ugoletti
  - Benoît Labit
  - Mack Van Rossem
  - Pascale Hennequin
  - Sascha Rienäcker

- **Scientific Background & Objectives**

Investigate turbulence activity and transport to identify their key characteristics and understand their role in determining the shape and stability properties of the pedestal in the EDA regime, specifically detecting and characterizing modes localized in the edge region, like the QCM using as primary diagnostic the Thermal Helium Beam (THB) diagnostic, together with SPR diagnostic and DBS diagnostic that will be used to:

- Characterize the fluctuation activity across the pedestal and the separatrix to better identify/discriminate instability regimes, reconstructing the electron temperature and density fluctuations;
- Characterize of edge instabilities, including QCM modes;
- Characterize the SOL filaments;



- **Experimental Strategy/Machine Constraints and essential diagnostic**

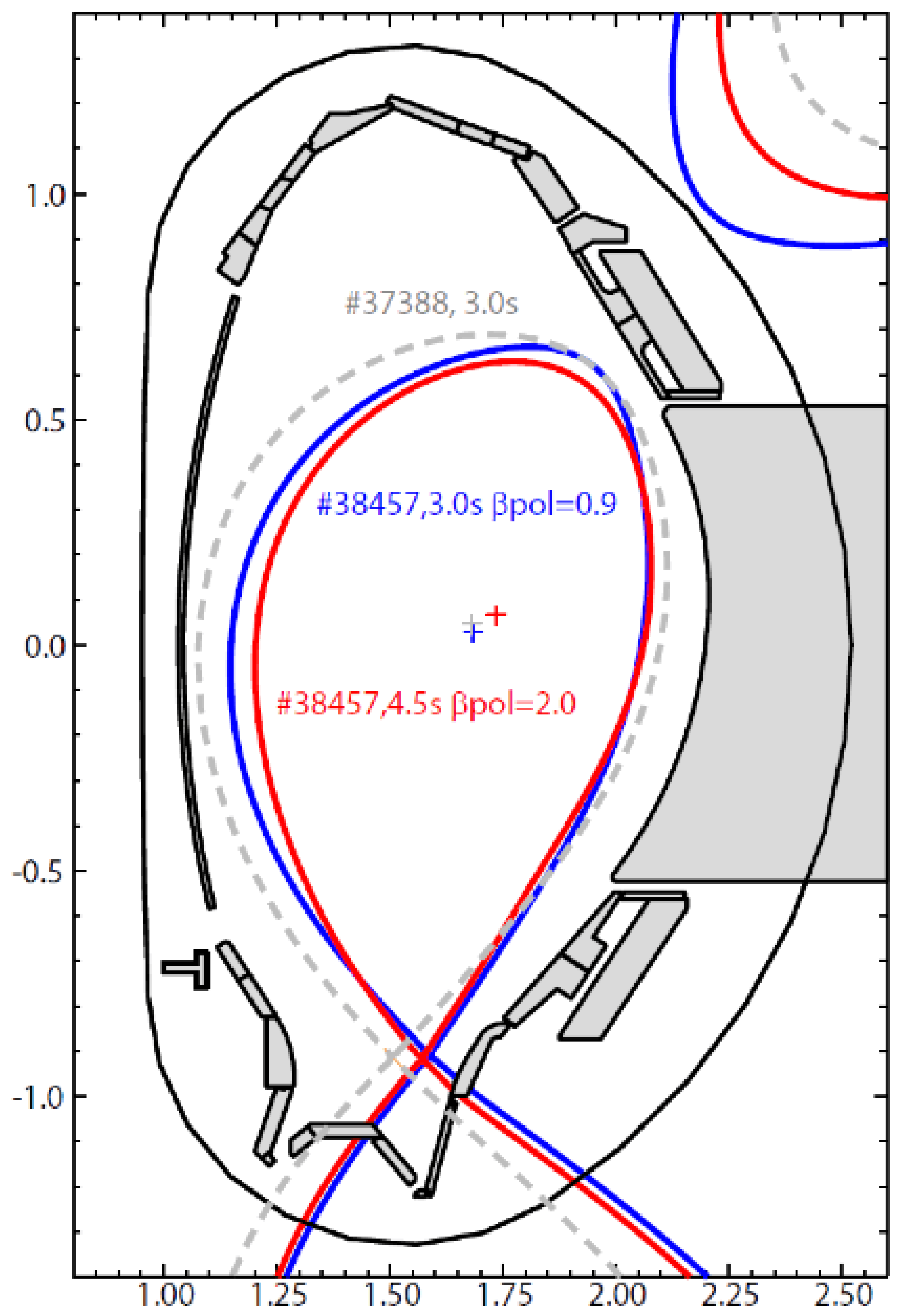
  - Perform parameter scans: heating power, plasma density) (around 4 pulses for each scan)
  - Vary the plasma shape and study its influence on the regime and ELM avoidance (4 pulses)
  - Execute stationary discharges with optimized diagnostic settings for detailed characterization of plasma (4 pulses)

Required non-standard diagnostics: THB, SPR and DBS

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	20	0
WEST		

#19 Turbulence properties in the Edge on NT plasmas



- **Proponents and contact person:**
  - Thomas.Pütterich thomas.puetterich@ipp.mpg.de
  - Branka Vanovac branka.vanovak@ipp.mpg.de
  - Jörg Hobirk joerg.hobirk@ipp.mpg.de
  - Tim Happel tim.happel@ipp.mpg.de

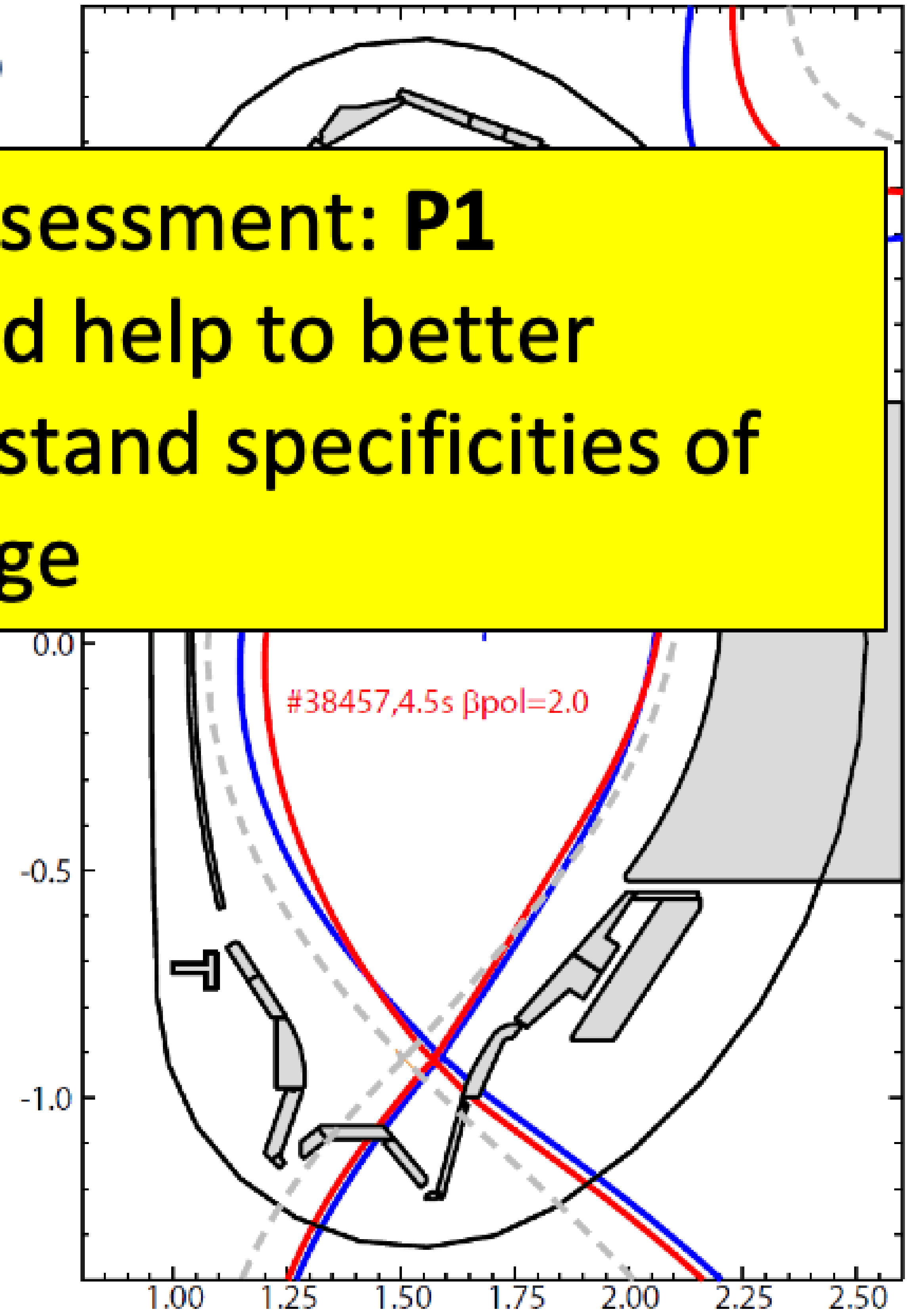
- **Scientific Background & Objectives**
  - NT plasmas provide a change in turbulence transport, which has not been characterized at AUG in detail
  - Measurement of fluctuation properties
  - Measurement of transport fluxes dependent on gradT/T

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Measure heat fluxes and gradT/T for varying gradT/T
    - Core heating + various ratios edge/core gyrotron provide different gradT/T at rho_pol=0.75
    - Modulation of a gyrotron provides chi_e
    - CECE and Doppler give fluctuation properties

Device	# Pulses/Session	# Development
AUG	8	2
MAST-U		
TCV		
WEST		

#19 Turbulence properties in the Edge on NT plasmas

- TFL assessment: **P1**
- Should help to better understand specificities of NT edge



- **Proponents and contact person:**
  - Thomas.Pütterich thomas.puetterich@ipp.mpg.de
  - Branka Vanovac branka.vanovak@ipp.mpg.de
  - Jörg Hobirk joerg.hobirk@ipp.mpg.de
  - Tim Happel tim.happel@ipp.mpg.de

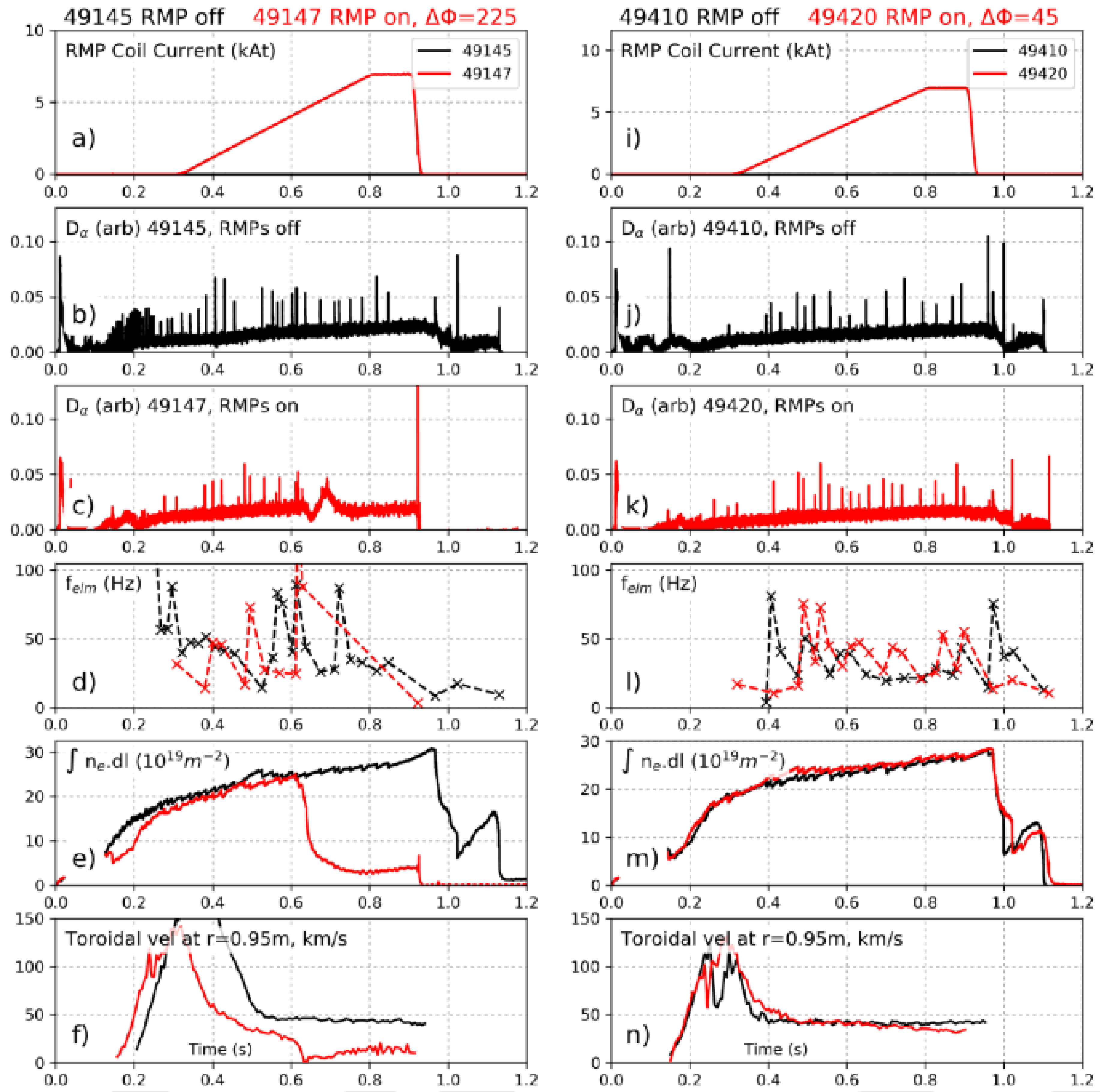
- **Scientific Background & Objectives**
  - NT plasmas provide a change in turbulence transport, which has not been characterized at AUG in detail
  - Measurement of fluctuation properties
  - Measurement of transport fluxes dependent on gradT/T

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Measure heat fluxes and gradT/T for varying gradT/T
    - Core heating + various ratios edge/core gyrotron provide different gradT/T at rho_pol=0.75
    - Modulation of a gyrotron provides chi_e
    - CECE and Doppler give fluctuation properties

Device	# Pulses/Session	# Development
AUG	8	2
MAST-U		
TCV		
WEST		

#20 Development of RMP ELM suppression scenario in tight aspect ratio geometry

- **Proponents and contact person:**
  D A Ryan (David.ryan@ukaea.uk)
- **Scientific Background & Objectives**
  - Optimize the RMP coil configuration to achieve n=2 ELM control without core mode locking.
  - Identify the access windows in global plasma parameters for ELM mitigation and suppression on MAST-U
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Complete the scan of n=2 RMP configurations begun in MU03
  - Compare measurements of rotation braking and density pump out with guidance from modelling, to identify optimal n=2 configuration for n=2 mitigation.
  - If mitigation not achieved in n=2, begin empirical scan of n=1 coil configuration, to investigate efficacy of n=3 sidebands.
  - Using newly developed cryopumped scenario, reduce density to lowest safe level
  - Applying optimized RMP field at lowest density, scan q95 to locate suppression access windows.



So far, n=2 applied RMPs on MAST-U have either no effect, or initiate a locked mode depending on the upper-lower coil phase. We must complete the scan to find a phase which reaches ELM mitigation without a LM.

Proposed pulses

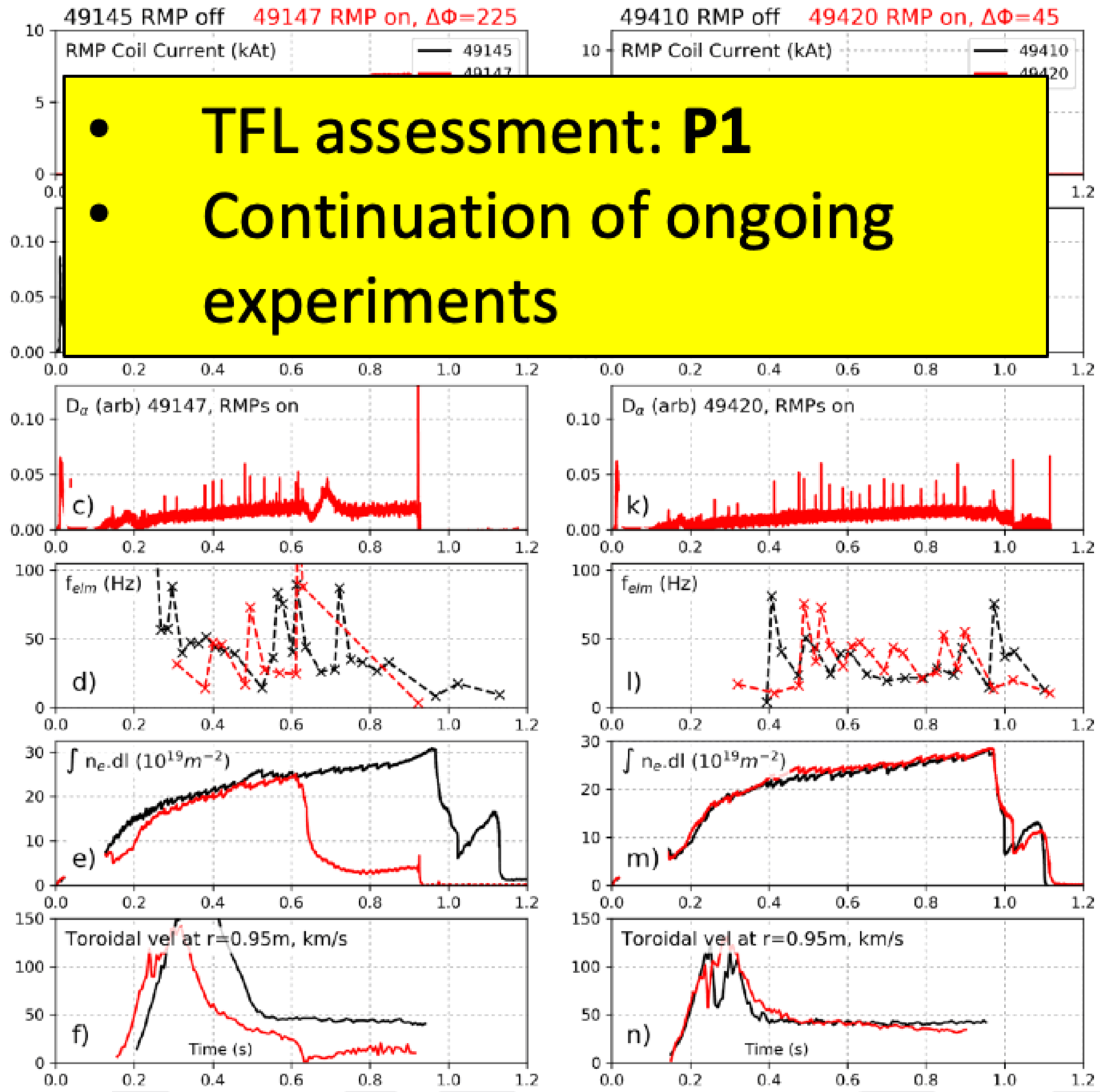
Device	# Pulses/Session	# Development
MAST-U	40/5	0/0

#20 Development of RMP ELM suppression scenario in tight aspect ratio geometry

- **Proponents and contact person:**
  D A Ryan (David.ryan@ukaea.uk)
- **Scientific Background & Objectives**
  - Optimize the RMP coil configuration to achieve n=2 ELM control without core mode locking.
  - Identify the access windows in global plasma parameters for ELM mitigation and suppression on MAST-U

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Complete the scan of n=2 RMP configurations begun in MU03
  - Compare measurements of rotation braking and density pump out with guidance from modelling, to identify optimal n=2 configuration for n=2 mitigation.
  - If mitigation not achieved in n=2, begin empirical scan of n=1 coil configuration, to investigate efficacy of n=3 sidebands.
  - Using newly developed cryopumped scenario, reduce density to lowest safe level
  - Applying optimized RMP field at lowest density, scan q95 to locate suppression access windows.

- TFL assessment: **P1**
- Continuation of ongoing experiments



So far, n=2 applied RMPs on MAST-U have either no effect, or initiate a locked mode depending on the upper-lower coil phase. We must complete the scan to find a phase which reaches ELM mitigation without a LM.

Proposed pulses

Device	# Pulses/Session	# Development
MAST-U	40/5	0/0

#21 Exploration of the QCE regime in ASDEX Upgrade

- **Proponents and contact person:**
  Michael.Faitsch@ipp.mpg.de,
  Mike.Dunne@ipp.mpg.de, many more

- **Scientific Background & Objectives**
  Two open aspect of the QCE are proposed to be addressed among others
  - Detachment and the interplay of the time dependent heat and particle fluxes due to the filaments (aka buffering)
  - High plasma current operation to investigate the leading access condition hypotheses

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  Seeding scans with N2, Ne and Ar
  - Main diagnostics: LPs, bolometry
  High plasma current operation (1MA+)
  - Main constraint are the shaping coil limits, disruption forces and the challenge of large and infrequent type-I ELM when searching the boundary of QCE
  - ...

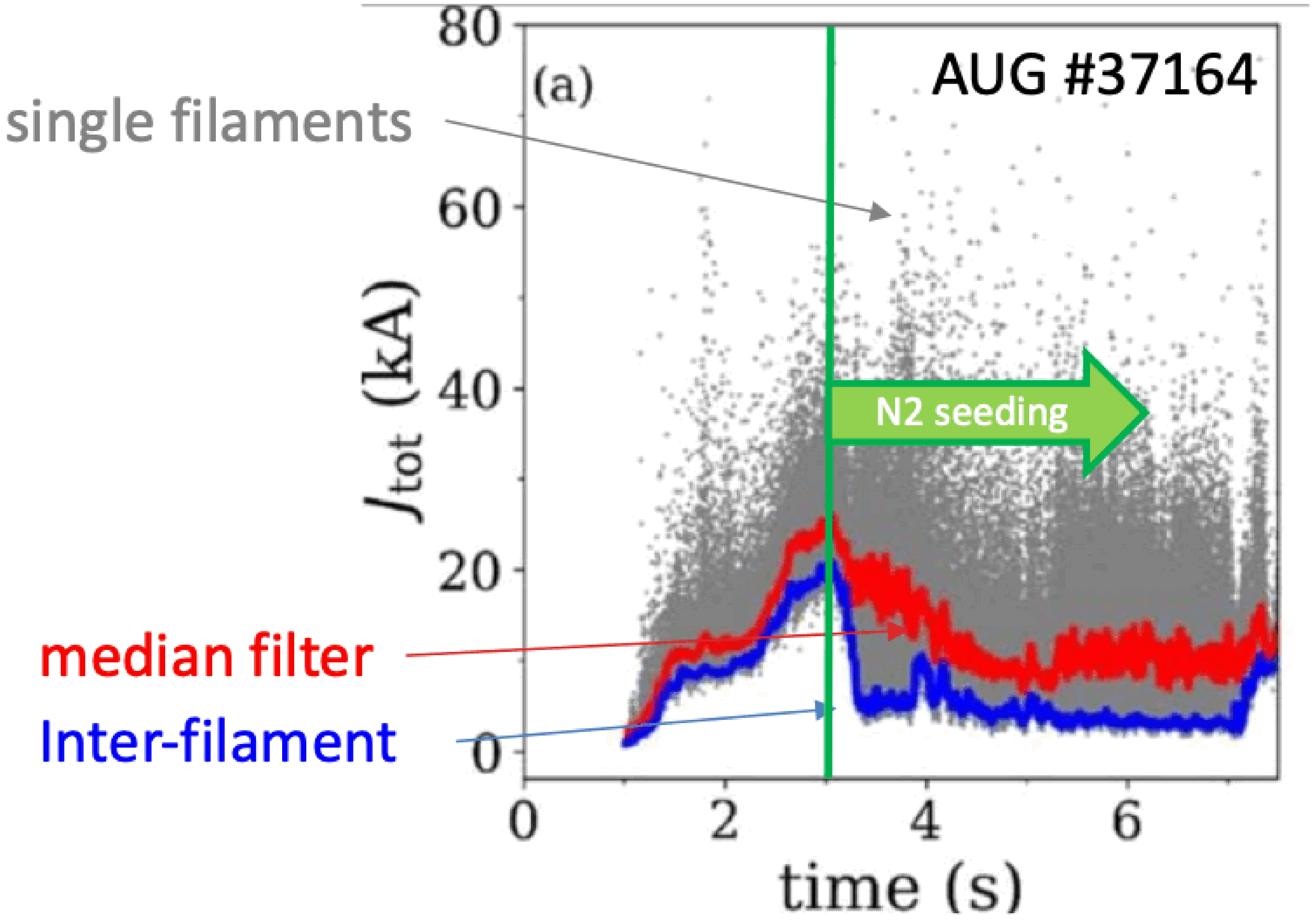


Figure from *[Faitsch, NF, 2023]*

Proposed pulses

Device	# Pulses/Session	# Development
AUG	26	-
MAST-U	-	-
TCV	-	-
WEST	-	-

#21 Exploration of the QCE regime in ASDEX Upgrade

- **Proponents and contact person:**
  Michael.Faitsch@ipp.mpg.de,
  Mike.Dunne@ipp.mpg.de, many more

- **Scientific Background & Objectives**
  Two open aspect of the QCE are proposed to be addressed among others
  - Detachment and the interplay of the time dependent heat and particle fluxes due to the filaments (aka buffering)
  - High plasma current operation to investigate the leading access condition hypotheses

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  Seeding scans with N2, Ne and Ar
  - Main diagnostics: LPs, bolometry

  High plasma current operation (1MA+)
  - Main constraint are the shaping coil limits, disruption forces and the challenge of large and infrequent type-I ELM when searching the boundary of QCE
  - ...

- TFL assessment: **P1**
- Established scenario
- Combine with #34

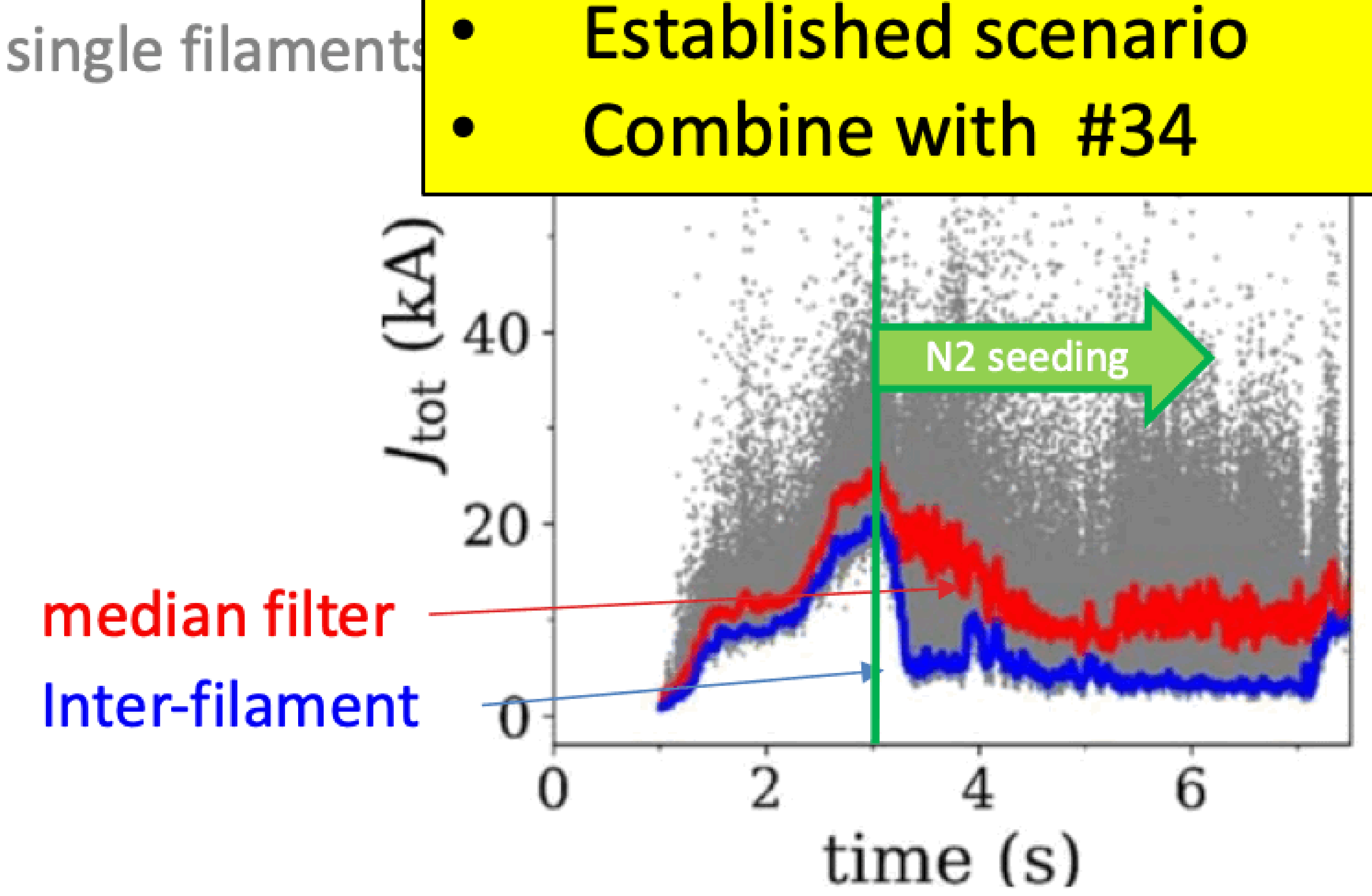


Figure from *[Faitsch, NF, 2023]*

Proposed pulses

Device	# Pulses/Session	# Development
AUG	26	-
MAST-U	-	-
TCV	-	-
WEST	-	-

Exploration of the QCE regime in MAST-U

- **Proponents and contact person:**
  Jessica.Stobbs@ipp.mpg.de,
  Mike.Dunne@ipp.mpg.de, many more

- **Scientific Background & Objectives**
  - Identify optimal divertor configurations to achieve high separatrix density.
  - Test shaping parameters in spherical tokamaks, focusing on double null vs single null configurations.
  - Examine filament behavior in the SOL and assess their burn-through potential to the divertor.
  - Compare filament characteristics with those observed on JET and AUG.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Compare conventional, extended leg, and Super-X divertors using gas puff ramps.
  - Shaping Parameters test, assess triangularity effects with double null (high elongation) and single null configurations.
  - Use strike point sweeps on the best QCE discharges to analyse filament burn-through to the divertor.
  - Density scans from ELMy H-mode to QCE to evaluate filament behavior across various q values.

MAST-U Reference shot

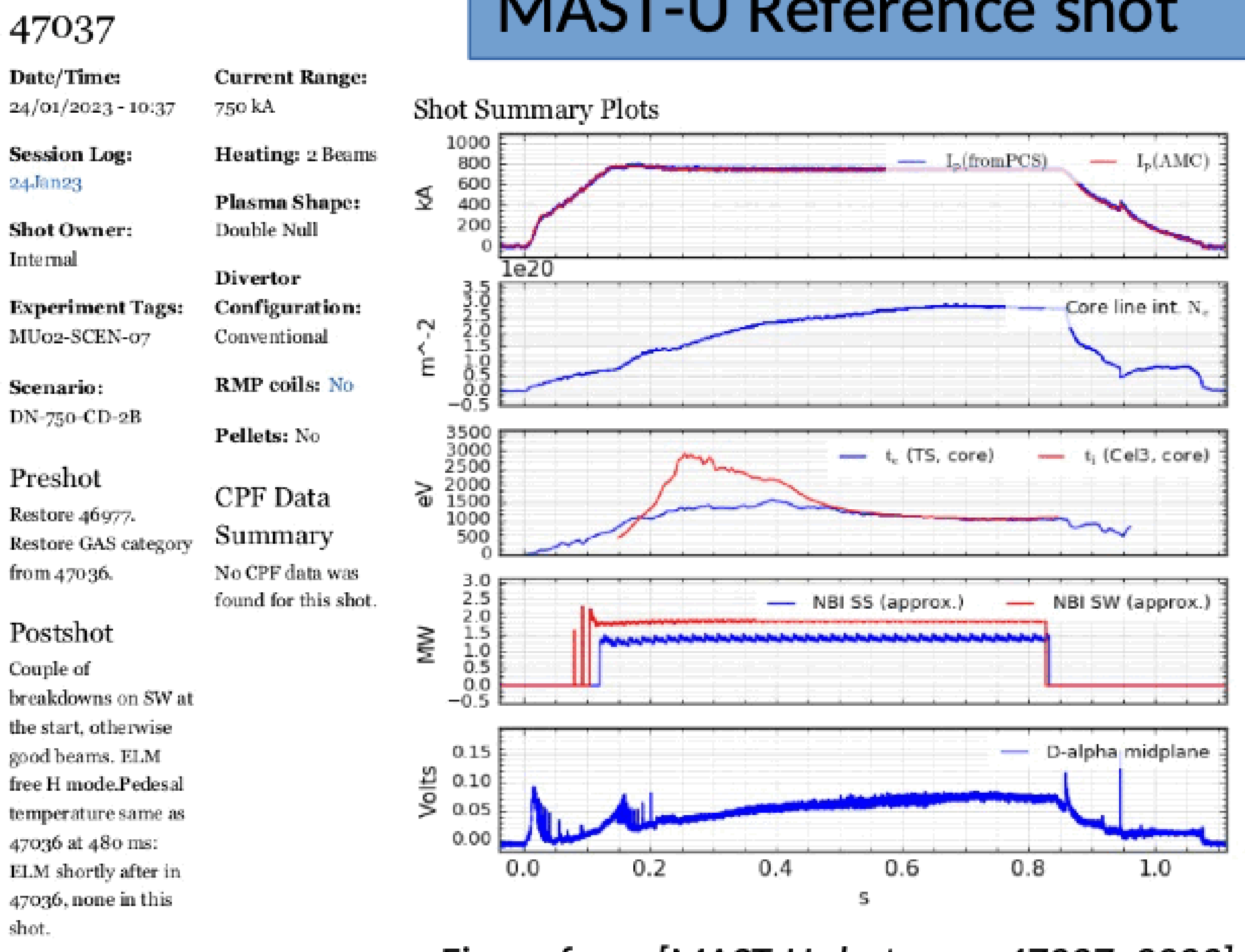


Figure from *[MAST-U shot page 47037, 2023]*

Proposed pulses

Device	# Pulses/Session	# Development
AUG	-	-
MAST-U	25	-
TCV	-	-
WEST	-	-

#22 Exploration of the QCE regime in MAST-U

- **Proponents and contact person:**
Jessica.Stobbs@ipp.mpg.de, Mike.Dunne@ipp.mpg.de, many more

- **Scientific Background & Objectives**
  - Identify optimal divertor configurations to achieve high separatrix density.
  - Test shaping parameters in spherical tokamaks, focusing on double null vs single null configurations.
  - Examine filament behavior in the SOL and assess their burn-through potential to the divertor.
  - Compare filament characteristics with those observed on JET and AUG.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Compare conventional, extended leg, and Super-X divertors using gas puff ramps.
  - Shaping Parameters test, assess triangularity effects with double null (high elongation) and single null configurations.
  - Use strike point sweeps on the best QCE discharges to analyse filament burn-through to the divertor.
  - Density scans from ELMy H-mode to QCE to evaluate filament behavior across various q values.

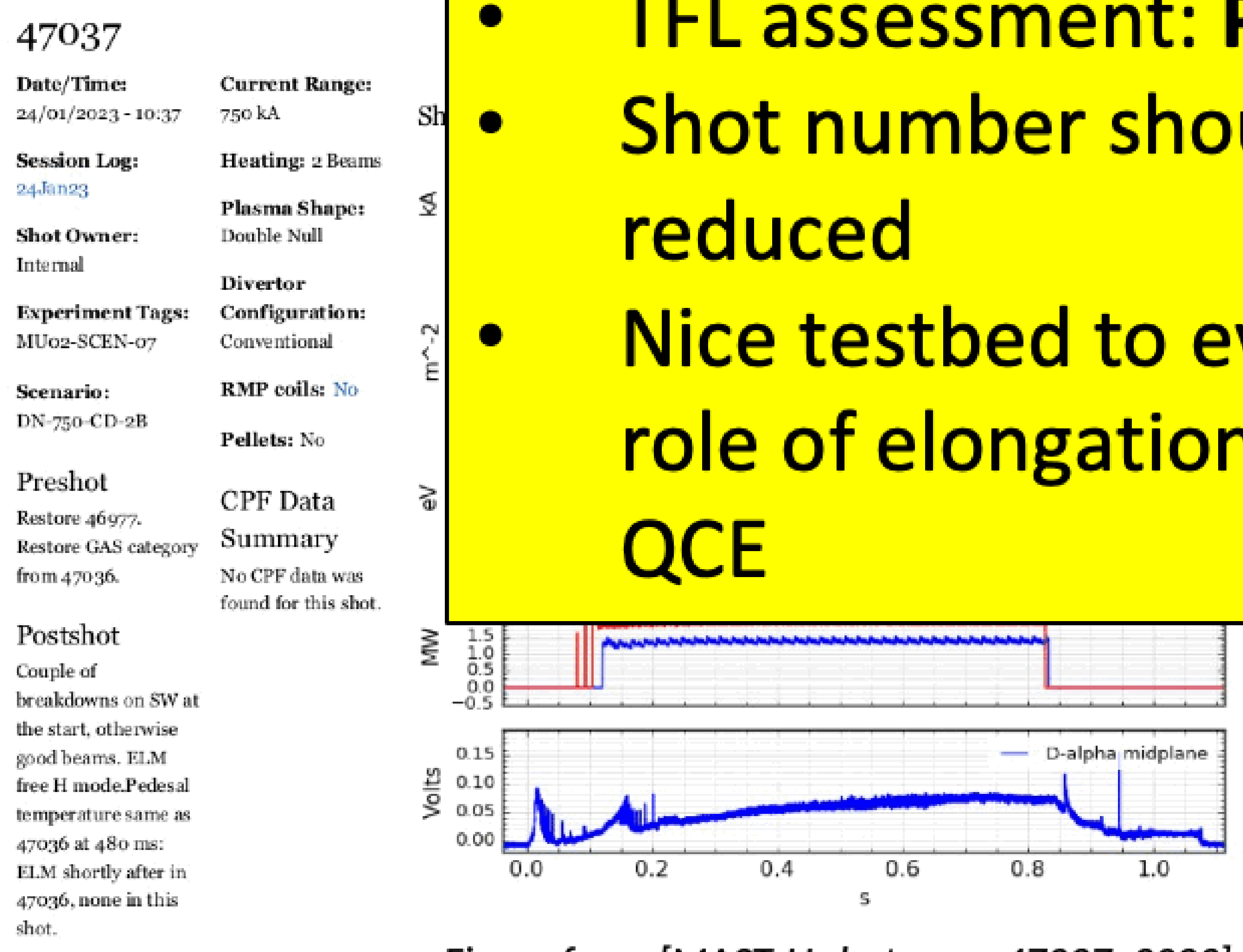


Figure from *[MAST-U shot page 47037, 2023]*

- TFL assessment: **P1**
- Shot number should be reduced
- Nice testbed to evaluate the role of elongation to access QCE

Proposed pulses

Device	# Pulses/Session	# Development
AUG	-	-
MAST-U	25	-
TCV	-	-
WEST	-	-

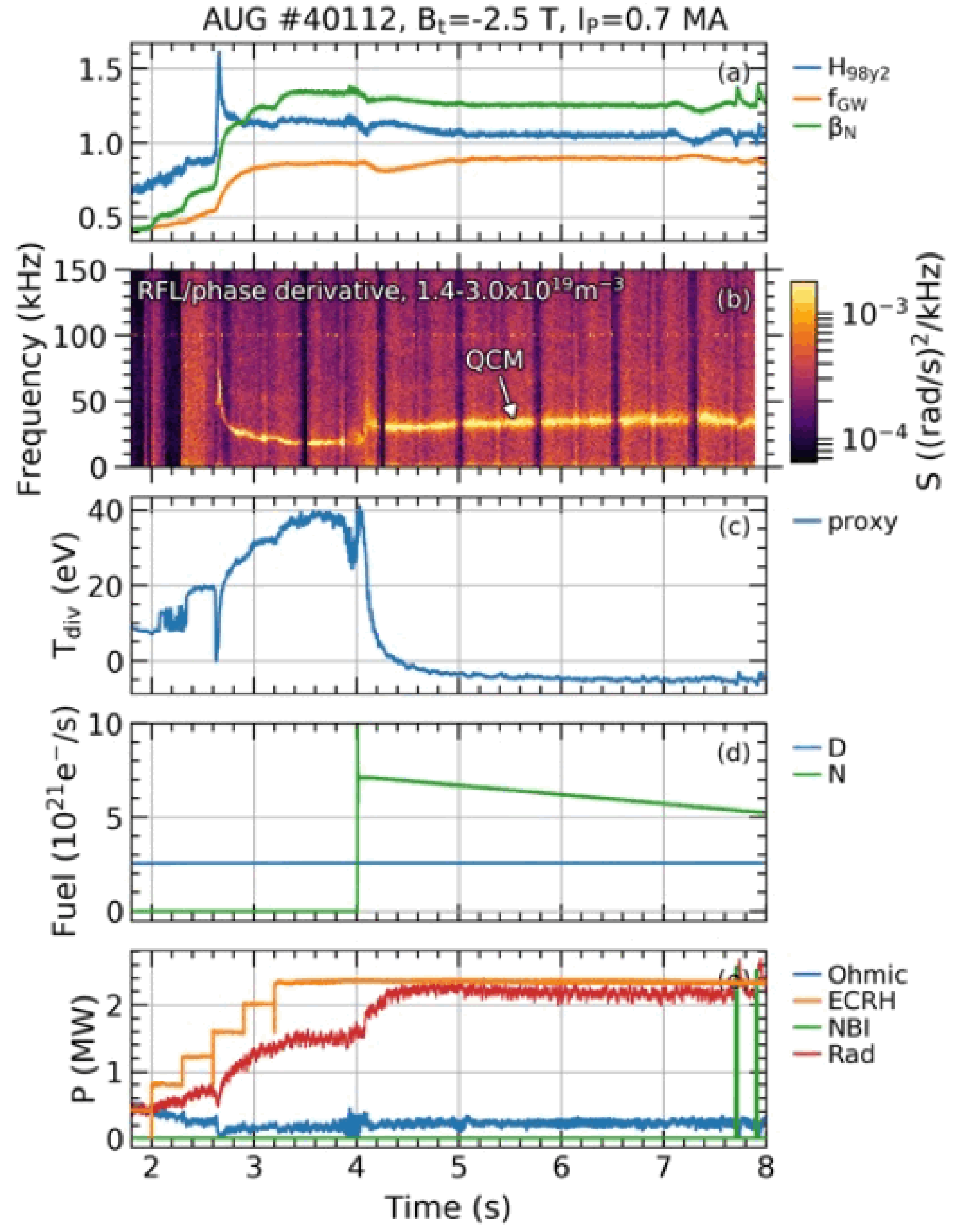
#23 EDA H-mode in AUG and TCV

- **Proponents and contact person:**
  L. Gil (lgil@ipfn.tecnico.ulisboa.pt), C. Silva, M. Faitsch, M. Dunne, T. Pütterich, O. Sauter, A. Merle, …

- **Scientific Background & Objectives**
  EDA H-mode is a promising no-ELM regime, but there are several open questions, such as:
  - Access conditions (incl. compatibility with low ν^*_{ped})
  - Pedestal structure and ELM avoidance
  - Effect of shaping, heating method, B_t, I_p, etc.
  - Quasi-coherent mode (QCM) nature and role
  - Controlled full detachment of divertor

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  AUG:
  - Scans of shape, heating mix, B_t, I_p, power, fueling, …
  - Alternative divertor configurations
  - Impurity seeding (N, Ar, Ne) and control
  - Stationary discharges for detailed characterization

  TCV:
  - High δ discharges predominantly heated by ECRH (X3)
  - If regime is found - Parameter scans (incl. shape), stationary pulses and impurity seeding



Proposed pulses

Device	# Pulses/Session	# Development
AUG	15	
TCV	10 pulses + 40 if regime is found	

#23 EDA H-mode in AUG and TCV

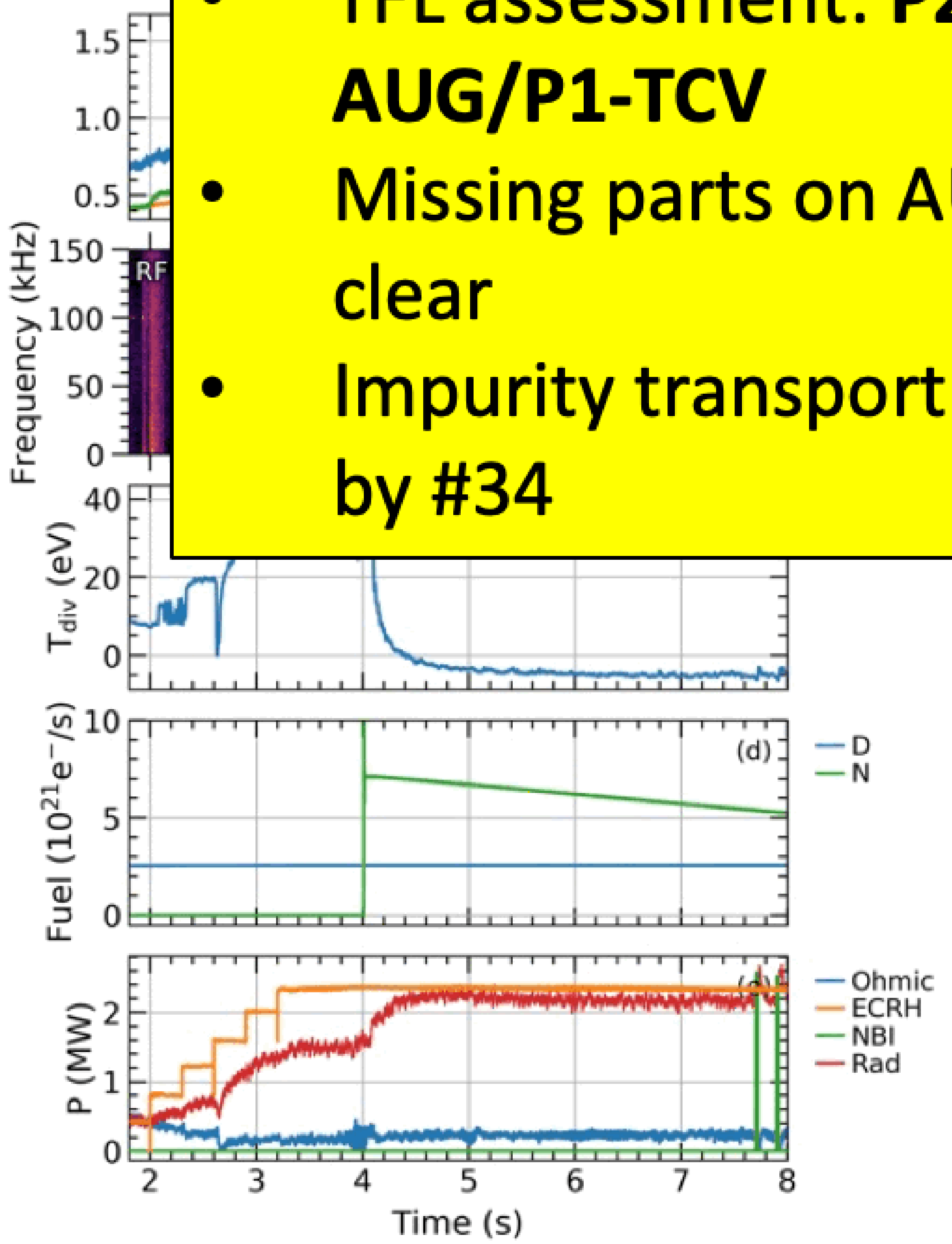
- **Proponents and contact person:**
  L. Gil (lgil@ipfn.tecnico.ulisboa.pt), C. Silva, M. Faitsch, M. Dunne, T. Pütterich, O. Sauter, A. Merle, …

- **Scientific Background & Objectives**
  EDA H-mode is a promising no-ELM regime, but there are several open questions, such as:
  - Access conditions (incl. compatibility with low ν^*_{ped})
  - Pedestal structure and ELM avoidance
  - Effect of shaping, heating method, B_t, I_p, etc.
  - Quasi-coherent mode (QCM) nature and role
  - Controlled full detachment of divertor

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  AUG:
  - Scans of shape, heating mix, B_t, I_p, power, fueling, …
  - Alternative divertor configurations
  - Impurity seeding (N, Ar, Ne) and control
  - Stationary discharges for detailed characterization

  TCV:
  - High δ discharges predominantly heated by ECRH (X3)
  - If regime is found - Parameter scans (incl. shape), stationary pulses and impurity seeding

- TFL assessment: **P2-AUG/P1-TCV**
- Missing parts on AUG not clear
- Impurity transport covered by #34

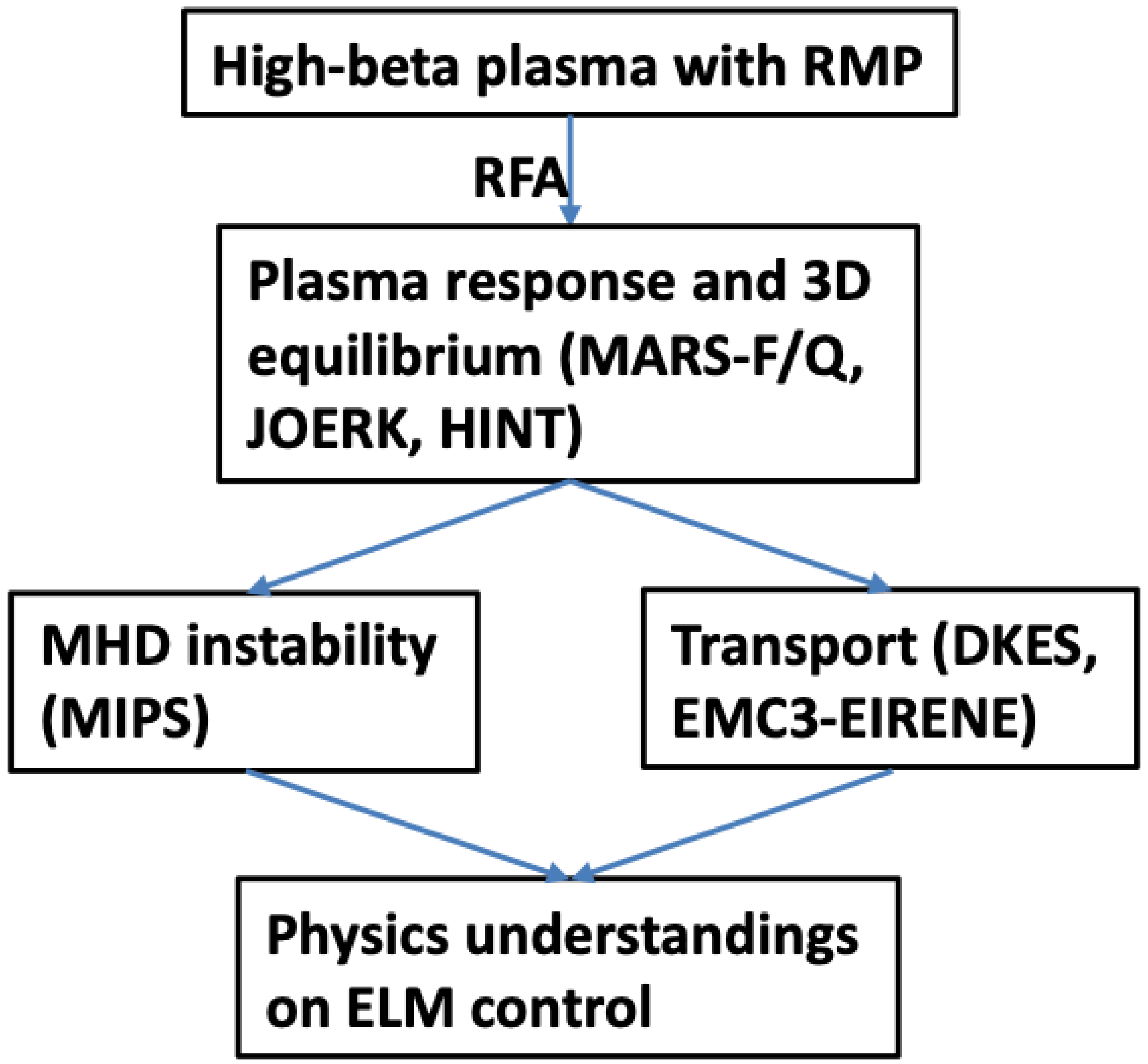


Proposed pulses

Device	# Pulses/Session	# Development
AUG	15	
TCV	10 pulses + 40 if regime is found	

#24 Impact of resonant field amplification (RFA) on edge magnetic structure and ELM control in high-beta plasmas

- **Proponents and contact person:**
  - y.liang@fz-juelich.de
- **Scientific Background & Objectives**
  - It is necessary to investigate the characteristics of RFA and the induced changes of edge magnetic structure and transport in high-beta plasmas, for the purpose of understanding physics mechanisms and designing experimental strategies for ELM control;
  - Measure and simulate plasma response due to RFA effect in high-beta plasmas for different beta and RMP configurations;
  - Measure and simulate RFA-induced changes of edge magnetic structure, pressure, bootstrap current and divertor heat load, investigate their relations to ELM control;
  - AUG: compare different physics mechanisms of ELM suppression in high-beta and low-beta plasmas, prepare for upcoming JT-60SA ELM control study;
  - MAST-U: explore effective strategy to achieve full ELM suppression in spherical tokamak by taking advantages of RFA effect in high-beta plasmas using different RMP configurations.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - AUG:
    - Establish conventional and hybrid ELMy H-mode plasmas with different beta;
    - For each pulse, apply n=1 or n=2 RMP, scan coil phasing during the discharge.
  - MAST-U:
    - Establish target ELMy H-mode plasmas with different beta;
    - Double-row RMP configuration: apply n=1 & 2 RMP, for best and worst coil phasing (predicted by MARS-F modeling) respectively;
    - Single-row (lower-row) RMP configuration: apply n=1, 2 and 4 RMP.
  - Essential diagnostics: magnetic diagnostics, TS, CXRS, MSE, IR cameras.



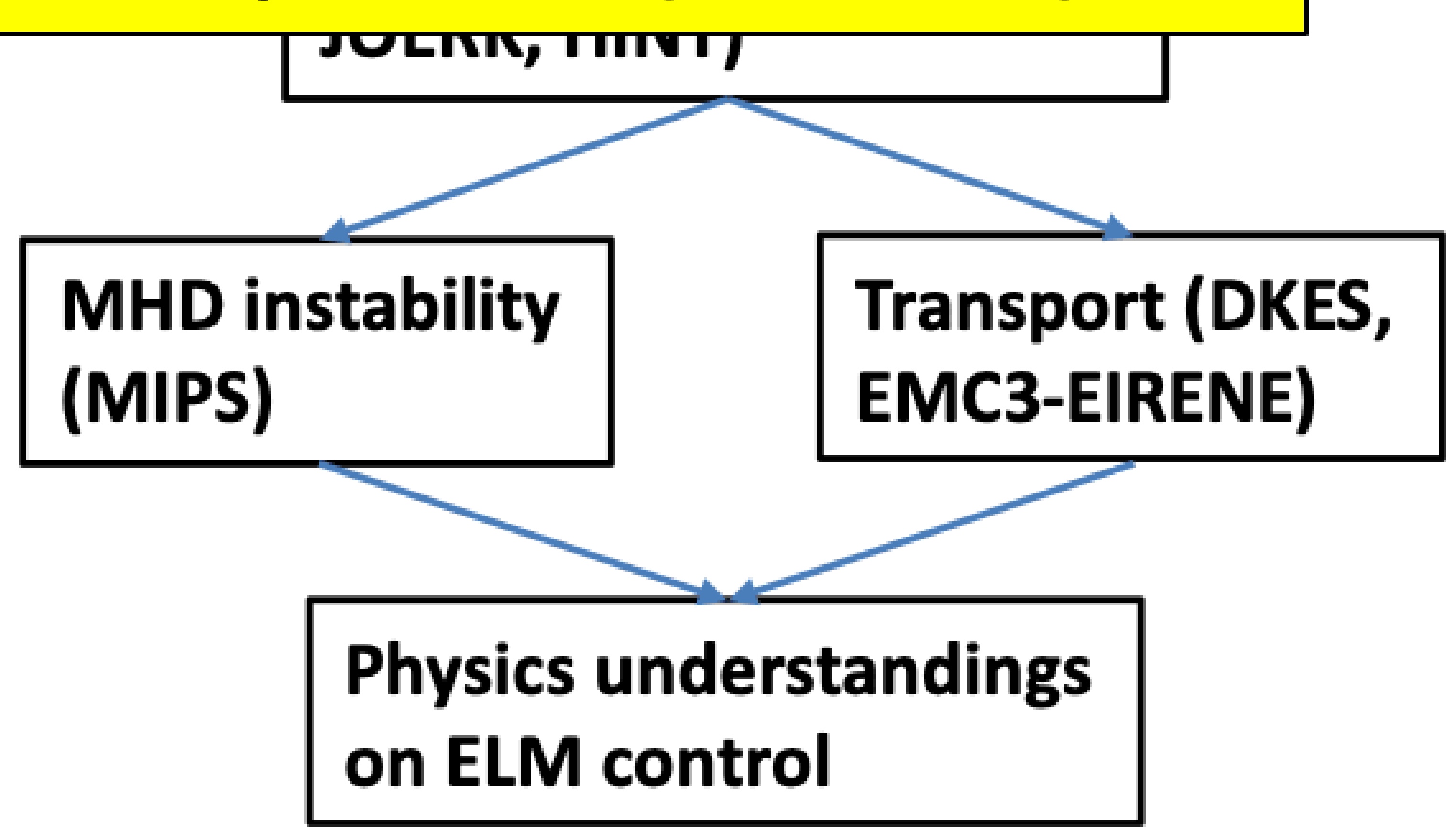
Proposed pulses

Device	# Pulses/Session	# Development
AUG	10	
MAST-U	14	
TCV		
WEST		

#24 Impact of resonant field amplification (RFA) on edge magnetic structure and ELM control in high beta plasmas

- TFL assessment: **P2**
- Strategy not clear
- Assess if combination with #20 is possible (MAST-U)

- **Proponents and contact person:**
  - y.liang@fz-juelich.de
- **Scientific Background & Objectives**
  - It is necessary to investigate the characteristics of RFA and the induced changes of edge magnetic structure and transport in high-beta plasmas, for the purpose of understanding physics mechanisms and designing experimental strategies for ELM control;
  - Measure and simulate plasma response due to RFA effect in high-beta plasmas for different beta and RMP configurations;
  - Measure and simulate RFA-induced changes of edge magnetic structure, pressure, bootstrap current and divertor heat load, investigate their relations to ELM control;
  - AUG: compare different physics mechanisms of ELM suppression in high-beta and low-beta plasmas, prepare for upcoming JT-60SA ELM control study;
  - MAST-U: explore effective strategy to achieve full ELM suppression in spherical tokamak by taking advantages of RFA effect in high-beta plasmas using different RMP configurations.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - AUG:
    - Establish conventional and hybrid ELMy H-mode plasmas with different beta;
    - For each pulse, apply n=1 or n=2 RMP, scan coil phasing during the discharge.
  - MAST-U:
    - Establish target ELMy H-mode plasmas with different beta;
    - Double-row RMP configuration: apply n=1 & 2 RMP, for best and worst coil phasing (predicted by MARS-F modeling) respectively;
    - Single-row (lower-row) RMP configuration: apply n=1, 2 and 4 RMP.
  - Essential diagnostics: magnetic diagnostics, TS, CXRS, MSE, IR cameras.



Proposed pulses

Device	# Pulses/Session	# Development
AUG	10	
MAST-U	14	
TCV		
WEST		

#25 Investigating possible reasons of different NT performance in AUG and TCV in view of iDTT NT scenarios

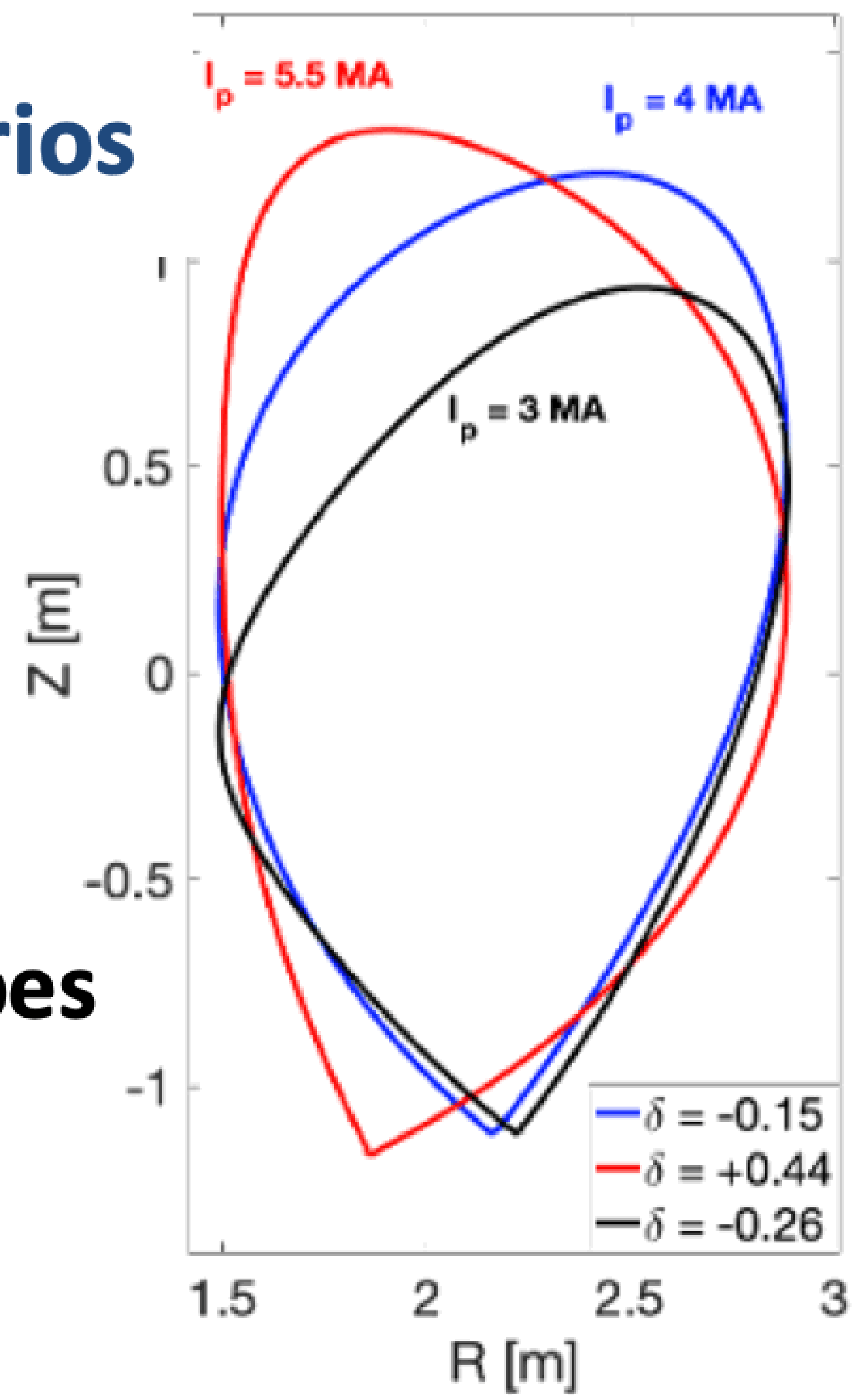
- **Proponents and contact person:**
- paola.mantica@istp.cnr.it,A.Mariani, A.Balestri, P.Innocente, L.Aucone,T.Pütterich, J.Hobirk

- **Scientific Background & Objectives**
  - A marked difference of the effect of NT geometry was observed in AUG and TCV even using the same shape and similar type of heating, with a remarkable density increase only in TCV. A special attention should be devoted to the impact that the neutral source may have in the NT vs PT transport changes. Main objectives:
  - Understand the role of neutrals in the confinement improvement with NT in TCV.
  - Clarify if this is a cause for better performance of NT in TCV wrt AUG, reproducing TCV conditions in AUG using pellets.
  - Test higher delta_top shape in AUG to see an increased effect of NT in AUG.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Repeat AUG NT shots with increased neutrals in the region 0.7-1 by pellet injection, to check if phenomenology becomes more similar to TCV NT. Reference pulses LD 40473, 40866,40869.
  - Repeat TCV NT shots with baffles to reduce neutrals and density increase, to check if phenomenology becomes more similar to AUG NT. Reference pulses LD 73382, HD 79911, HD 82672
  - Develop AUG NT shape with higher delta-top as designed for DTT and tested on TCV, to see if there is a clearer effect of NT on AUG plasmas

Devices	I_p/B_t	Shape	Heating	Gas	Essential non-standard Diagnostic
AUG	0.6-0.8 MA/2.5T	LSN, low-delta and high-delta NT shapes	NBI 4 MW, ECH 1.5-3 MW	D	Li-beam, ?
TCV	170->280 kA/1.4 T	LSN, low-delta and high-delta NT shapes	NBI 0.5 MW, ECRH 0.7 MW	D	CXRS, ?

iDTT shapes



Proposed pulses

Device	# Pulses/Session	# Development
AUG	8	4
TCV	6	3

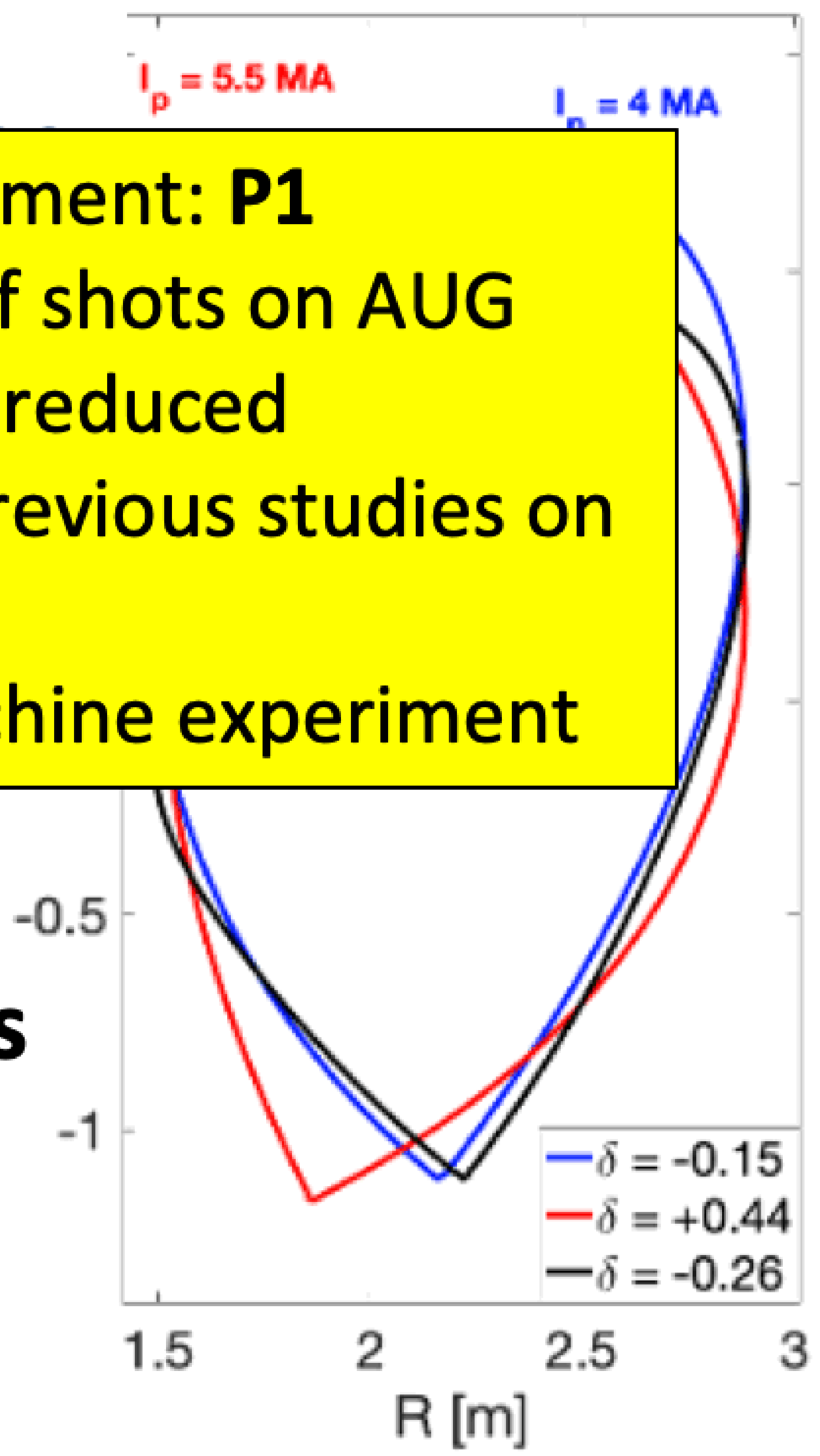
#25 Investigating possible reasons of different NT performance in AUG and TCV in view of iDTT

- **TFL assessment: P1**
- Number of shots on AUG should be reduced
- Extends previous studies on iDTT
- Cross-machine experiment

- **Proponents and contact person:**
  - paola.mantica@istp.cnr.it,A.Mariani, A.Balestri, P.Innocente, L.Aucone,T.Pütt
- **Scientific Background & Objectives**
  - A marked difference of the effect of NT geometry was observed in AUG and TCV ev using the same shape and similar type of heating, with a remarkable density increa only in TCV. A special attention should be devoted to the impact that the neutral so may have in the NT vs PT transport changes. Main objectives:
  - Understand the role of neutrals in the confinement improvement with NT in TCV.
  - Clarify if this is a cause for better performance of NT in TCV wrt AUG, reproducing TCV conditions in AUG using pellets.
  - Test higher delta_top shape in AUG to see an increased effect of NT in AUG.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Repeat AUG NT shots with increased neutrals in the region 0.7-1 by pellet injection, to check if phenomenology becomes more similar to TCV NT. Reference pulses LD 40473, 40866,40869.
  - Repeat TCV NT shots with baffles to reduce neutrals and density increase, to check if phenomenology becomes more similar to AUG NT. Reference pulses LD 73382, HD 79911, HD 82672
  - Develop AUG NT shape with higher delta-top as designed for DTT and tested on TCV, to see if there is a clearer effect of NT on AUG plasmas

Devices	I_p/B_t	Shape	Heating	Gas	Essential non-standard Diagnostic
AUG	0.6-0.8 MA/2.5T	LSN, low-delta and high-delta NT shapes	NBI 4 MW, ECH 1.5-3 MW	D	Li-beam, ?
TCV	170->280 kA/1.4 T	LSN, low-delta and high-delta NT shapes	NBI 0.5 MW, ECRH 0.7 MW	D	CXRS, ?

iDTT shapes



Proposed pulses

Device	# Pulses/Session	# Development
AUG	8	4
TCV	6	3

#28 QCM properties in EDA H-mode and its relation to QCE in ASDEX Upgrade

- **Proponents and contact person:**
  G. Grenfell (gustavo.grenfell@ipp.mpg.de), L. Gil, B. Vanovac, M. Griener, M. Faitsch, C. Silva…

- **Scientific Background & Objectives**
  The presence of a QCM is the main signature of EDA H-mode. In QCE, a less coherent QCM is often observed in AUG, which makes a possible link between these two regimes. Understanding their similarities and differences is the main focus of this proposal.
  - Combine different diagnostics for better QCM characterization (e.g., scanning probes, THB, CECE, DR, and reflectometry);
  - Compare fingerprints: mode radial location and amplitude, wavenumber, mode propagation velocity, cross-phases, and turbulence spreading rate.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  Discharges with EDA and QCE H-mode phases
  - Fueling scans in low power EDA H-mode
  - High shaping, ECRH and NBI
  - Midplane manipulator with high-heat flux ball-pen probe and magnetic probe heads.

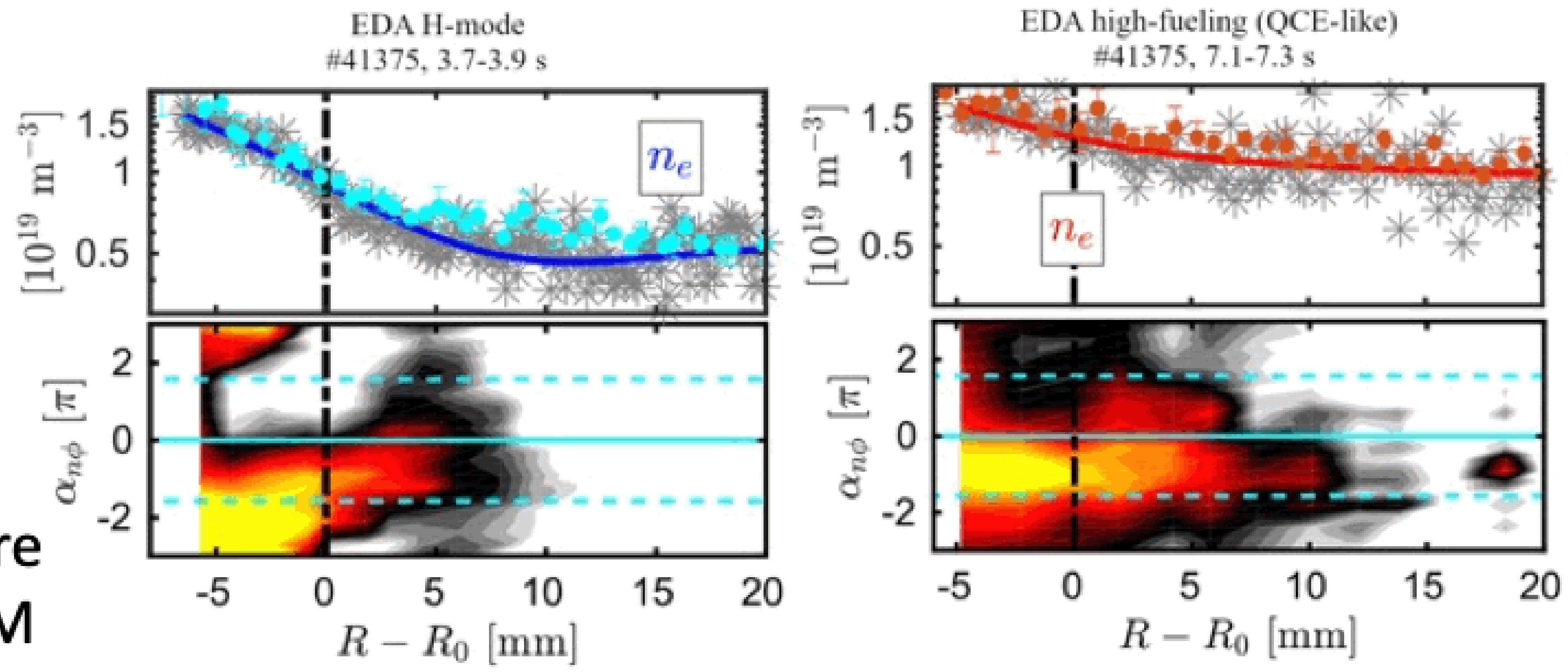


Figure 1: boundary density profiles measured by scanning probes and Li-beam, and QCM cross-phase between density and potential fluctuations during EDA H-mode and EDA high fueling (QCE-like) phases.

Proposed pulses

Device	# Pulses/Session	# Development
AUG	8	2
MAST-U		
TCV		
WEST		

#28 QCM properties in EDA H-mode and its relation to QCE in ASDEX Upgrade

- TFL assessment: **P2/PB**
- Piggyback whenever possible

- **Proponents and contact person:**
  G. Grenfell (gustavo.grenfell@ipp.mpg.de), L. Gil, B. Vanovac, M. Griener, M. Faitsch, C. Silva…

- **Scientific Background & Objectives**

  The presence of a QCM is the main signature of EDA H-mode. In QCE, a less coherent QCM is often observed in AUG, which makes a possible link between these two regimes. Understanding their similarities and differences is the main focus of this proposal.

  - Combine different diagnostics for better QCM characterization (e.g., scanning probes, THB, CECE, DR, and reflectometry);

  - Compare fingerprints: mode radial location and amplitude, wavenumber, mode propagation velocity, cross-phases, and turbulence spreading rate.

- **Experimental Strategy/Machine Constraints and essential diagnostic**

  Discharges with EDA and QCE H-mode phases
  - Fueling scans in low power EDA H-mode
  - High shaping, ECRH and NBI
  - Midplane manipulator with high-heat flux ball-pen probe and magnetic probe heads.

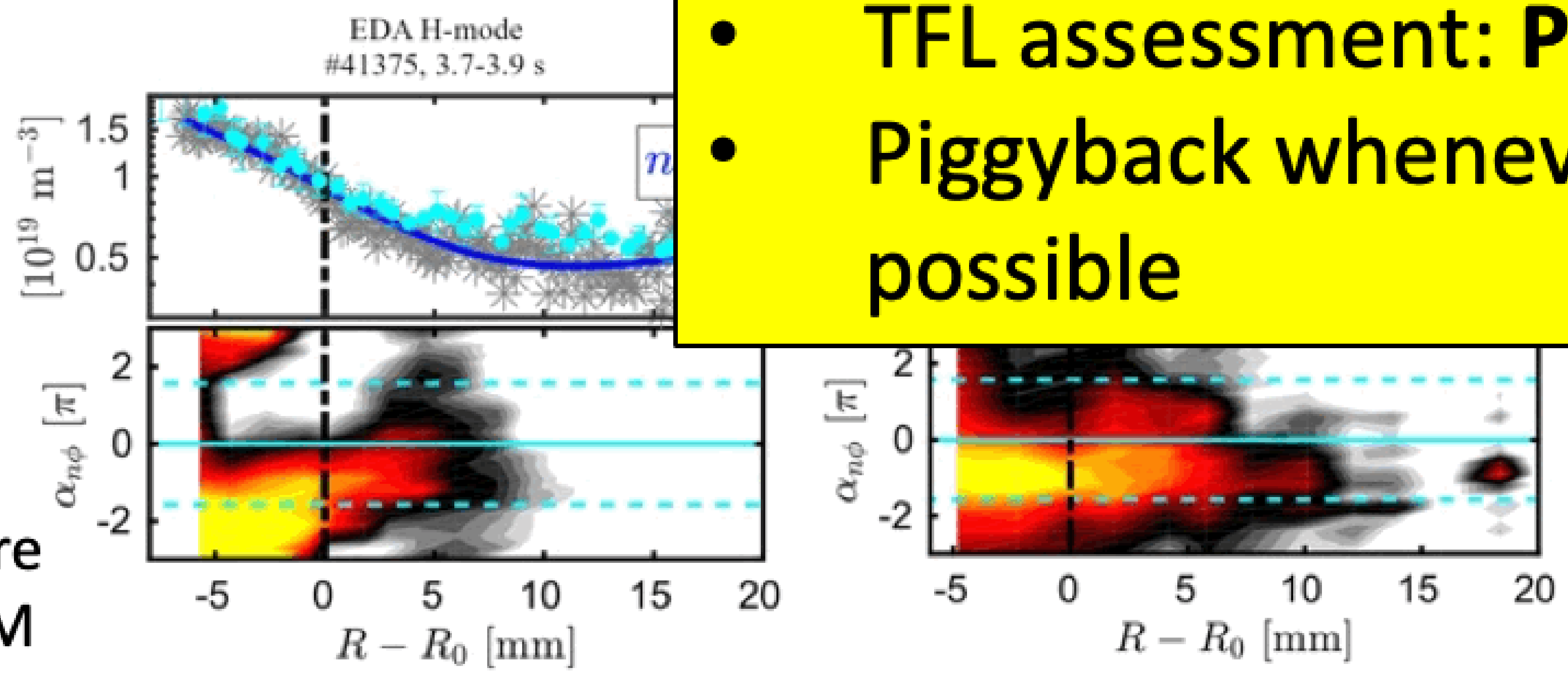


Figure 1: boundary density profiles measured by scanning probes and Li-beam, and QCM cross-phase between density and potential fluctuations during EDA H-mode and EDA high fueling (QCE-like) phases.

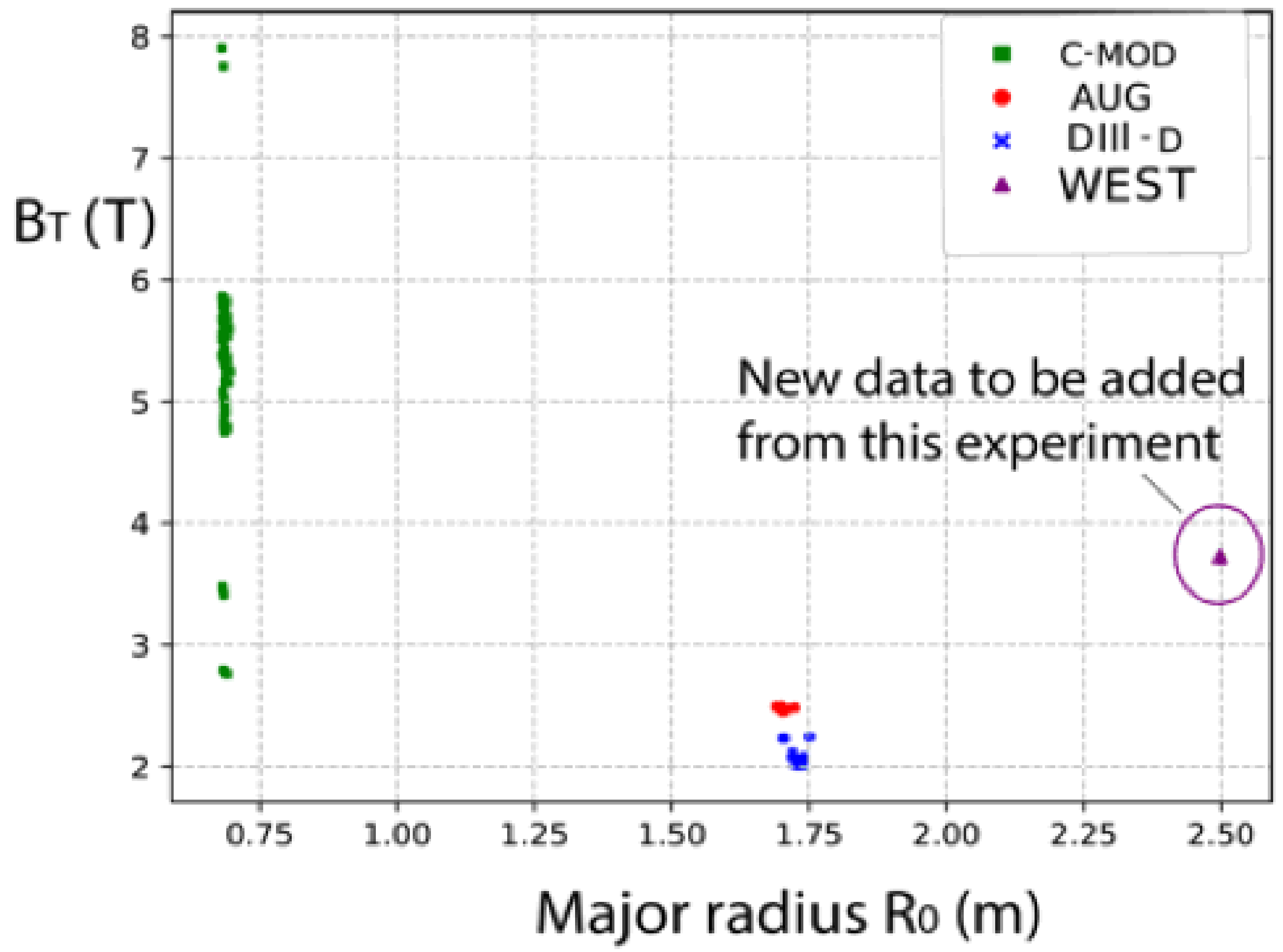
Proposed pulses

Device	# Pulses/Session	# Development
AUG	8	2
MAST-U		
TCV		
WEST		

#29 I-mode access, power thresholds and confinement on WEST

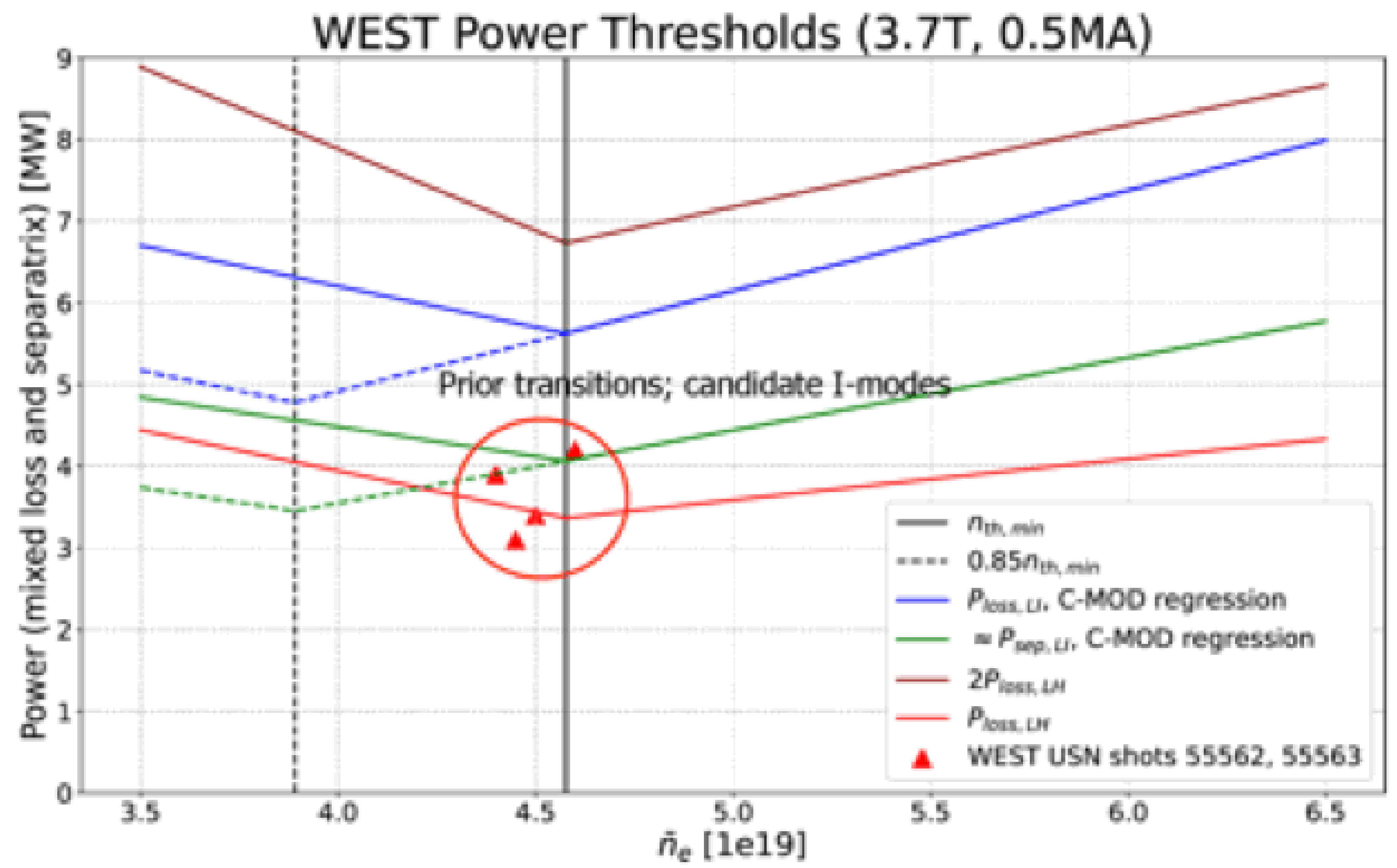
Contact person: Amanda Hubbard (hubbard@psfc.mit.edu),

- **Other Proponents** Laure Vermare, Ecole Polytechnique LPP, J. Rice, A. Cavallaro, MIT PSFC, Davide Silvagni, IPP Garching,



Scientific Background & Objectives

- Study the magnetic field, density and size dependence of I-mode access and energy confinement to improve extrapolations to future devices. WEST data will break correlations, improve scalings *(top figure)*.
- Additional ECRH power and new edge Thomson scattering system available in new campaign will strongly help access and identification of stable I-mode



Experimental Strategy

- Start with existing transitions/candidate I-modes (Vermare et al NF 2022): **USN, 3.7 T, 500 kA, n_e~4.5x10^{19} m^{-3}.**
  Close to predicted P_{sep}(L-I) from C-Mod! *(bottom figure)*
- Step ICRH and/or LH power to find L-I, I-H thresholds. +ECH if avail.
- Scan target n_e up and down to determine n_e for minimum P(L-I), scaling. Repeat P scans (2-3 shots per density, 6 densities).
- Small I_p scan at optimum n_e to reduce q_{95}. (2-3 shots).
- Edge TS, DBS among important diagnostics.
- A 2nd session would enable other objectives *(see full proposal)*.

Device	# Pulses/Session	# Development
WEST	20 pulses/1 session	

#29 I-mode access, power thresholds and confinement on WEST

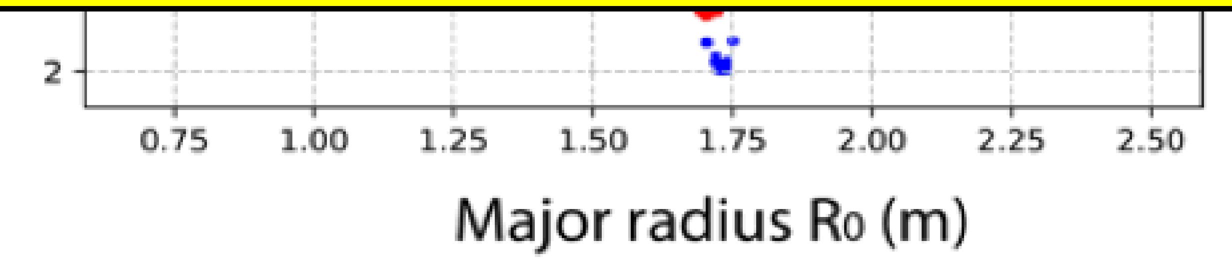
- TFL assessment: **P1**
- New WEST capabilities
- Dependence on Bt for I-mode access needs clarification

Contact person: Amanda Hubbard (hubbard@psfc.mit.edu),

- **Other Proponents** Laure Vermare, Ecole Polytechnique LPP, J. Rice, A. Cavallar[o] MIT PSFC, Davide Silvagni, IPP Garching,

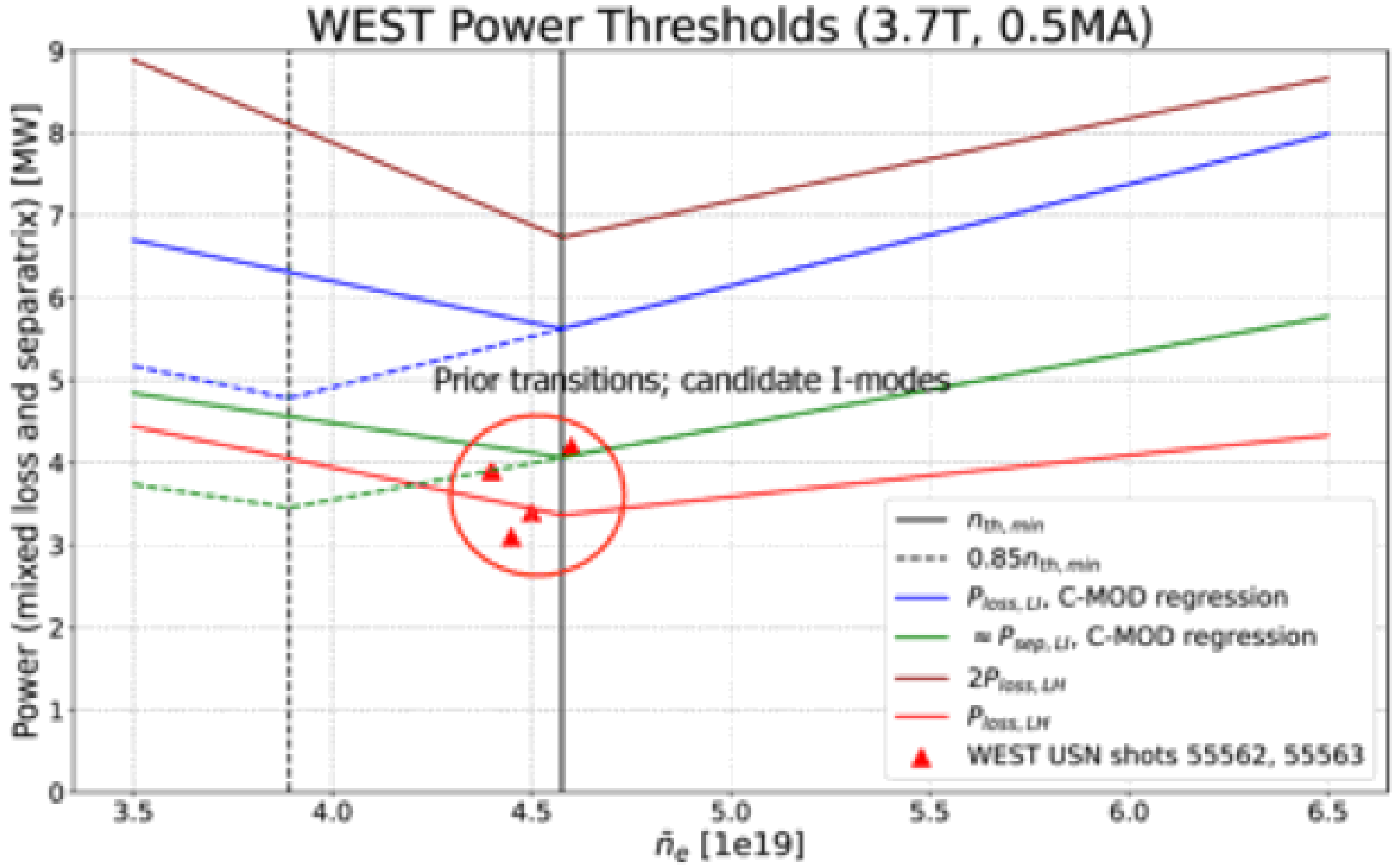
Scientific Background & Objectives

- Study the magnetic field, density and size dependence of I-mode access and energy confinement to improve extrapolations to future devices. WEST data will break correlations, improve scalings *(top figure)*.
- Additional ECRH power and new edge Thomson scattering system available in new campaign will strongly help access and identification of stable I-mode



Experimental Strategy

- Start with existing transitions/candidate I-modes (Vermare et al NF 2022): **USN, 3.7 T, 500 kA, n_e~4.5x10^{19} m^{-3}**.
  Close to predicted P_{sep}(L-I) from C-Mod! *(bottom figure)*
- Step ICRH and/or LH power to find L-I, I-H thresholds. +ECH if avail.
- Scan target n_e up and down to determine n_e for minimum P(L-I), scaling. Repeat P scans (2-3 shots per density, 6 densities).
- Small I_p scan at optimum n_e to reduce q_{95}. (2-3 shots).
- Edge TS, DBS among important diagnostics.
- A 2nd session would enable other objectives *(see full proposal)*.



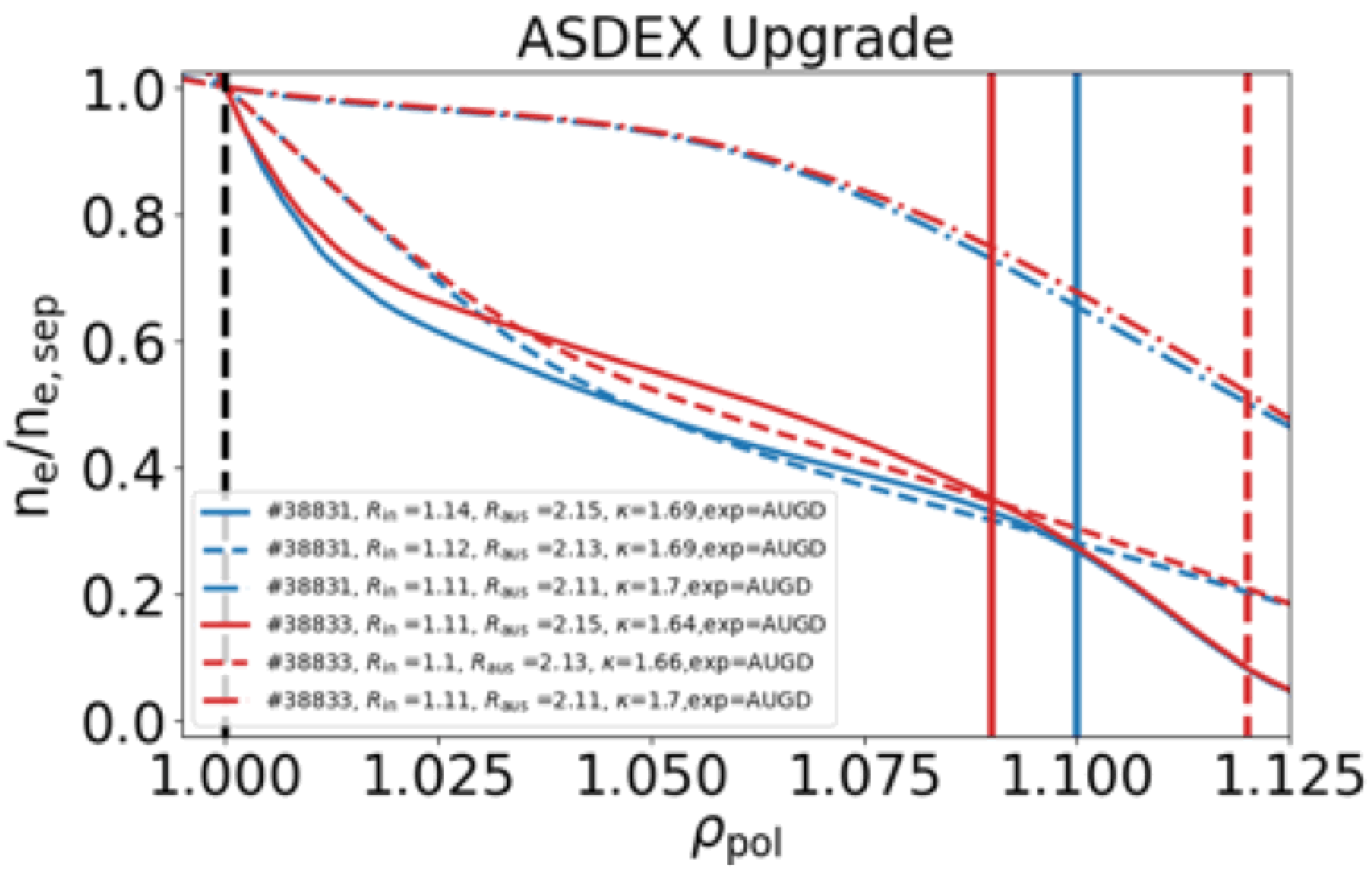
Device	# Pulses/Session	# Development
WEST	20 pulses/1 session	

#30 Investigations of the first wall power loads at different midplane separatrix positions

- **Proponents and contact person:**
  Andreas Redl, Luca Scotti, many more

- **Scientific Background & Objectives**
  One key aspect of the density shoulder is proposed to be addressed among others
  - The connection between wall gap and formation of the density shoulder in QCE H-modes and its implication for the first wall PFCs

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  Fuelling scan at three different midplane separatrix positions.
  - Main diagnostics: Ballpen probe, Lithium Beam, calorimetric diagnostics
  - Scenario development required to achieve QCE at uncommon Btor/Ip



Proposed pulses

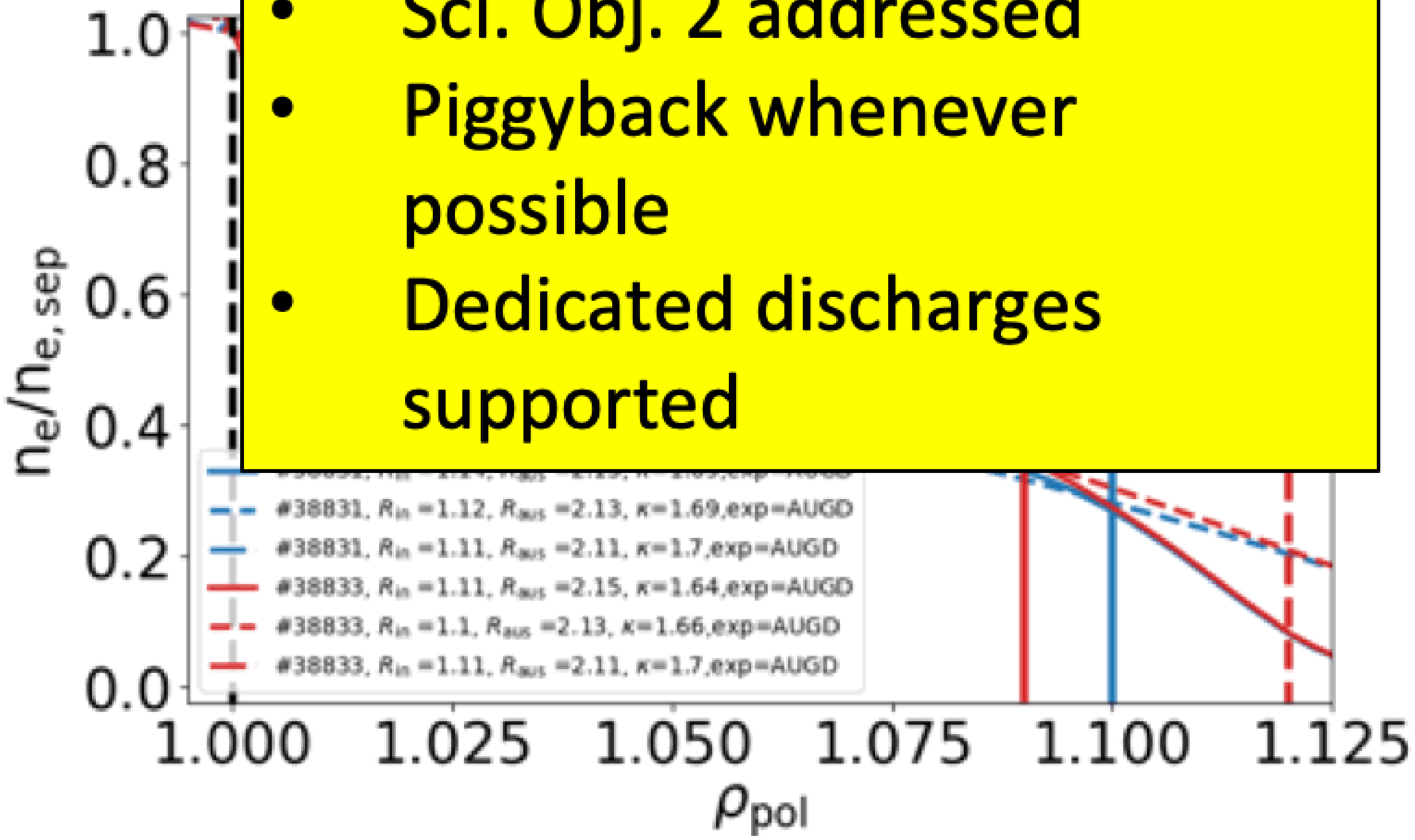
Device	# Pulses/Session	# Development
AUG	6	2
MAST-U	-	-
TCV	-	-
WEST	-	-

#30 Investigations of the first wall power loads at different midplane separatrix positions

- **Proponents and contact person:**
  Andreas Redl, Luca Scotti, many more

- **Scientific Background & Objectives**
  One key aspect of the density shoulder is proposed to be addressed among others
  - The connection between wall gap and formation of the density shoulder in QCE H-modes and its implication for the first wall PFCs

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  Fuelling scan at three different midplane separatrix positions.
  - Main diagnostics: Ballpen probe, Lithium Beam, calorimetric diagnostics
  - Scenario development required to achieve QCE at uncommon Btor/Ip



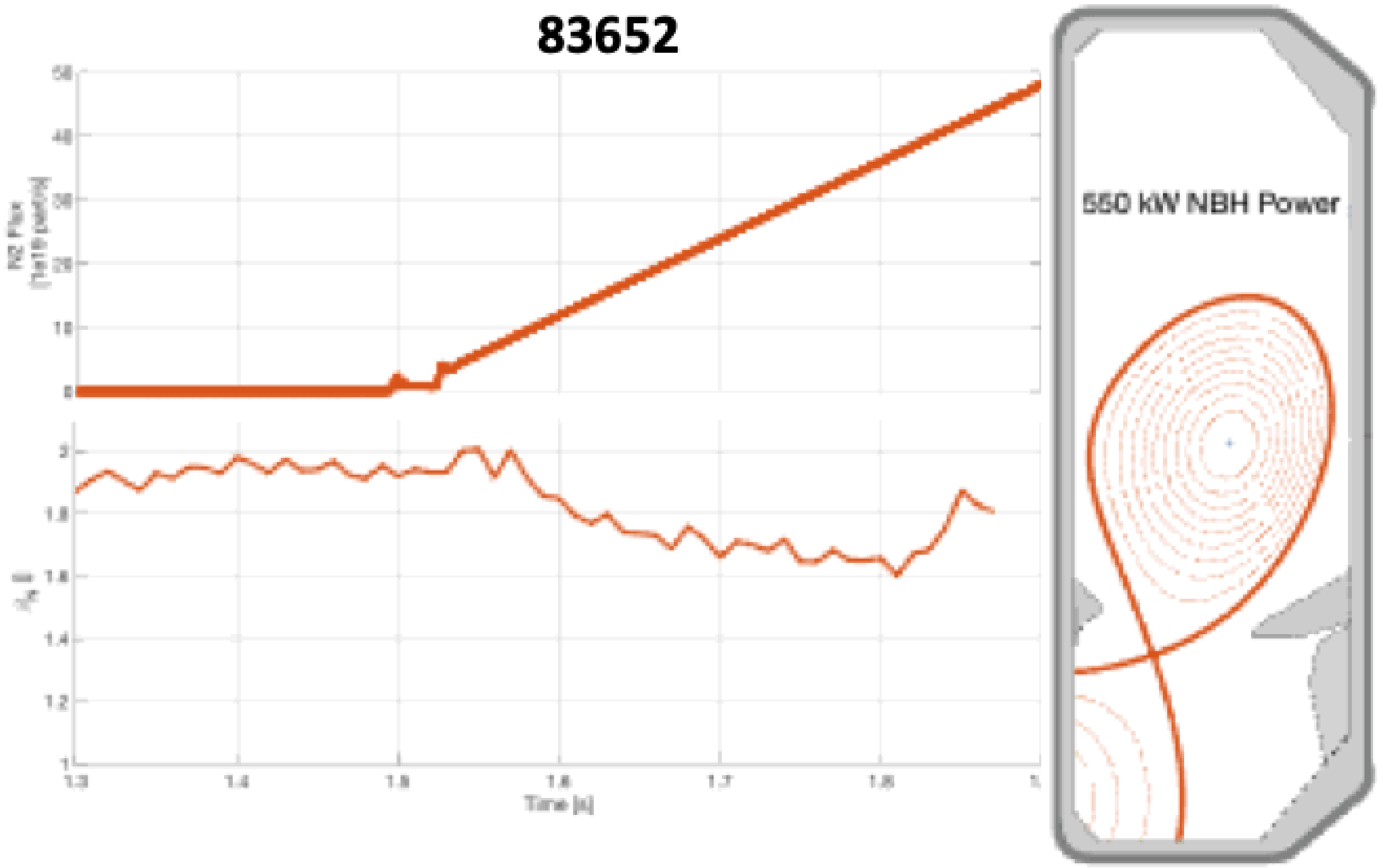
- TFL assessment: **PB/P1**
- Sci. Obj. 2 addressed
- Piggyback whenever possible
- Dedicated discharges supported

Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	2
MAST-U	-	-
TCV	-	-
WEST	-	-

#31 Detachment in high-power L-Mode negative-triangularity plasmas and comparison with positive-triangularity H-Mode plasmas

- **Proponents and contact person:**
  - garance.durr-legoupil-nicoud@epfl.ch
  - O. Février, S. Coda, O. Sauter, H. Reimerdes, C. Theiler



- **Scientific Background & Objectives**

Negative triangularity (NT) may bring H-mode grade confinement in L-Mode operation, making it an attractive solution for a reactor.

This proposal aims to pursue the investigation and characterization of this scenario, and more generally to explore detachment in high-power NT scenarios in TCV.

→ Continue developing and characterizing a high-performance high-power NBI-heated NT L-mode scenario with a matching high-performance PT H-mode reference, developed end of 2024.

→ Perform detachment studies in these scenarios using N2 injection at various degrees of power. Investigate the nitrogen penetration in the core and thus core-edge compatibility

Can a fully detached NT L-mode matching H-mode PT performances be obtained on TCV? Does XPR regime exist in detached NT L-mode ?

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - N_2 seeding steps/ramps with NBI/ECRH in NT plasma: multiple input power levels, N_2 seeding at different rates
  - Detached NT L-mode and PT H-mode plasmas with NBH and or/ECRH
  - essential diagnostics: edge diagnostics (IR,LP,etc) and CXRS

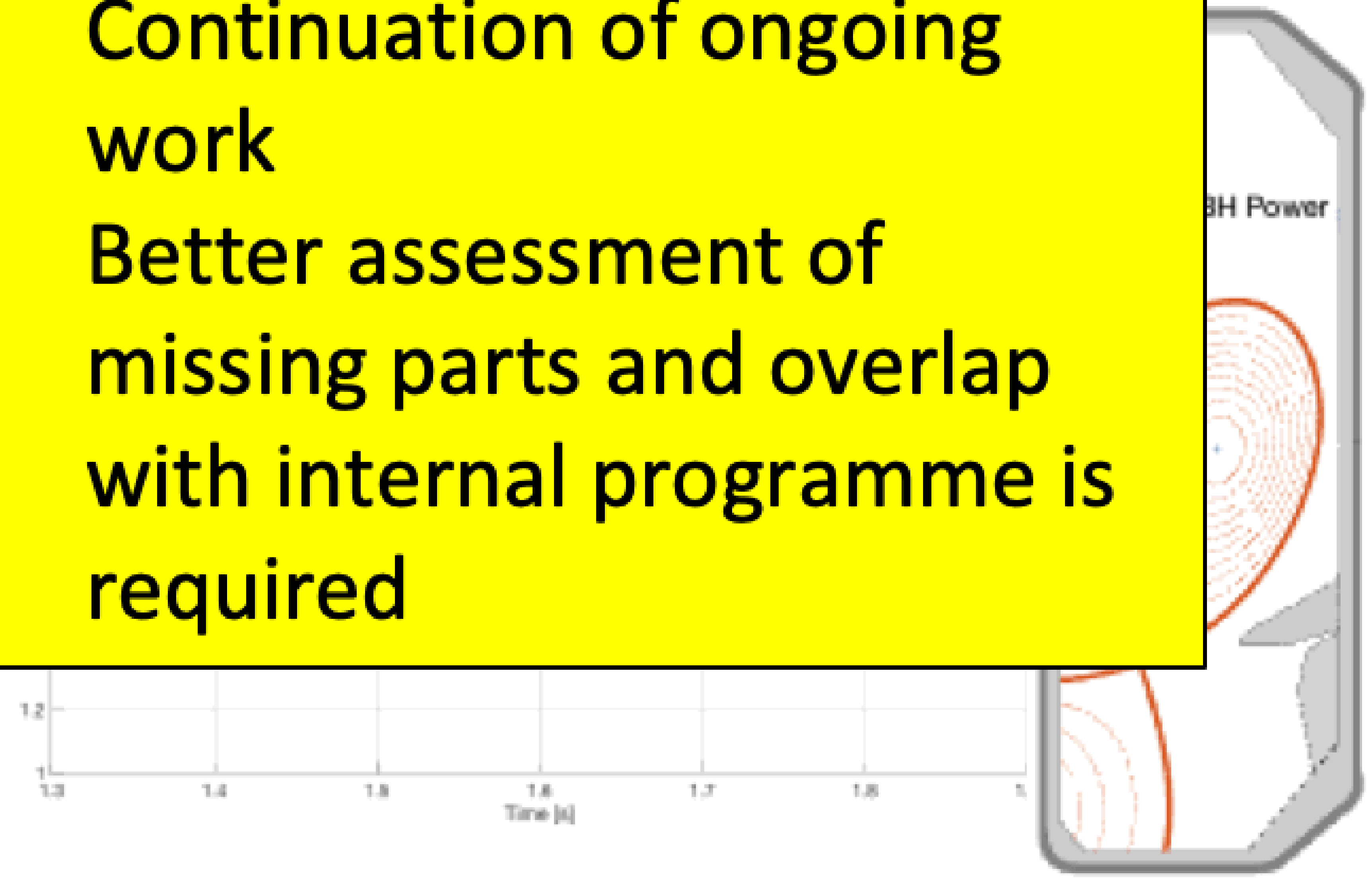
Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	20	20
WEST		

#31 Detachment in high-power L-Mode negative-triangularity plasmas and comparison with positive-triangularity H-Mode plasmas

- **Proponents and contact person:**
  - garance.durr-legoupil-nicoud@epfl.ch
  - O. Février, S. Coda, O. Sauter, H. Reimerdes, C. Theiler

- **TFL assessment: P1**
- **Continuation of ongoing work**
- **Better assessment of missing parts and overlap with internal programme is required**



Scientific Background & Objectives

Negative triangularity (NT) may bring H-mode grade confinement in L-Mode operation, maki it an attractive solution for a reactor.

This proposal aims to pursue the investigation and characterization of this scenario, and more general to explore detachment in high-power NT scenarios in TCV.

→ Continue developing and characterizing a high-performance high-power NBI-heated NT L-mode scenario with a matching high-performance PT H-mode reference, developed end of 2024.

→ Perform detachment studies in these scenarios using N2 injection at various degrees of power. Investigate the nitrogen penetration in the core and thus core-edge compatibility

Can a fully detached NT L-mode matching H-mode PT performances be obtained on TCV? Does XPR regime exist in detached NT L-mode ?

Experimental Strategy/Machine Constraints and essential diagnostic

- N_2 seeding steps/ramps with NBI/ECRH in NT plasma: multiple input power levels, N_2 seeding at different rates
- Detached NT L-mode and PT H-mode plasmas with NBH and or/ECRH
- essential diagnostics: edge diagnostics (IR,LP,etc) and CXRS

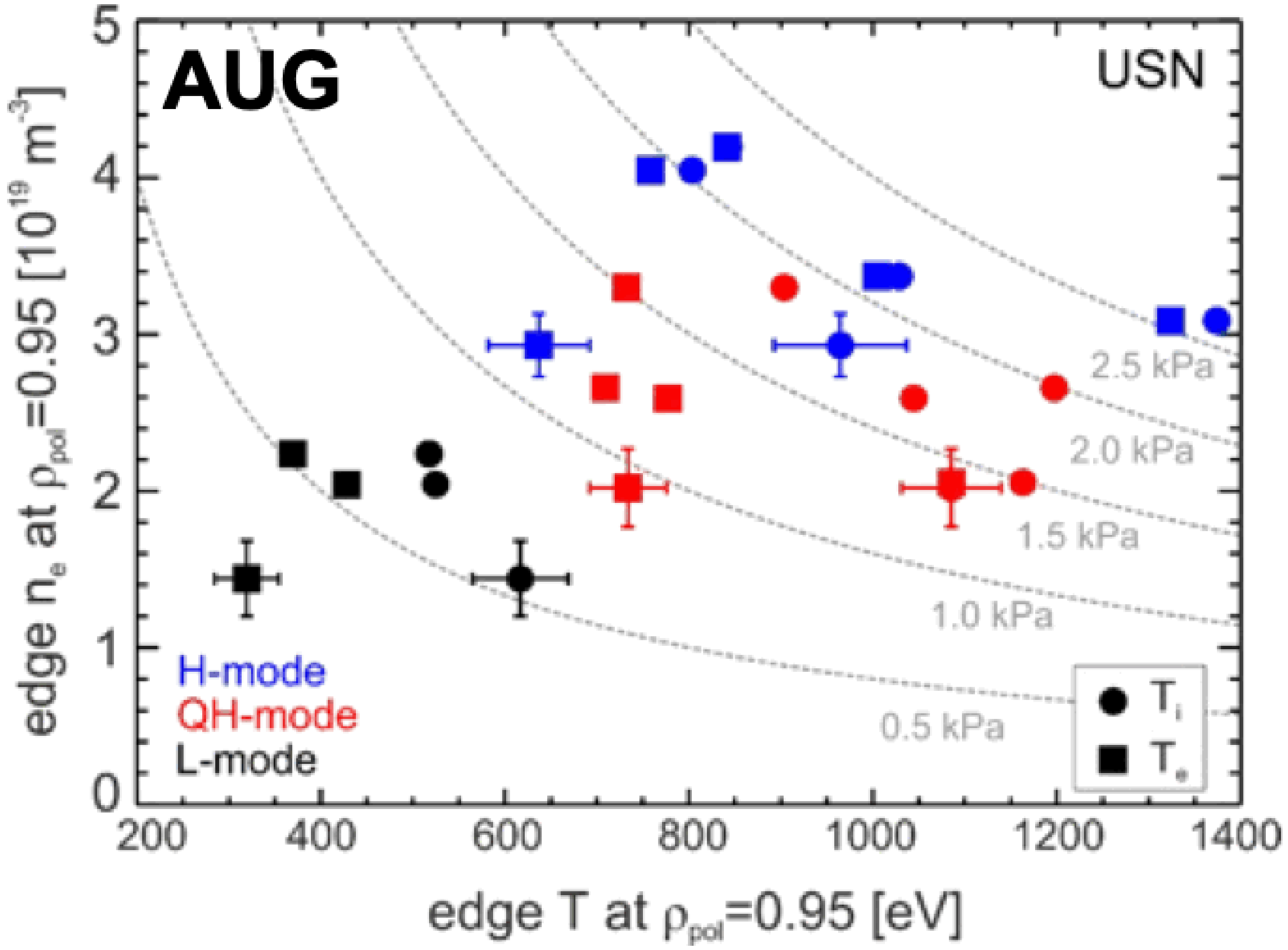
Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	20	20
WEST		

#32 Development of a stationary QH-mode scenario

- **Proponents and contact person:**
  E. Viezzer, S. Saarelma, A. Merle, E. R. Solano, X. Chen, D. J. Cruz Zabala, W. Suttrop, P. Cano Megias, D. R. Ernst, J. Hobirk, B. Vanovac

- **Scientific Background & Objectives**
  - Future fusion devices need to avoid high confinement operation with ELMs – natural no-ELM regimes are considered as alternative
  - **Demonstrate compatibility of stationary QH-mode with W wall**
  - **Establish stationary QH-mode in tight aspect ratio tokamak**
  - - Characterize parameter dependencies of QH-mode
  - - Analyse pedestal structure and stability and compare to ELMy H-modes
  - - Quantify effect of rotation on EHO
  - - Study role of q_{95} for accessing QH-mode
  - - Study impact of edge ECCD on EHO and ELMs
  - - Test and further develop models for EHO



- **Experimental Strategy/Machine Constraints and essential diagnostic**

AUG:
- Low collisionality USN scenario at high delta with cryo-pump on (#38877, #41229). Fresh boronization essential.
- Subset of pulses with edge ECRH at 105 GHz to drive edge ECCD (#41229, #41231). Scan in edge rotation (tangential vs. radial beams, MPs, NBI vs wave heating)

MAST-U:
- High temperature pedestal reference scenario (#49360), use new cryopump. Fresh boronization essential.
- Change plasma rotation using RMP coils.

TCV:
- Based on #68667, investigate effect of different balance of beam sources and current directions.
- Study central ECRH vs counter-ECCD. Study top vs bottom fuelling. Employ DN.

Common to all 3:
- Scan in heating power, q95 via Ip scan, outer gap. At best current value, do Bt scan. Gas puff scan.
- Profile and fluctuation diagnostics essential to characterize QH-mode pedestal and EHO

Proposed pulses

Device	# Pulses/Session	# Development
AUG	40 pulses in total	20
MAST-U	30 pulses in total	10
TCV	60 pulses in total	40
WEST		

#32 Development of a stationary QH-mode scenario

- **Proponents and contact person:**
  E. Viezzer, S. Saarelma, A. Merle, E. R. Solano, X. Chen, D. J. Cruz Zabala, W. Suttrop, P. Cano Megias, D. R. Ernst, J. Hobirk, B. Vanovac
- **Scientific Background & Objectives**
  - Future fusion devices need to avoid high confinement operation with ELMs – natural no-ELM regimes are considered as alternative
  - **Demonstrate compatibility of stationary QH-mode with W wall**
  - **Establish stationary QH-mode in tight aspect ratio tokamak**
  - - Characterize parameter dependencies of QH-mode
  - - Analyse pedestal structure and stability and compare to ELMy H-modes
  - - Quantify effect of rotation on EHO
  - - Study role of q_{95} for accessing QH-mode
  - - Study impact of edge ECCD on EHO and ELMs
  - - Test and further develop models for EHO
- **Experimental Strategy/Machine Constraints and essential diagnostic**

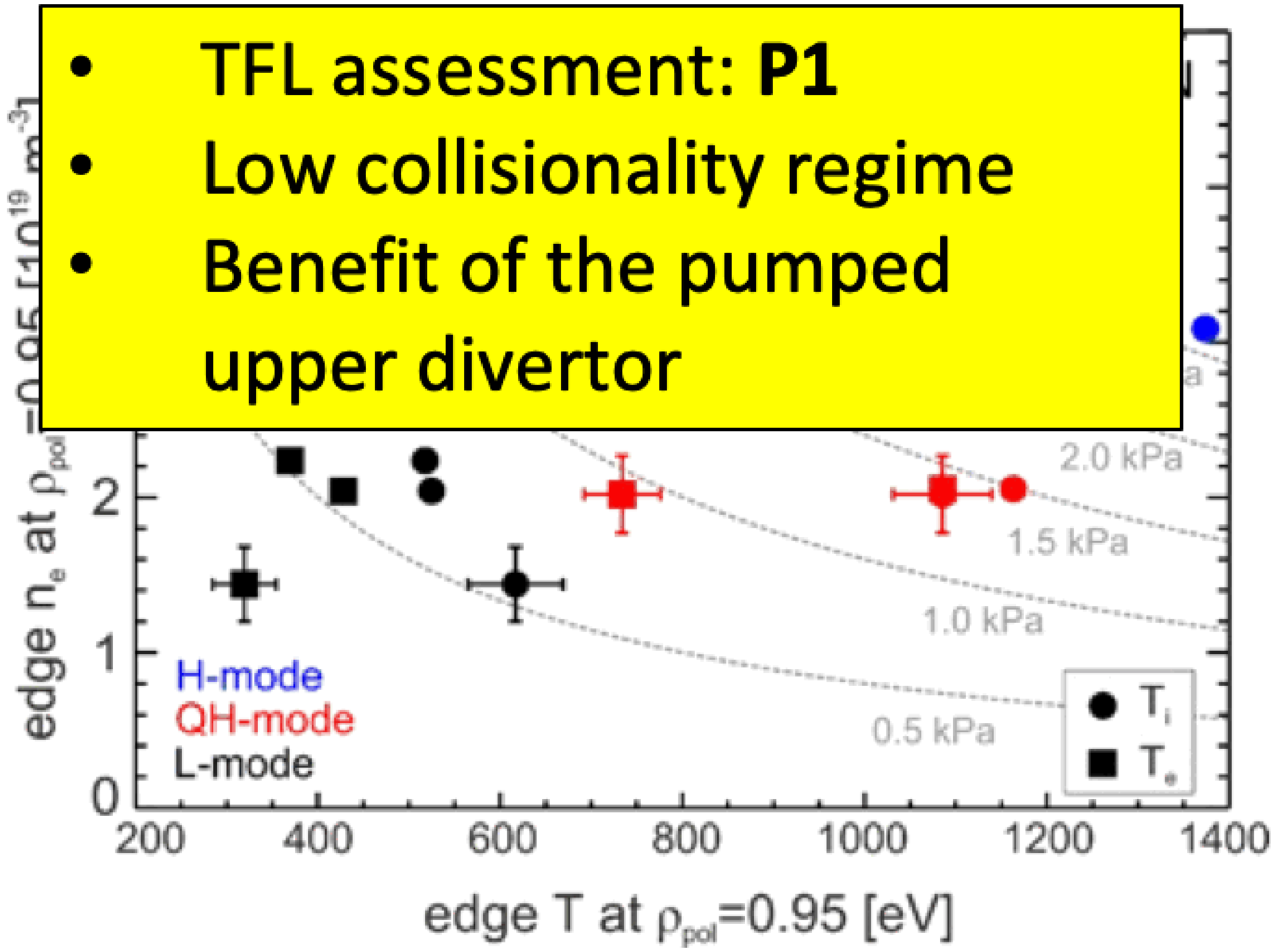
AUG:
- Low collisionality USN scenario at high delta with cryo-pump on (#38877, #41229). Fresh boronization essential.
- Subset of pulses with edge ECRH at 105 GHz to drive edge ECCD (#41229, #41231). Scan in edge rotation (tangential vs. radial beams, MPs, NBI vs wave heating)

MAST-U:
- High temperature pedestal reference scenario (#49360), use new cryopump. Fresh boronization essential.
- Change plasma rotation using RMP coils.

TCV:
- Based on #68667, investigate effect of different balance of beam sources and current directions.
- Study central ECRH vs counter-ECCD. Study top vs bottom fuelling. Employ DN.

Common to all 3:
- Scan in heating power, q95 via Ip scan, outer gap. At best current value, do Bt scan. Gas puff scan.
- Profile and fluctuation diagnostics essential to characterize QH-mode pedestal and EHO

- TFL assessment: **P1**
- Low collisionality regime
- Benefit of the pumped upper divertor



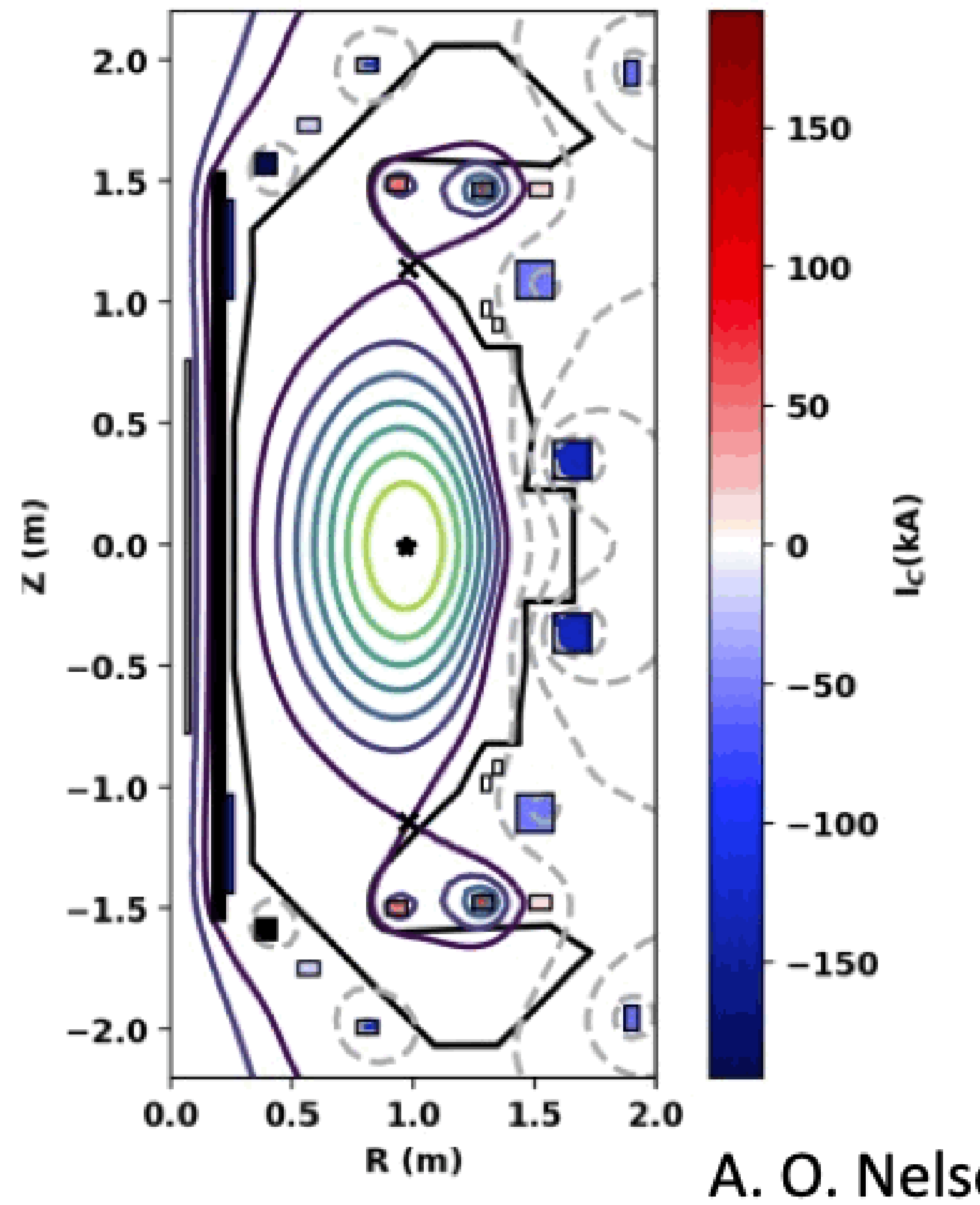
Proposed pulses

Device	# Pulses/Session	# Development
AUG	40 pulses in total	20
MAST-U	30 pulses in total	10
TCV	60 pulses in total	40
WEST		

#33 Negative triangularity in conventional vs spherical tokamaks

- **Proponents and contact person:**
  D.J. Cruz-Zabala (dcruz3@us.es), E. Viezzer, M. Garcia-Munoz, O. Sauter, A.O. Nelson, C. Vincent, S. Henderson, S. Saarelma, O. Myatra, H. Anand, W. Wehner, A. Jansen van Vuuren, B. Chapman, J.F. Rivero-Rodriguez.
- **Scientific Background & Objectives**
  - Negative triangularity (NT) in combination with spherical tokamaks (STs) might be a game changer for DEMO → **compact configuration with relaxed heat exhaust requirements**
  - Theoretical studies suggest a possible degradation of NT performance in STs when TEM dominated → **experiments are needed**
  - First **ST NT** plasma in MAST-U shows **promising results** (see figure)

  Objectives:
  - **Experimentally address** the impact of aspect ratio on NT's benefits:
    - Characterize transport and stability in STs NT → Which turbulence mechanism is dominant?
  - **Compare** NT performance in **three different machines** (TCV, MAST-U, SMART).
  - Assess **ELM-suppression** characteristics of NT plasmas in STs
  - Study **power degradation** in NT plasmas
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - **In MAST-U,** start from NT scenario developed by C. Vincent et al during the internal campaign. Then, scans in power, density, torque and triangularity (if possible)
  - **Take advantage** of the **shape capabilities** of **TCV** to develop NT plasmas as similar as possible to the ones at **MAST-U** and **SMART**
  - **Matching discharges** in **PT** to evaluate performance of **NT**
  - **Essential diagnostics**: TS, ECE, CXRS, turbulence diags, FILD



A. O. Nelson et al.

Proposed pulses

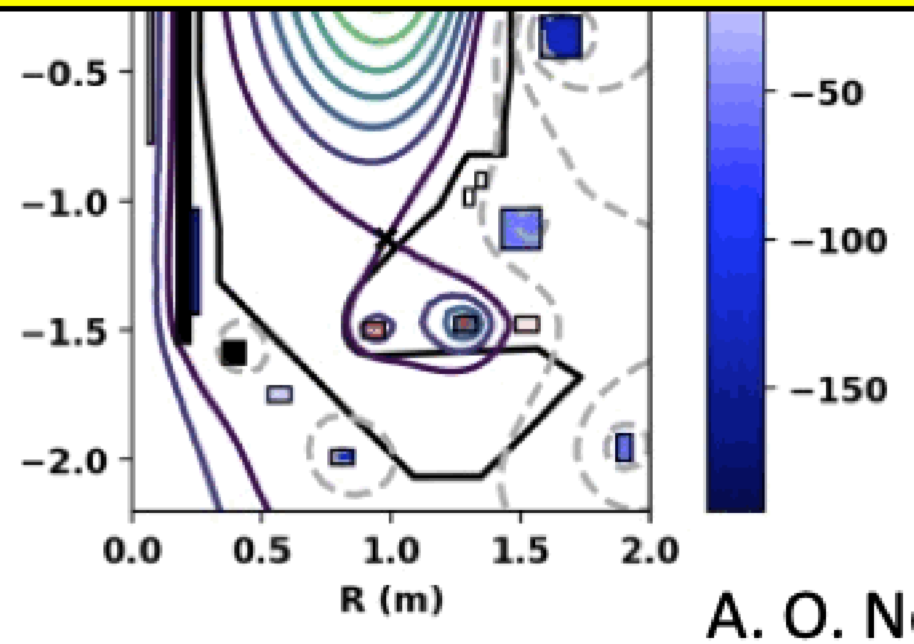
Device	# Pulses/Session	# Development
AUG		
MAST-U	20	0
TCV	15	15
WEST		

#33 Negative triangularity in conventional vs spherical tokamaks

- **Proponents and contact person:**
  D.J. Cruz-Zabala (dcruz3@us.es), E. Viezzer, M. Garcia-Munoz, O. Sauter, A.O. Nelson, C. Vincent, S. Henderson, S. Saarelma, O. Myatra, H. Anand, W. Wehner, A. Jansen van Vuuren, B. Chapman, J.F. Rivero-Rodriguez.
- **Scientific Background & Objectives**
  - Negative triangularity (NT) in combination with spherical tokamaks (STs) might be a game changer for DEMO → **compact configuration with relaxed heat exhaust requirements**
  - Theoretical studies suggest a possible degradation of NT performance in STs when TEM dominated → **experiments are needed**
  - First **ST NT** plasma in MAST-U shows **promising results** (see figure)

  Objectives:
  - **Experimentally address** the impact of aspect ratio on NT's benefits:
    - Characterize transport and stability in STs NT → Which turbulence mechanism is dominant?
  - **Compare** NT performance in **three different machines** (TCV, MAST-U, SMART).
  - Assess **ELM-suppression** characteristics of NT plasmas in STs
  - Study **power degradation** in NT plasmas
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - **In MAST-U,** start from NT scenario developed by C. Vincent et al during the internal campaign. Then, scans in power, density, torque and triangularity (if possible)
  - **Take advantage** of the **shape capabilities** of **TCV** to develop NT plasmas as similar as possible to the ones at **MAST-U** and **SMART**
  - **Matching discharges** in **PT** to evaluate performance of **NT**
  - **Essential diagnostics**: TS, ECE, CXRS, turbulence diags, FILD

- TFL assessment: **P2**
- Sci. Obj. 5
- Better evaluation of shaping capabilities (MAST-U) needed



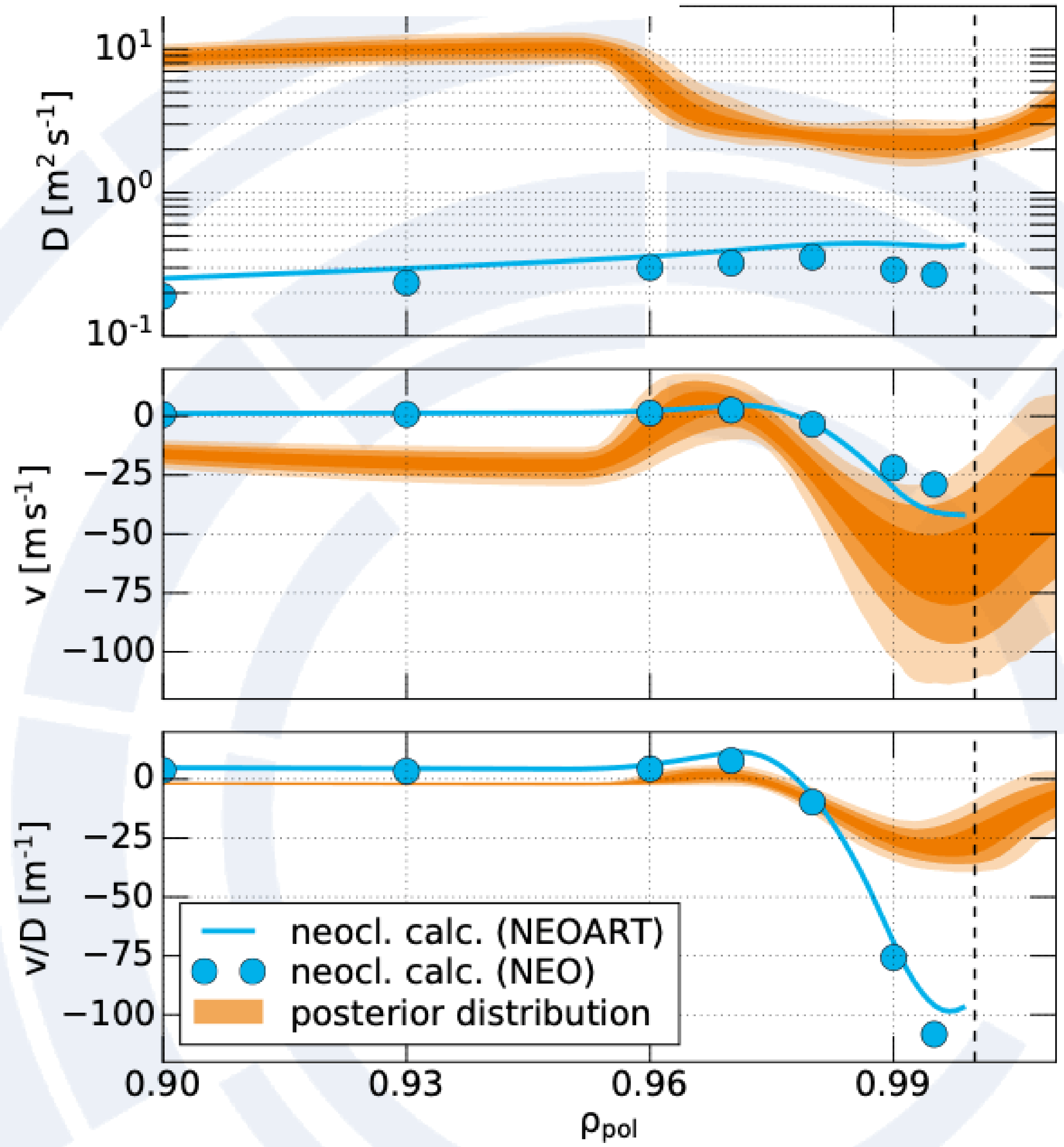
A. O. Nelson et al.

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U	20	0
TCV	15	15
WEST		

#34 Impurity transport in ELM-free scenarios in AUG

- **Proponents and contact person:**
  - M. Dunne, T. Gleiter, E. Wolfrum
- **Scientific Background & Objectives**
  - Pedestal impurity transport now high priority topic for ITER
    - Particular focus on ELM-free regimes
  - Recently developed diagnostic technique to measure v and D separately for single impurity (Gleiter et al.) shows higher-than-neoclassical impurity transport in QCE regime
  - Extend analysis to other ELM-free regimes (RMP, EDA) and compare results to modulated argon puffing experiments
  - Aim to provide data for comparison to neoclassical/gyrokinetic modelling to understand impurity transport in these scenarios
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Expand existing data-set of impurity transport coefficients to further ELMing/QCE and EDA & RMP discharges (references available)
  - Essential conditions: fresh boronisation, special spectrometer set up (preferable execution still in 2024)
  - Significant data analysis/modelling requirement for this proposal



Gleiter et al., NF (submitted)

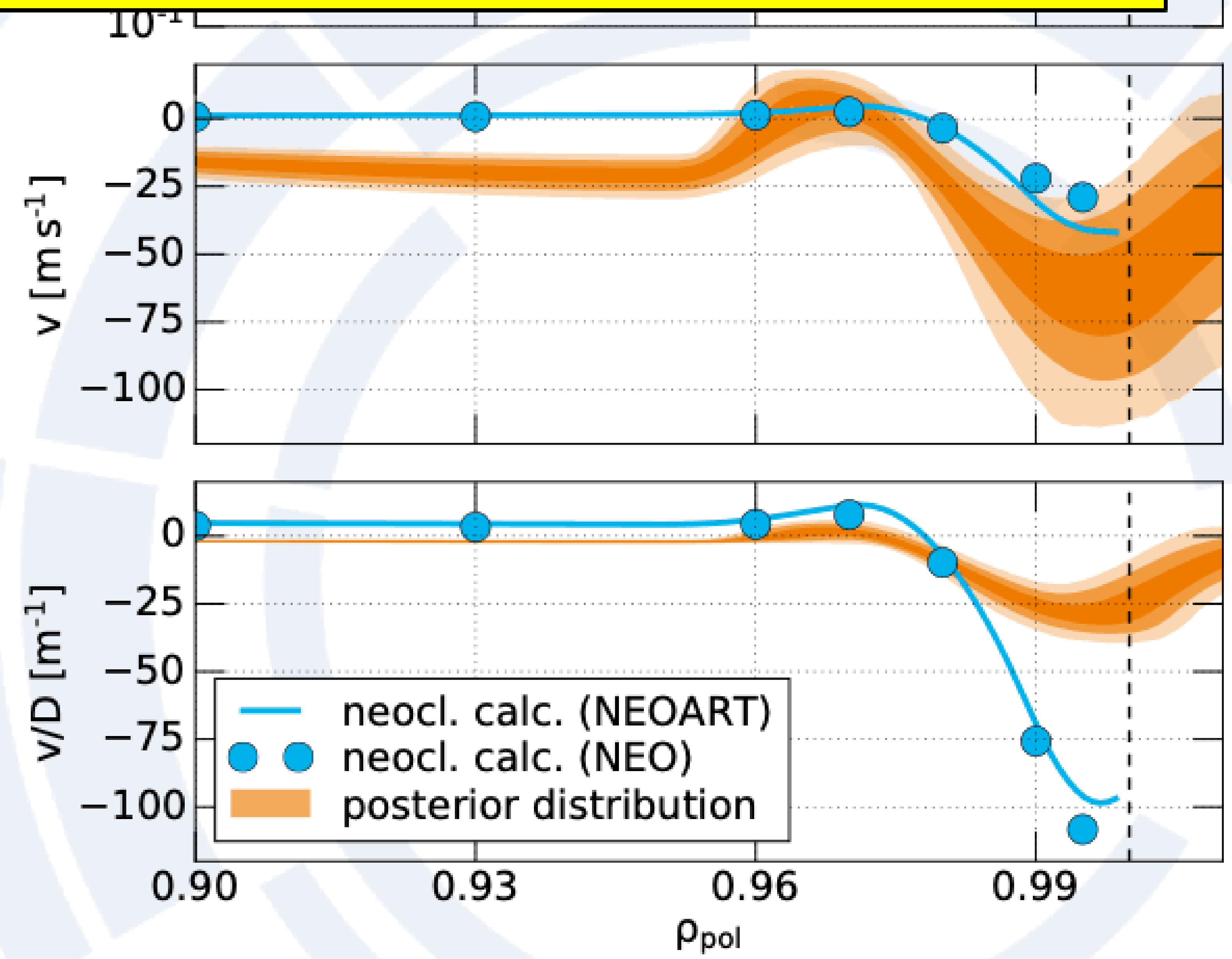
Proposed pulses

Device	# Pulses/Session	# Development
AUG	12	

#34 Impurity transport in ELM-free scenarios in AUG

- TFL assessment: **P1**
- Sci. Obj. 1, 4 addressed
- Work started in 2024

- **Proponents and contact person:**
  - M. Dunne, T. Gleiter, E. Wolfrum
- **Scientific Background & Objectives**
  - Pedestal impurity transport now high priority topic for ITER
    - Particular focus on ELM-free regimes
  - Recently developed diagnostic technique to measure v and D separately for single impurity (Gleiter et al.) shows higher-than-neoclassical impurity transport in QCE regime
  - Extend analysis to other ELM-free regimes (RMP, EDA) and compare results to modulated argon puffing experiments
  - Aim to provide data for comparison to neoclassical/gyrokinetic modelling to understand impurity transport in these scenarios
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Expand existing data-set of impurity transport coefficients to further ELMing/QCE and EDA & RMP discharges (references available)
  - Essential conditions: fresh boronisation, special spectrometer set up (preferable execution still in 2024)
  - Significant data analysis/modelling requirement for this proposal

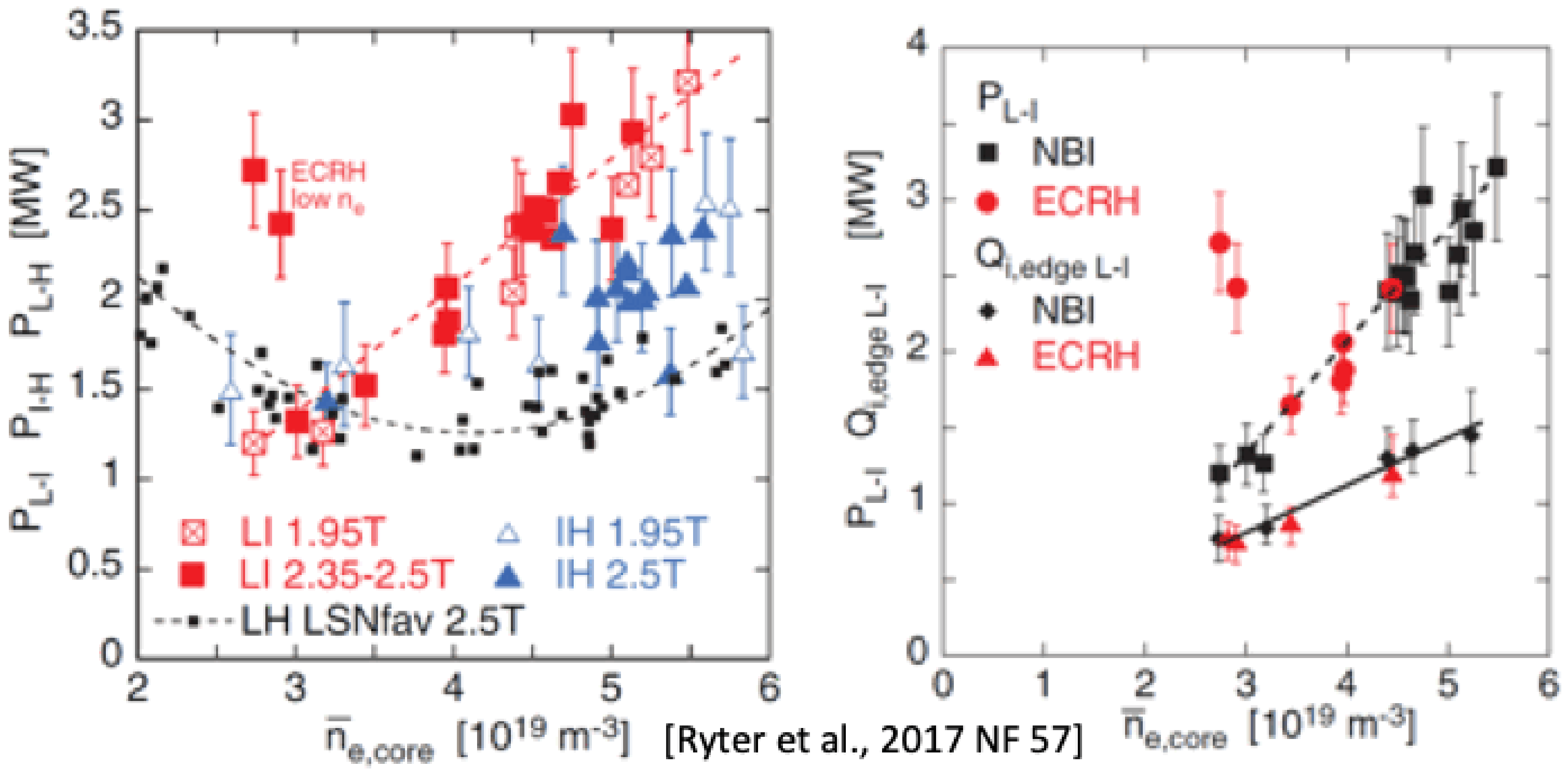


Gleiter et al., NF (submitted)

Proposed pulses

Device	# Pulses/Session	# Development
AUG	12	

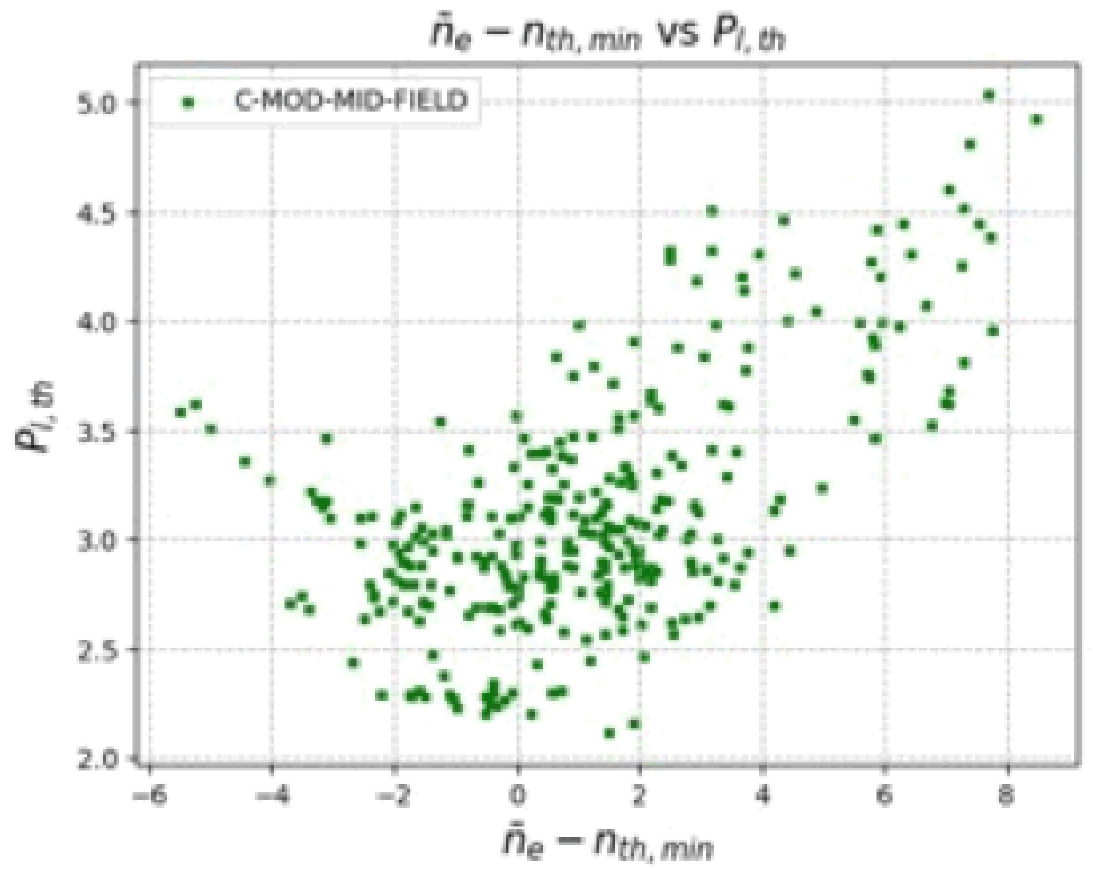
#35 Power threshold density minimum in I-mode and edge ion heat flux scanling



Proponents and contact person:
Jan Cecrdle (cecrdle@ipp.cas.cz), M. Komm, D. Silvagni, A. Hubbard, A. Cavallaro, O. Grover, T. Happel, B. Vanovac, L. Gil

Scientific Background & Objectives

- I-mode access in high density devices (COMPASS-U, SPARC) may be difficult
- A minimal requirement I-mode access scaling or "low-cost I-mode" should be established
- Objectives:
  - Conduct measurements of L-I threshold powers at low densities (in a range around 3.5e19 m^{-3}) (AUG)
  - Increase the amount of $Q_{i,edge}$ data at L-I transition to infer scalings
  - Construct a low requirement I-mode threshold scaling



Experimental Strategy/Machine Constraints and essential diagnostics

The experimental strategy applies to all proposed densities (5 density levels around 3.5e19 m^{-3} each repeated twice with different X-point positions):

•First phase: After reaching flat-top phase (2 s < t < 4 s) Ramp up ECRH power by 200 kW increments to find I-mode threshold

•Further increase power to find H-mode thresholds if possible

•Second phase: (4 s < t) switch of ECRH and repeat the first phase procedure with NBI until ramp-down

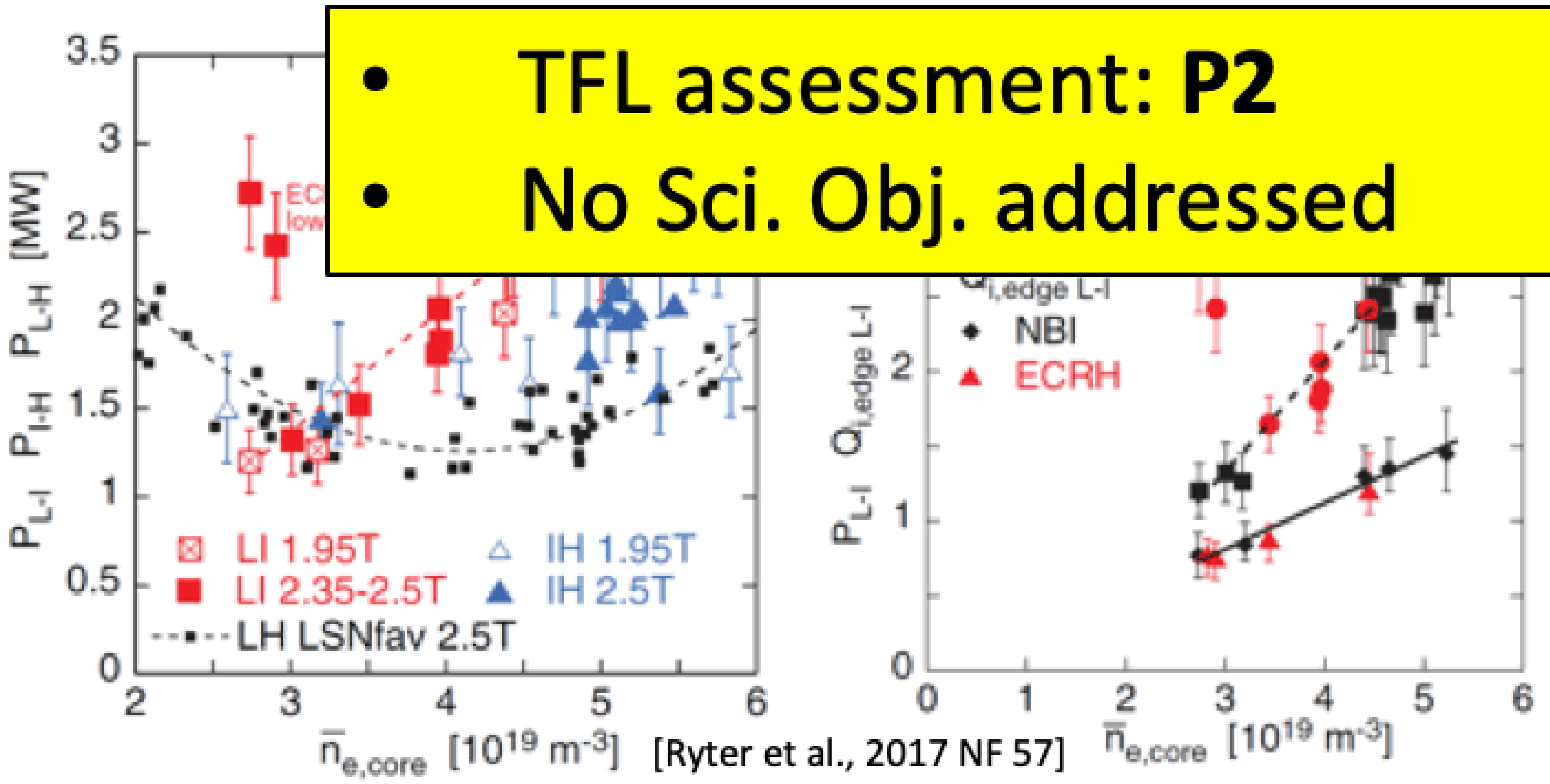
During the ECHR phase NBI blips will be utilized for Ti data acquisition

Proposed pulses

Device	# Pulses	# Dev.
AUG	10	

#35 Power threshold density minimum in I-mode and edge ion heat flux scanling

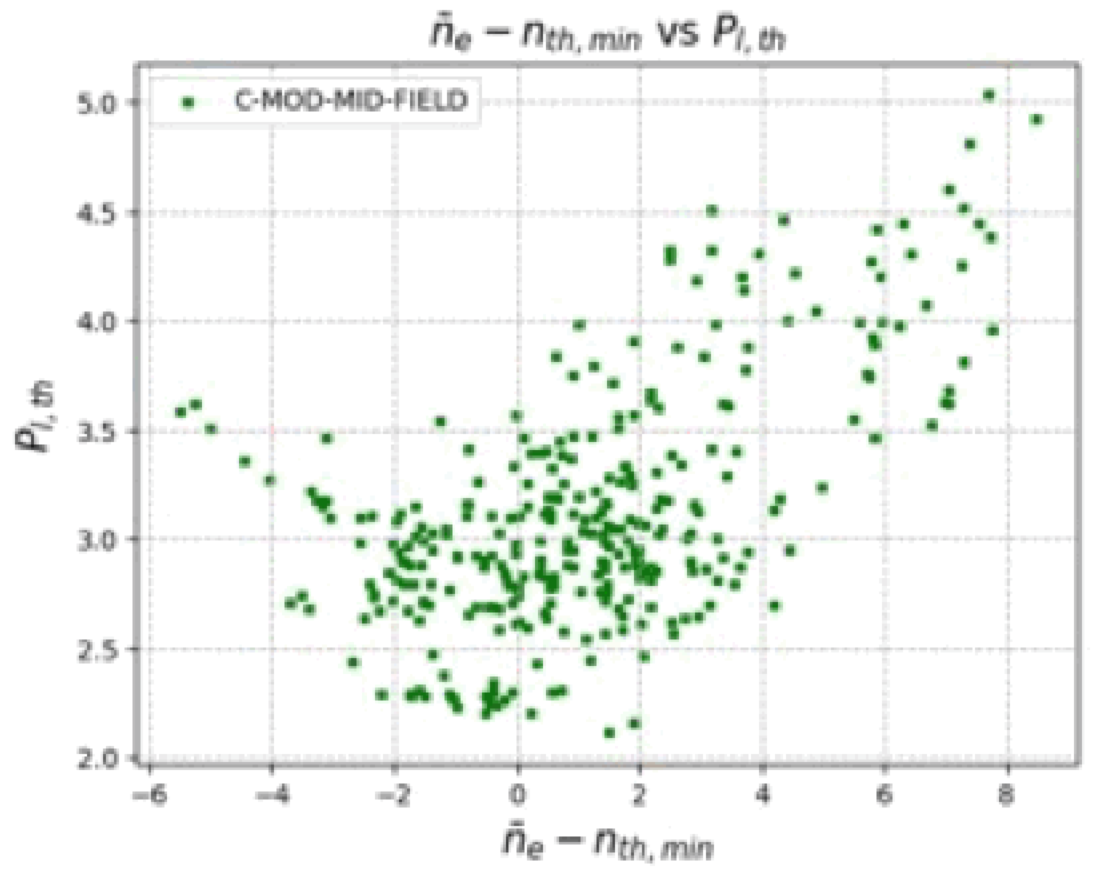
- TFL assessment: **P2**
- No Sci. Obj. addressed



Proponents and contact person:
Jan Cecrdle (cecrdle@ipp.cas.cz), M. Komm, D. Silvagni, A. Hubbard, A. Cavallaro, O. Grover, T. Happel, B. Vanovac, L. Gil

Scientific Background & Objectives

- I-mode access in high density devices (COMPASS-U, SPARC) may be difficult
- A minimal requirement I-mode access scaling or “low-cost I-mode” should be established
- Objectives:
  - Conduct measurements of L-I threshold powers at low densities (in a range around 3.5e19 m^{-3}) (AUG)
  - Increase the amount of $Q_{i,edge}$ data at L-I transition to infer scalings
  - Construct a low requirement I-mode threshold scaling



Experimental Strategy/Machine Constraints and essential diagnostics

The experimental strategy applies to all proposed densities (5 density levels around 3.5e19 m^{-3} each repeated twice with different X-point positions):

•First phase: After reaching flat-top phase (2 s < t < 4 s) Ramp up ECRH power by 200 kW increments to find I-mode threshold

•Further increase power to find H-mode thresholds if possible

•Second phase: (4 s < t) switch of ECRH and repeat the first phase procedure with NBI until ramp-down

During the ECHR phase NBI blips will be utilized for Ti data acquisition

Proposed pulses

Device	# Pulses	# Dev.
AUG	10	

#36 Advanced scenarios in negative triangularity

- **Proponents and contact person:**
  - Antonia Frank (antonia.frank@epfl.ch)
  - Olivier Sauter
  - Stefano Coda
- **Scientific Background & Objectives**

➢ **Negative triangularity** (NT) operation comes with high beta_N operation without accessing H-mode and ELM-free operation

➢ **Advanced tokamak (AT) scenario**: needs reversed/elevated flat safety factor profile to build up internal transport barrier (ITB)

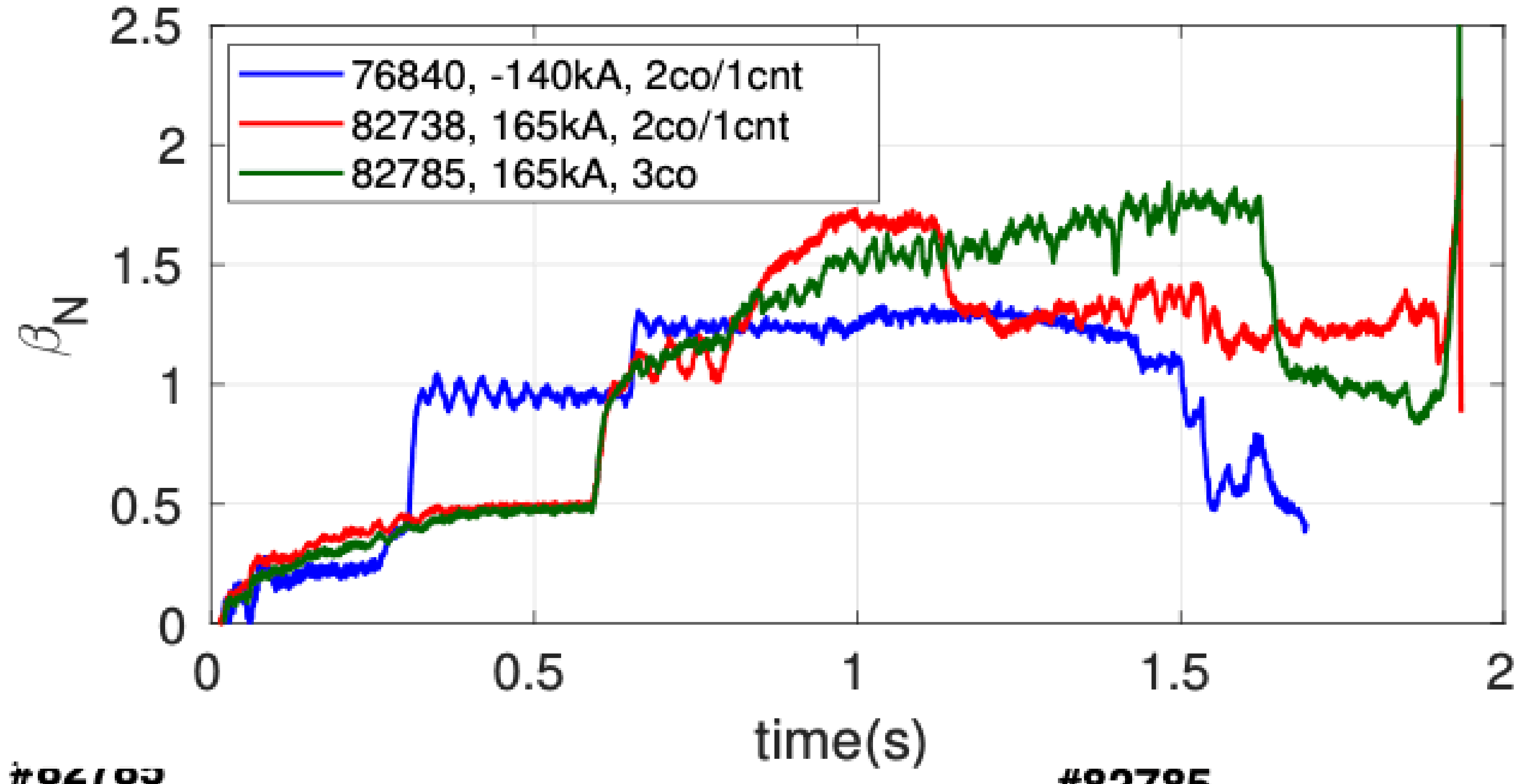
➢ **Start from AT scenario in NT at TCV developed in RT02 2024 with 3 ECCD in co-Ip off-axis** to demonstrate & study:

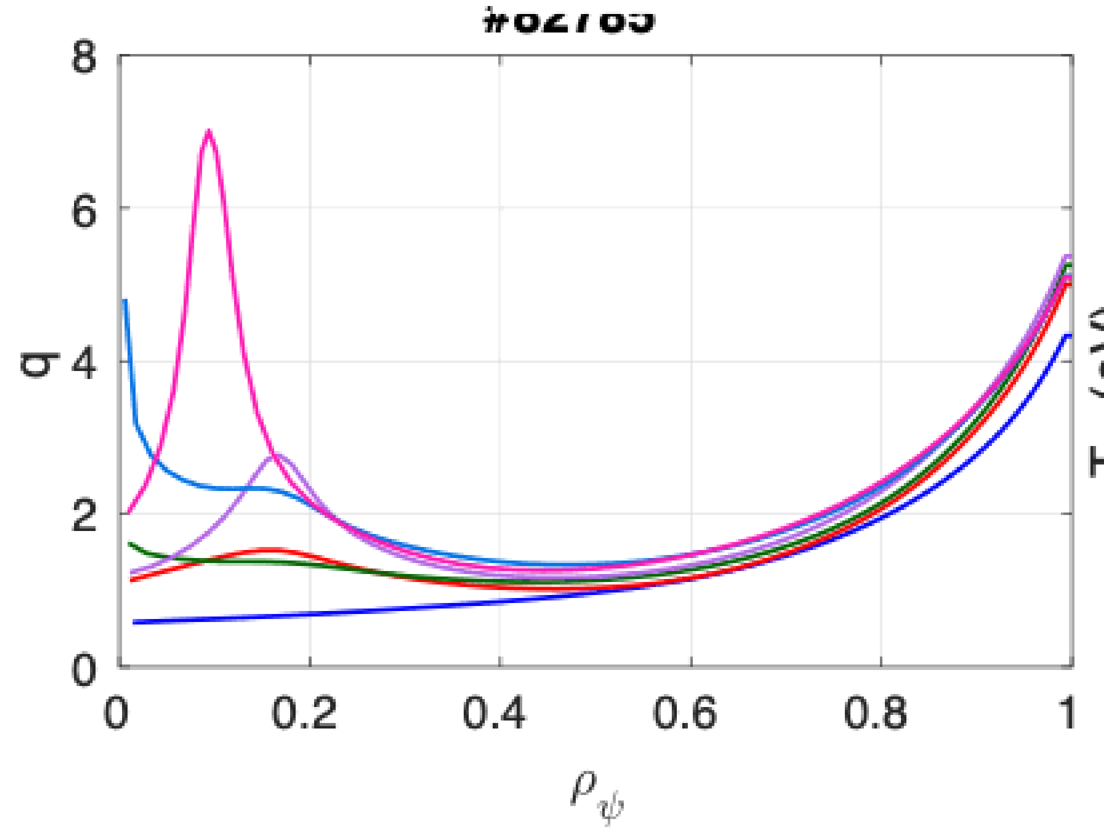
  ➢ Fully non-inductive NT operation, first with ECCD only, then add NBI to go towards high beta_N (first attempts already started)

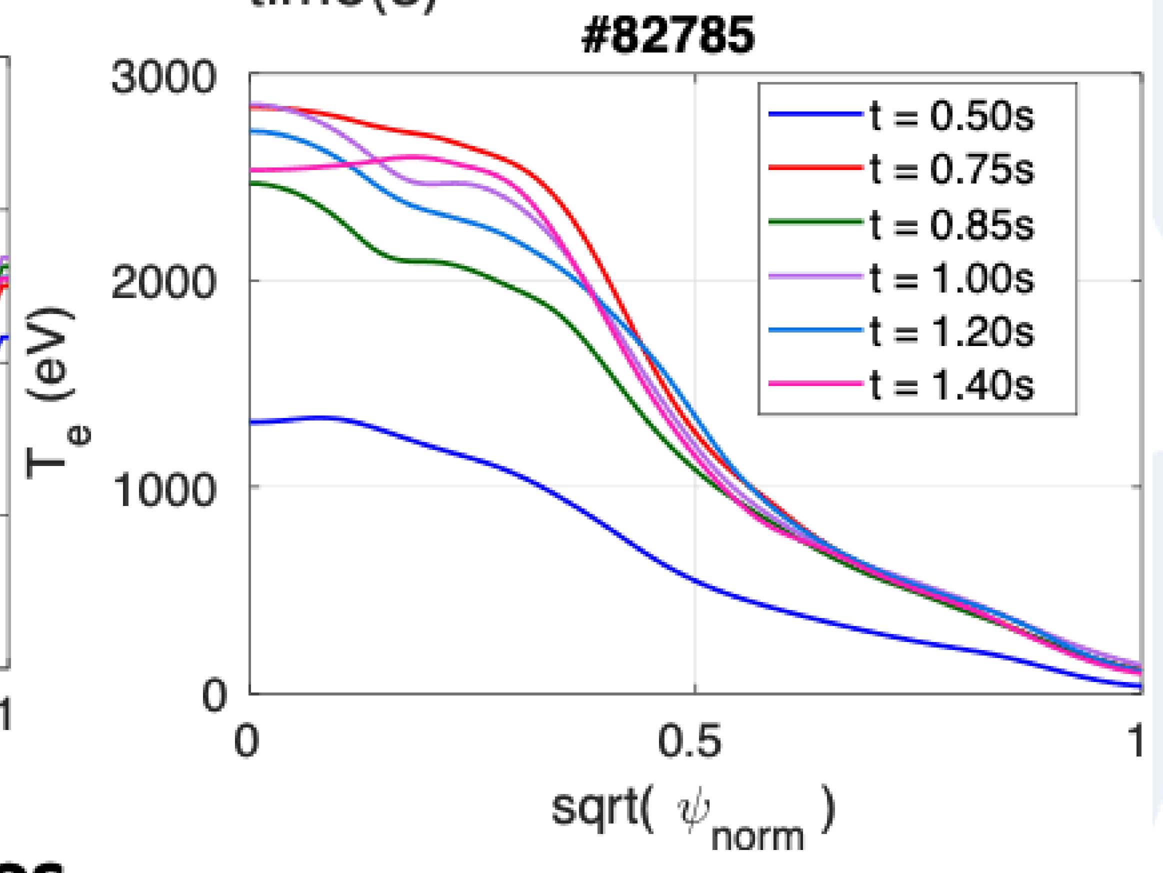
  ➢ Study (e)ITB in NT in limited and diverted NTM shapes

  ➢ Real-time controlled ITB using tools developed within RT04 proposal on q-profile control

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Clamp loop voltage to zero to obtain a steady-state, fully non-inductive eITB in NT (no NBI)
  - Add NBI to ion contribution to the ITB and to go towards high-beta aiming also fully non-inductive scenario
  - Use tools developed with RT04 proposal on q-profile control for AT scenarios on NT discharges, eventually combine with NBI-controlled power for RT-beta control
  - Essential diagnostics: CXRS/DNBI, SCD for RT tools







Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	30	10
WEST		

#36 Advanced scenarios in negative triangularity

- **Proponents and contact person:**
  - Antonia Frank (antonia.frank@epfl.ch)
  - Olivier Sauter
  - Stefano Coda
- **Scientific Background & Objectives**

➢ **Negative triangularity** (NT) operation comes with high beta_N operation without accessing H-mode and ELM-free operation

➢ **Advanced tokamak (AT) scenario**: needs reversed/elevated flat safety factor profile to build up internal transport barrier (ITB)

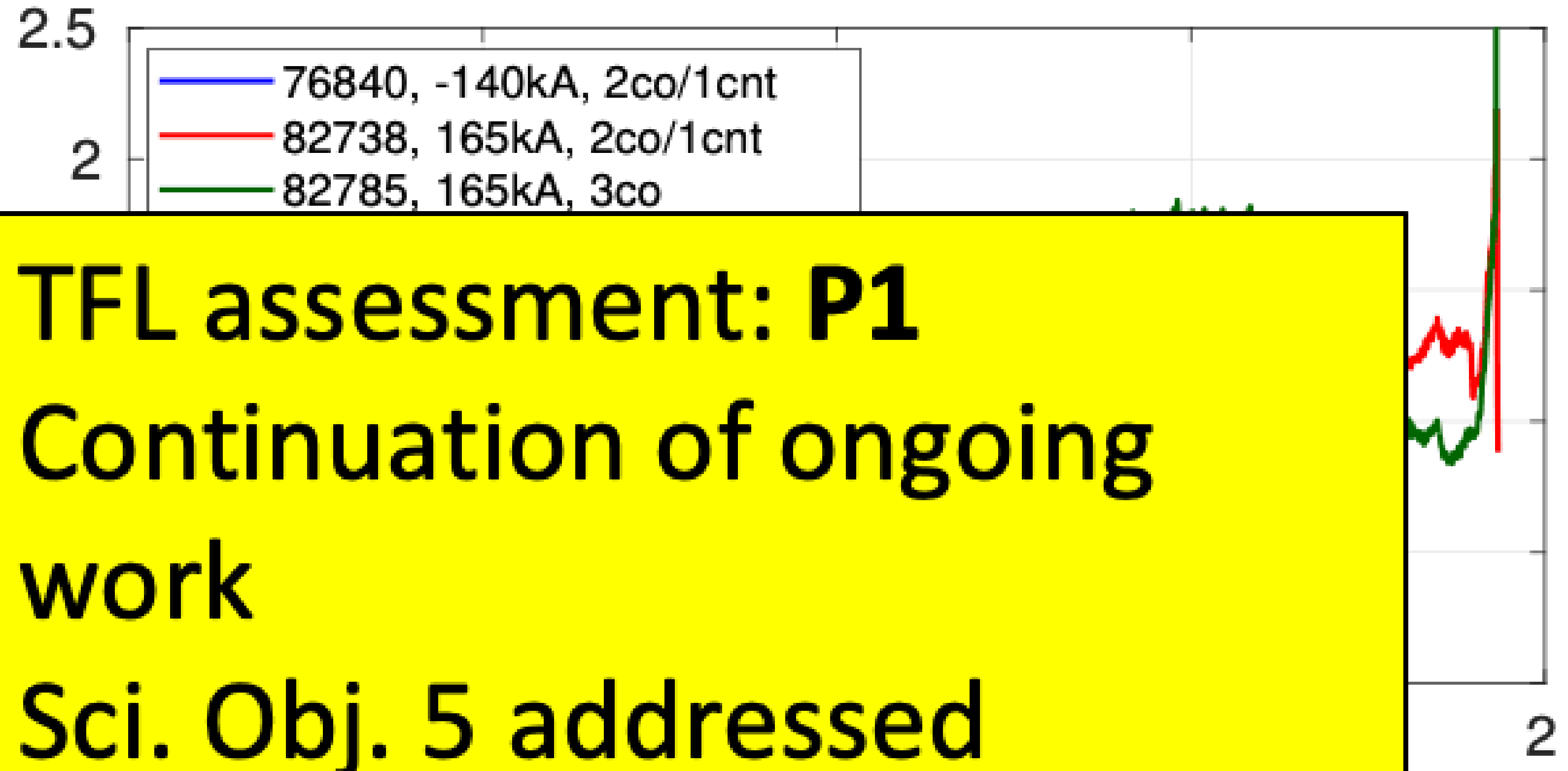
➢ **Start from AT scenario in NT at TCV developed in RT02 2024 with 3 ECCD in co-Ip off-axis** to demonstrate & study:

  ➢ Fully non-inductive NT operation, first with ECCD only, then add NBI to go towards high beta_N (first attempts already started)

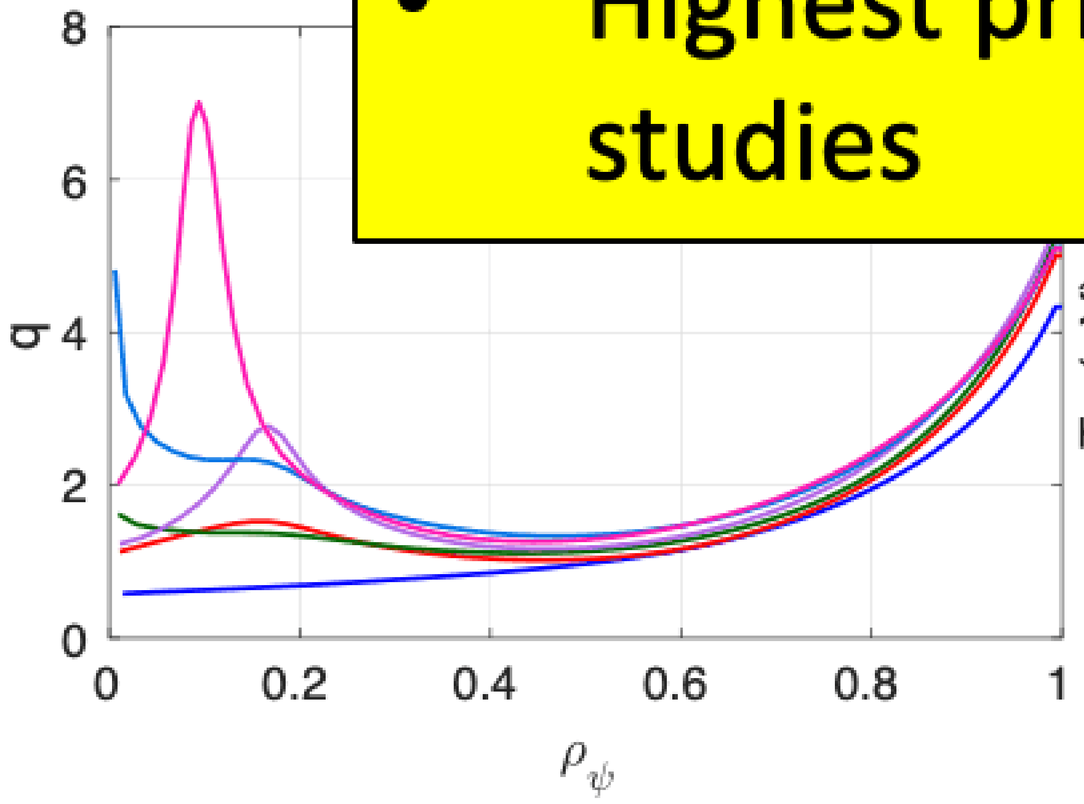
  ➢ Study (e)ITB in NT in limited and diverted NTM shapes

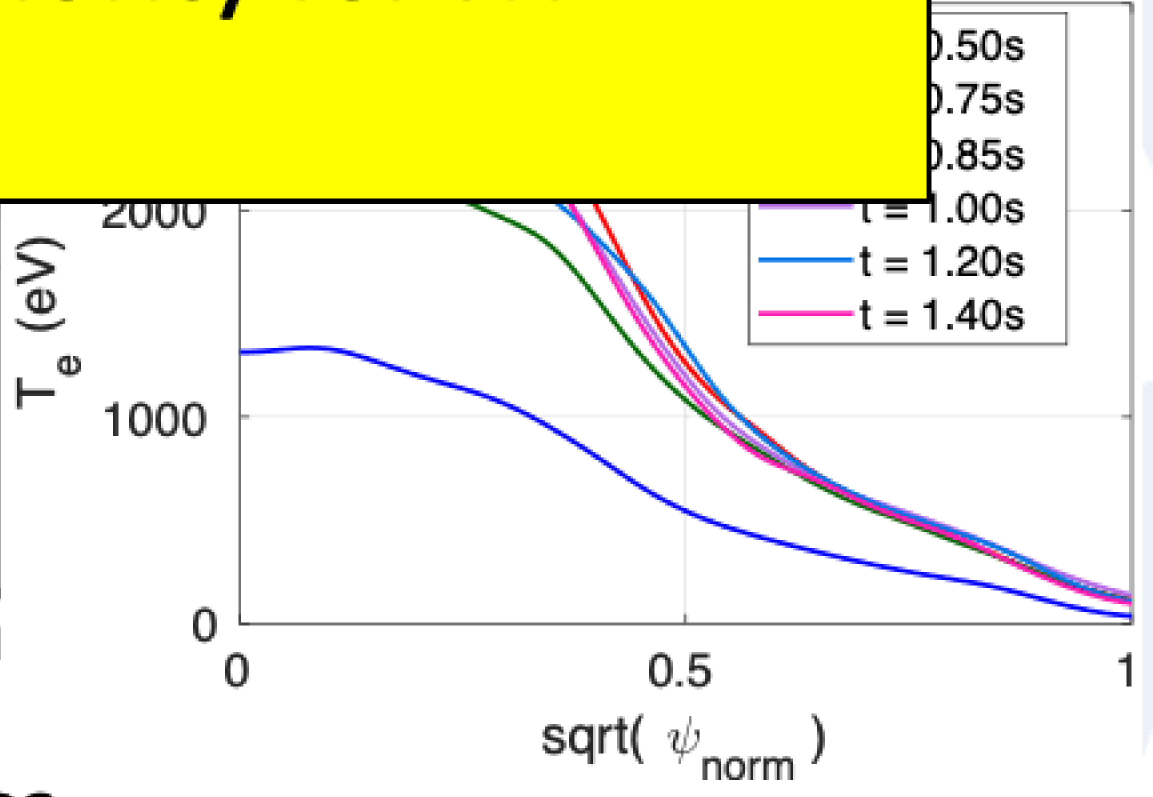
  ➢ Real-time controlled ITB using tools developed within RT04 proposal on q-profile control

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Clamp loop voltage to zero to obtain a steady-state, fully non-inductive eITB in NT (no NBI)
  - Add NBI to ion contribution to the ITB and to go towards high-beta aiming also fully non-inductive scenario
  - Use tools developed with RT04 proposal on q-profile control for AT scenarios on NT discharges, eventually combine with NBI-controlled power for RT-beta control
  - Essential diagnostics: CXRS/DNBI, SCD for RT tools



- TFL assessment: **P1**
- Continuation of ongoing work
- Sci. Obj. 5 addressed
- Highest priority for NT studies





Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	30	10
WEST		

#37 Study of supershot-like scenario confinement on a ST

- **Proponents and contact person:**
- francesco.orsitto@enea.it
- **Scientific Background & Objectives**
  - The supershot or hot ion mode scenario was studied intensively in TFTR and JET DTE1/2
  - **A scaling law of energy confinement has been recently proposed based on TFTR supershot confinement and L-mode scaling law : this scaling law was found in broad agreement with ST40 data on a wide range of plasma parameters[1].**
  - **The present proposal is aimed for the first time at a detailed experimental check of the various dependences of this energy confinement time scaling as proposed in [5] at a different aspect ratio A=1.4 and different major radius**
- **[1] F P Orsitto and M Romanelli , 48th EPS 2022 P5a.103; F P Orsitto , M Romanelli and ST40 Team 49th EPS 2023 poster Mo_MCF_019; F P Orsitto et al, IAEA FEC 2023 London Paper CN1708.**
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - 1.study the parametric dependences of the confinement time in supershot scenario mainly the dependence upon the plasma current and magnetic field .
  - 2.study the paramedic dependence on the density and density peaking
  - 3.study the parametric dependence on the heating power
  - 4.study the parametric dependence on the beam energy

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U	30	10
TCV		
WEST		

#37 Study of supershot-like scenario confinement on a ST

- TFL assessment: **P3**
- This scenario is not foreseen in DEMO

- **Proponents and contact person:**
- francesco.orsitto@enea.it
- **Scientific Background & Objectives**
  - The supershot or hot ion mode scenario was studied intensively in TFTR and JET DTE1/2
  - **A scaling law of energy confinement has been recently proposed based on TFTR supershot confinement and L-mode scaling law : this scaling law was found in broad agreement with ST40 data on a wide range of plasma parameters[1].**
  - **The present proposal is aimed for the first time at a detailed experimental check of the various dependences of this energy confinement time scaling as proposed in [5] at a different aspect ratio A=1.4 and different major radius**
- **[1] F P Orsitto and M Romanelli , 48th EPS 2022 P5a.103; F P Orsitto , M Romanelli and ST40 Team 49th EPS 2023 poster Mo_MCF_019; F P Orsitto et al, IAEA FEC 2023 London Paper CN1708.**
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - 1.study the parametric dependences of the confinement time in supershot scenario mainly the dependence upon the plasma current and magnetic field .
  - 2.study the paramedic dependence on the density and density peaking
  - 3.study the parametric dependence on the heating power
  - 4.study the parametric dependence on the beam energy

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U	30	10
TCV		
WEST		

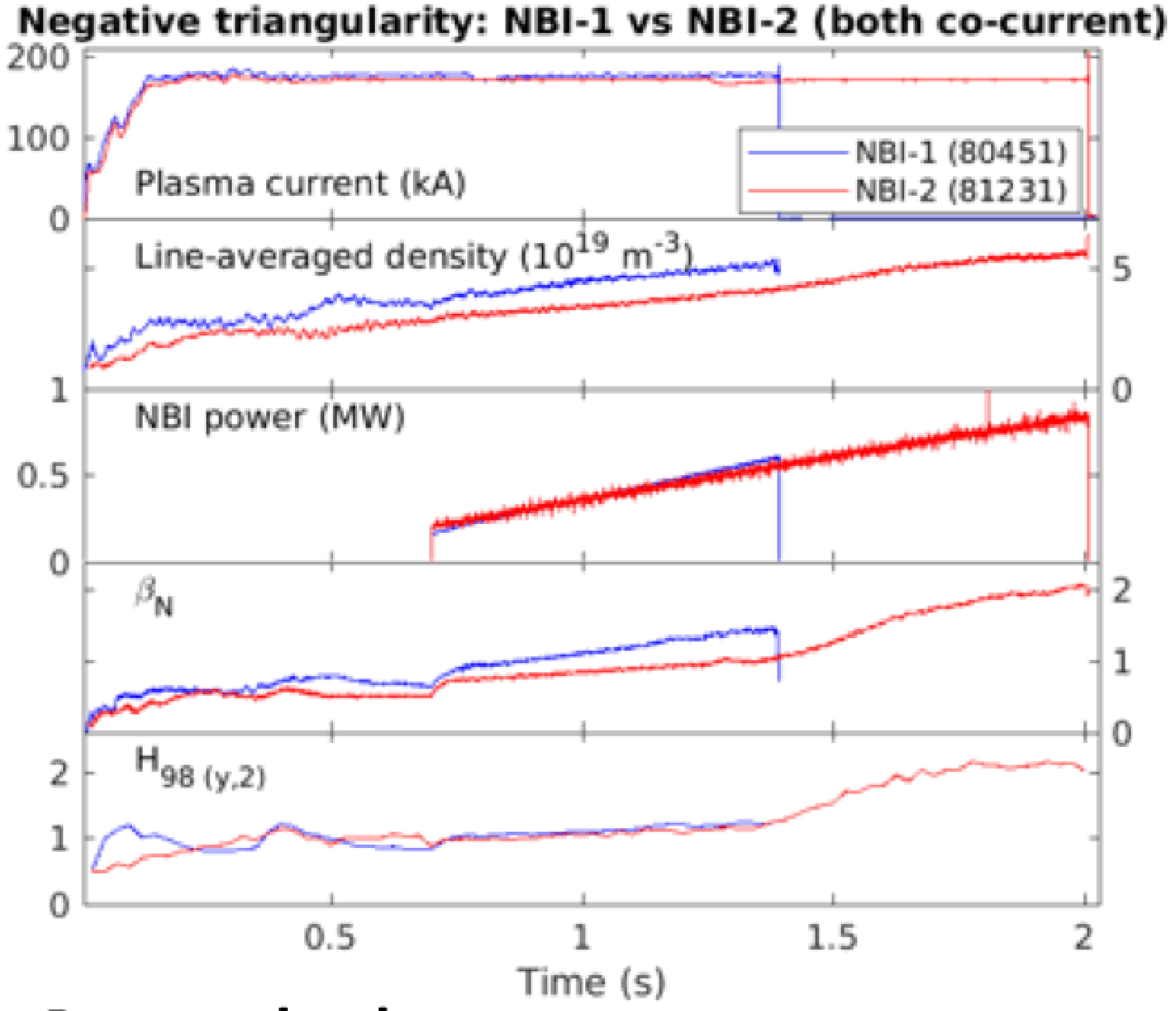
#38 Expansion of the stable β_N negative-triangularity L-mode existence domain

- **Proponents and contact person:**
  S. Coda & friends
- **Scientific Background & Objectives**

❖ Negative-triangularity (NT) plasmas provide H-mode-like confinement with an L-mode edge and no ELMs
❖ The current apparent stability limit (well below ideal stability) is β_N~1.4 for stationary diverted NT plasmas (and β_N~3 transiently)
❖ Performance-limiting NTMs and VDEs could be tamed by improvements in control tools

- **Experimental Strategy/Machine Constraints and essential diagnostics**

❖ Tools: optimize vertical control to avoid unwanted VDEs; update and deploy NTM control and integrate with other advanced control schemes (l_i, density, shape)
❖ Optimize scenario for L-mode resilience and high confinement
❖ Apply varying combinations of X3, NBI-1 and NBI-2 to diverted NT target; replicate on H-mode PT target
❖ Validation of transport and gyrokinetic codes
❖ Need: all profile, turbulence, edge and fast-particle diagnostics



Proposed pulses

Device	# Pulses	# Development
JET		
MAST-U		
TCV	40	20
WEST		

#38 Expansion of the stable β_N negative-triangularity L-mode existence domain

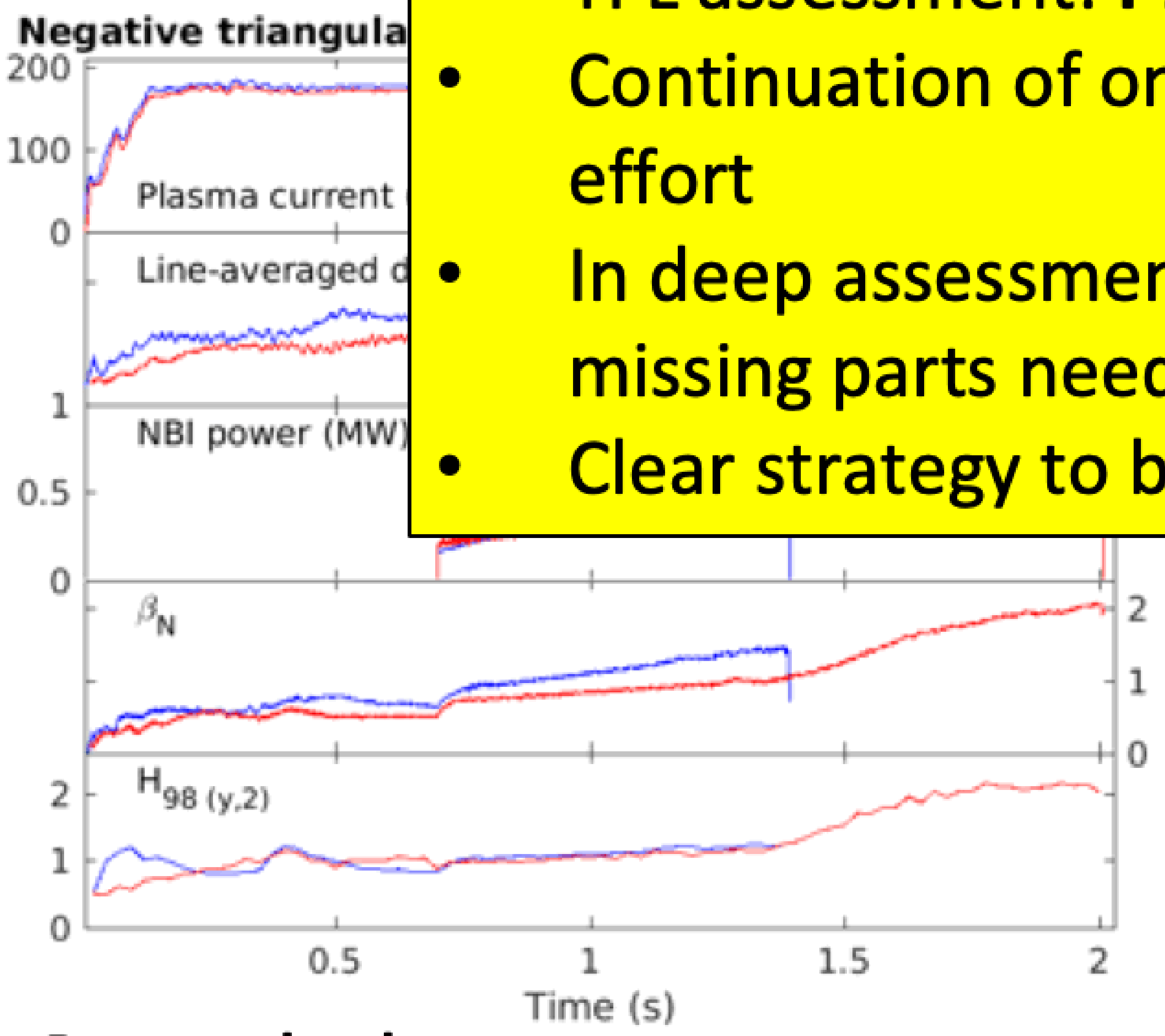
- **Proponents and contact person:**
  S. Coda & friends
- **Scientific Background & Objectives**

❖ Negative-triangularity (NT) plasmas provide H-mode-like confinement with an L-mode edge and no ELMs
❖ The current apparent stability limit (well below ideal stability) is β_N~1.4 for stationary diverted NT plasmas (and β_N~3 transiently)
❖ Performance-limiting NTMs and VDEs could be tamed by improvements in control tools

- **Experimental Strategy/Machine Constraints and essential diagnostics**

❖ Tools: optimize vertical control to avoid unwanted VDEs; update and deploy NTM control and integrate with other advanced control schemes (l_i, density, shape)
❖ Optimize scenario for L-mode resilience and high confinement
❖ Apply varying combinations of X3, NBI-1 and NBI-2 to diverted NT target; replicate on H-mode PT target
❖ Validation of transport and gyrokinetic codes
❖ Need: all profile, turbulence, edge and fast-particle diagnostics

- TFL assessment: **P1**
- Continuation of ongoing effort
- In deep assessment of missing parts needed
- Clear strategy to be refined

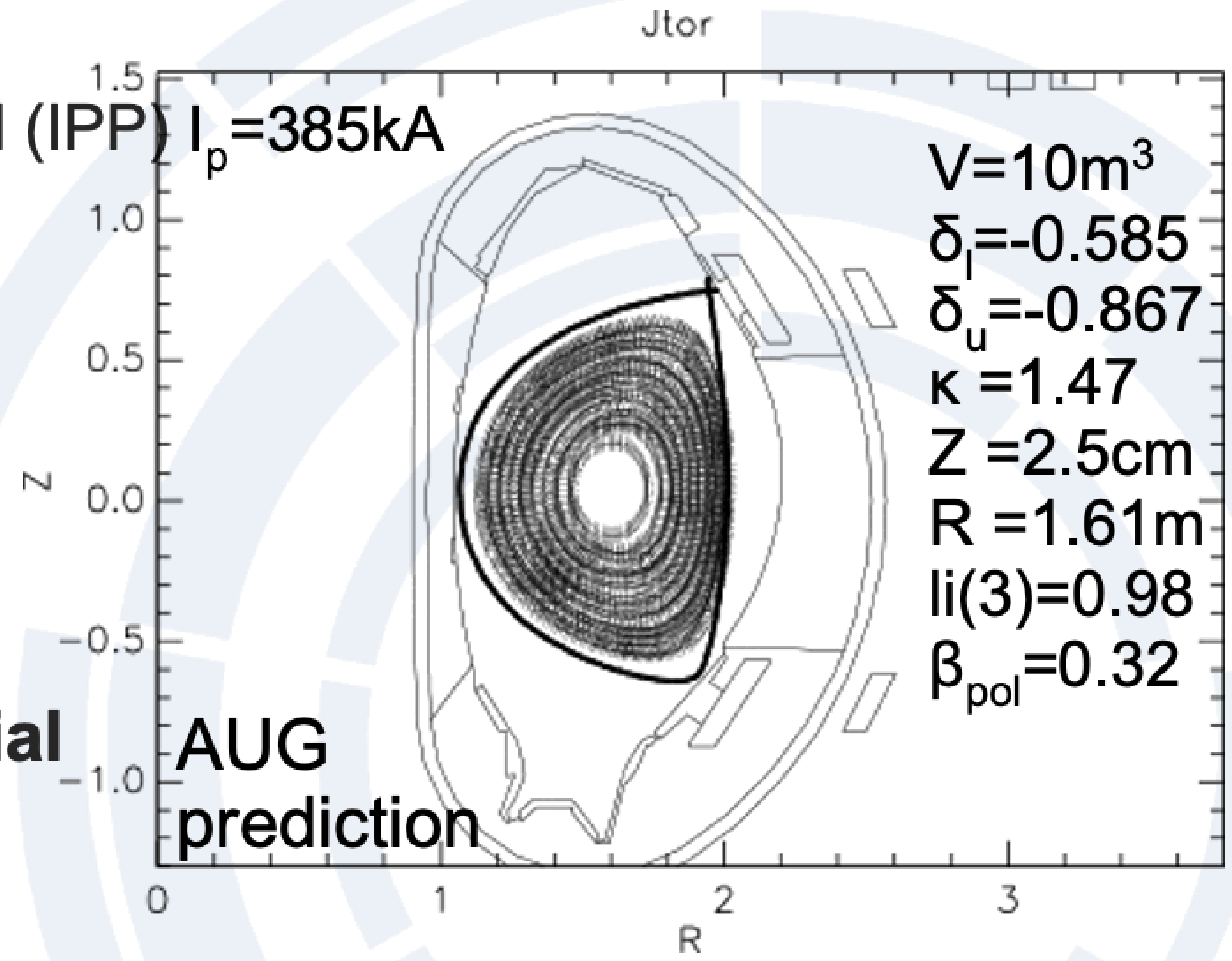


Proposed pulses

Device	# Pulses	# Development
JET		
MAST-U		
TCV	40	20
WEST		

#39 Using strongly negative triangularities on ASDEX Upgrade

- **Proponent(s)**
  - J.Hobirk (IPP), B. Vanovac (MIT), T. Pütterich (IPP), T. Happel (IPP)
- **Scientific Background & Objectives**
  - AUG negative triangularity discharges often enter H-mode
  - Main benefit of neg. delta is avoidance of H-mode
  - Stronger shaping desired to get TCV/DIII-D like performance in L-mode
- **Experimental Strategy/Machine Constraints and essential diagnostics**
  - A special coil/power supply setup can potentially reach high negative deltas at low plasma currents and limited power handling
  - Scans in power, ion-/electron heating ratio and density can characte potential L-mode operation in neg delta
  - Analysis of edge stability (e.g. Baloo, Iped) and core transport (TGLF/Gene) can give further insight to neg. delta operation



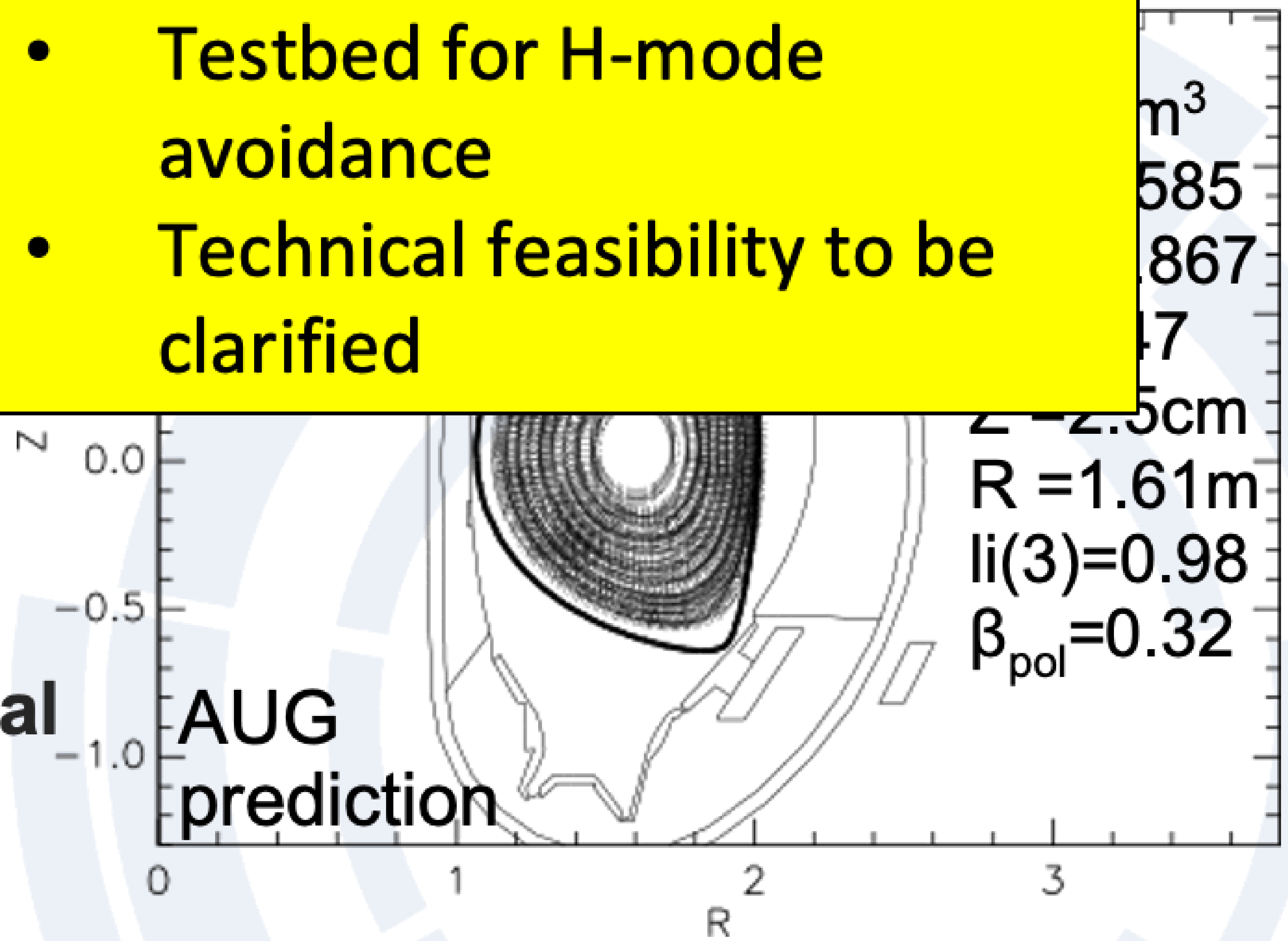
Proposed pulses

Device	# Pulses	# Development
AUG	6 pulses	6
MAST-U		
TCV		
WEST		

#39 Using strongly negative triangularities on ASDEX Upgrade

- **Proponent(s)**
  - J.Hobirk (IPP), B. Vanovac (MIT), T. Pütterich (IPP), T. Happel
- **Scientific Background & Objectives**
  - AUG negative triangularity discharges often enter H-mode
  - Main benefit of neg. delta is avoidance of H-mode
  - Stronger shaping desired to get TCV/DIII-D like performance in L-mode
- **Experimental Strategy/Machine Constraints and essential diagnostics**
  - A special coil/power supply setup can potentially reach high negative deltas at low plasma currents and limited power handling
  - Scans in power, ion-/electron heating ratio and density can characte potential L-mode operation in neg delta
  - Analysis of edge stability (e.g. Baloo, Iped) and core transport (TGLF/Gene) can give further insight to neg. delta operation

- TFL assessment: **P1**
- Testbed for H-mode avoidance
- Technical feasibility to be clarified



Proposed pulses

Device	# Pulses	# Development
AUG	6 pulses	6
MAST-U		
TCV		
WEST		

#40 Development of NT scenarios in WEST

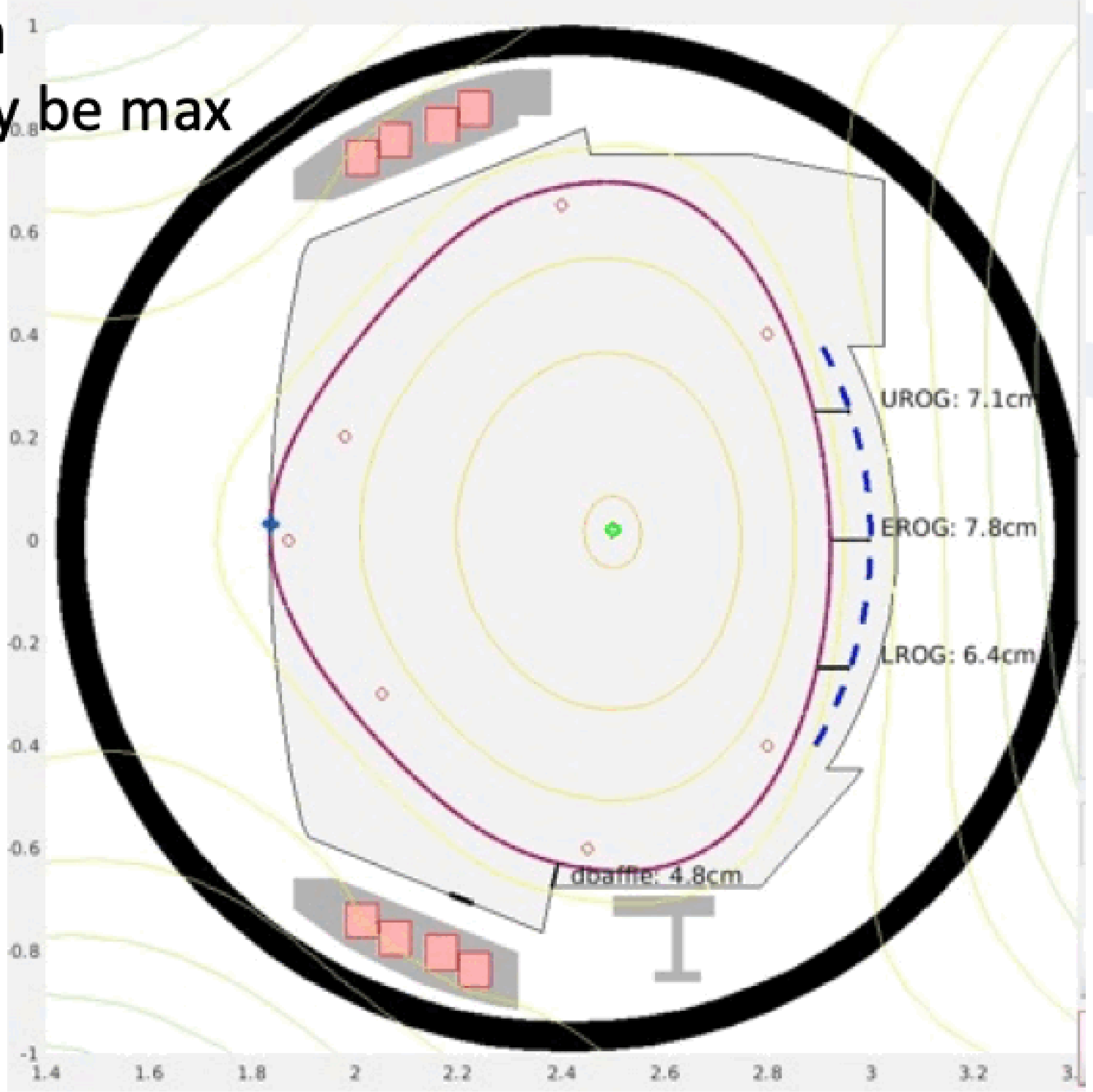
- **Proponents and contact person:**
  olivier.sauter@epfl.ch,
  remy.nouailletas@cea.fr

- **Scientific Background & Objectives**
  Improvement with negative triangularity also predicted at higher aspect ratio and lower rho* (high B_0), but needs to be tested experimentally. No need to test limited vs diverted, since L-H transition sufficiently tested in other tokamaks

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  Thanks to reverting sign of upper coils can make NT diverted shape in WEST
  - Density scan to test LOC-SOC and confinement
  - Vary Ip, LHCD
  - ECH additional in 2025
  - Best performance, long pulses

  Then do TCV similar shapes/scans for comparison

Pre-design
250kA may be max



Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	10	5
WEST	20	10

#40 Development of NT scenarios in WEST

- **Proponents and contact person:**
  olivier.sauter@epfl.ch,
  remy.nouailletas@cea.fr

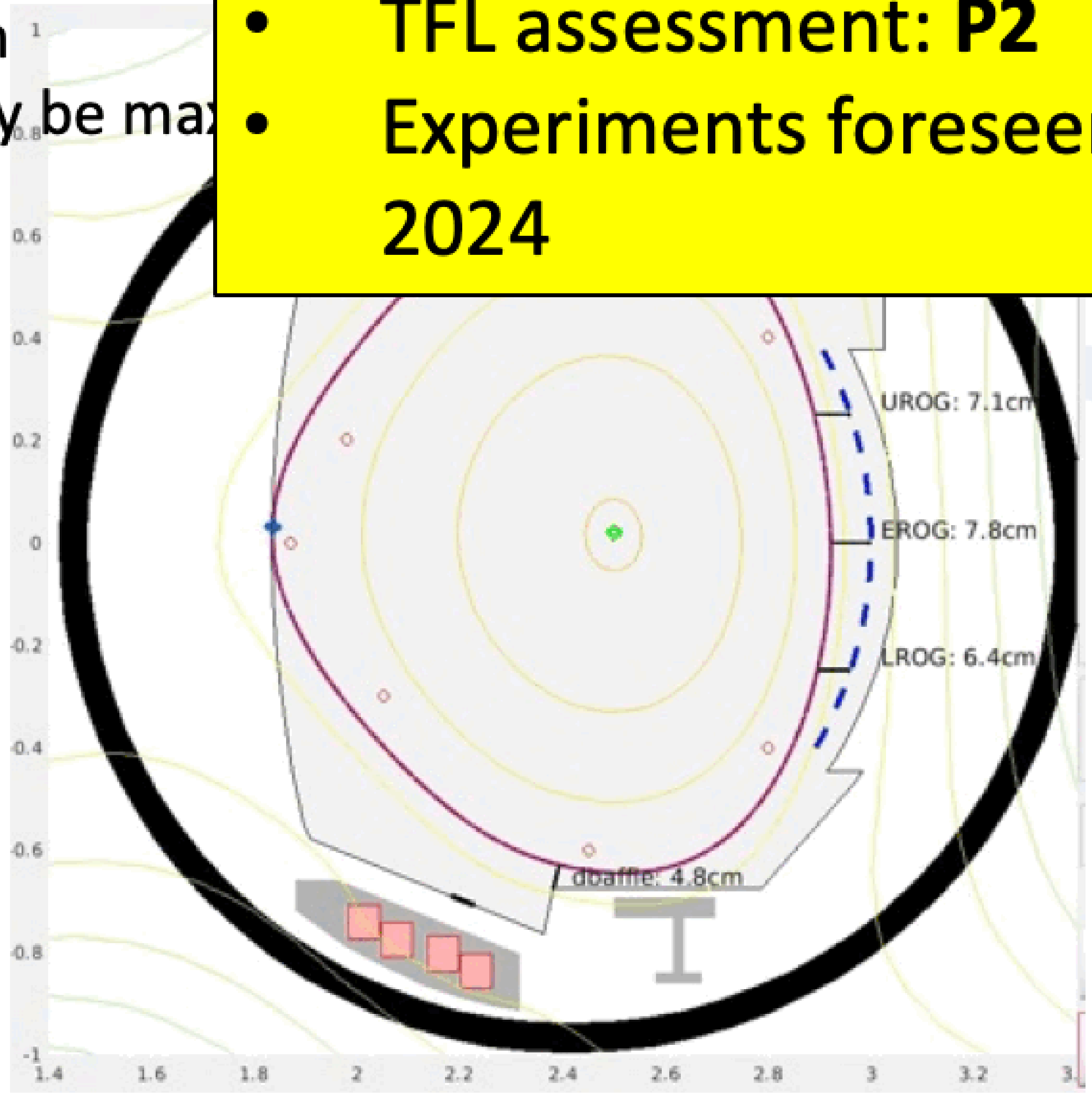
- **Scientific Background & Objectives**
  Improvement with negative triangularity also predicted at higher aspect ratio and lower rho* (high B_0), but needs to be tested experimentally. No need to test limited vs diverted, since L-H transition sufficiently tested in other tokamaks

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  Thanks to reverting sign of upper coils can make NT diverted shape in WEST
  - Density scan to test LOC-SOC and confinement
  - Vary Ip, LHCD
  - ECH additional in 2025
  - Best performance, long pulses

  Then do TCV similar shapes/scans for comparison

Pre-design
250kA may be ma

- TFL assessment: **P2**
- Experiments foreseen in 2024



Proposed pulses

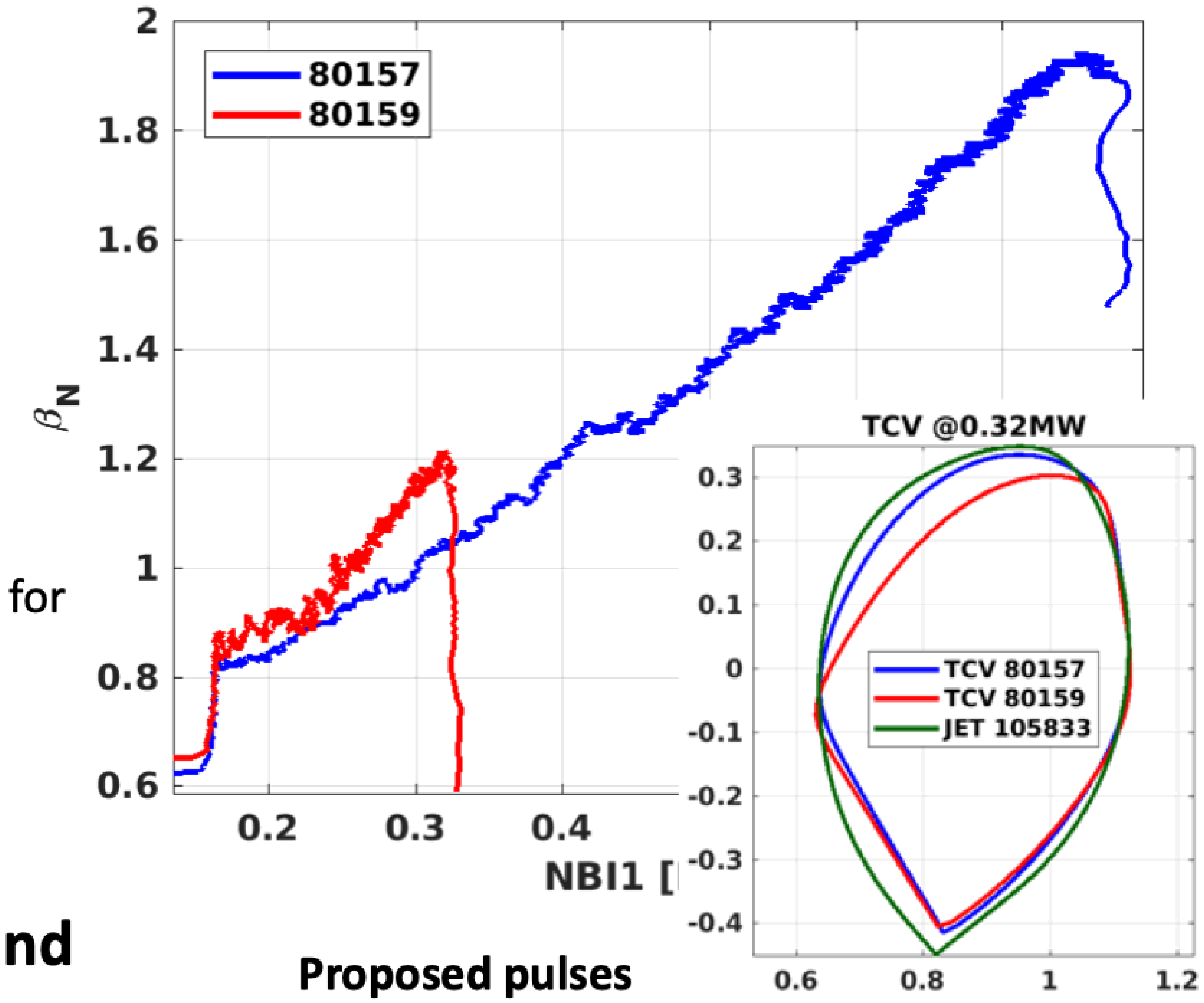
Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	10	5
WEST	20	10

#41 Similarity experiments of NT plasmas on TCV towards DEMO

- **Proponents and contact person:**
- Olivier.Sauter@epfl.ch

- **Scientific Background & Objectives**
  - Use similarity experiments developed in 2024
  - Start with largest range for validating simulations: TCV-JET for size and TCV-MAST-U for aspect ratio
  - Aim to predict for a NT-DEMO

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - All heating
  - Standards for NT plasmas
  - May use baffles since focusing on top delta NT cases



Proposed pulses

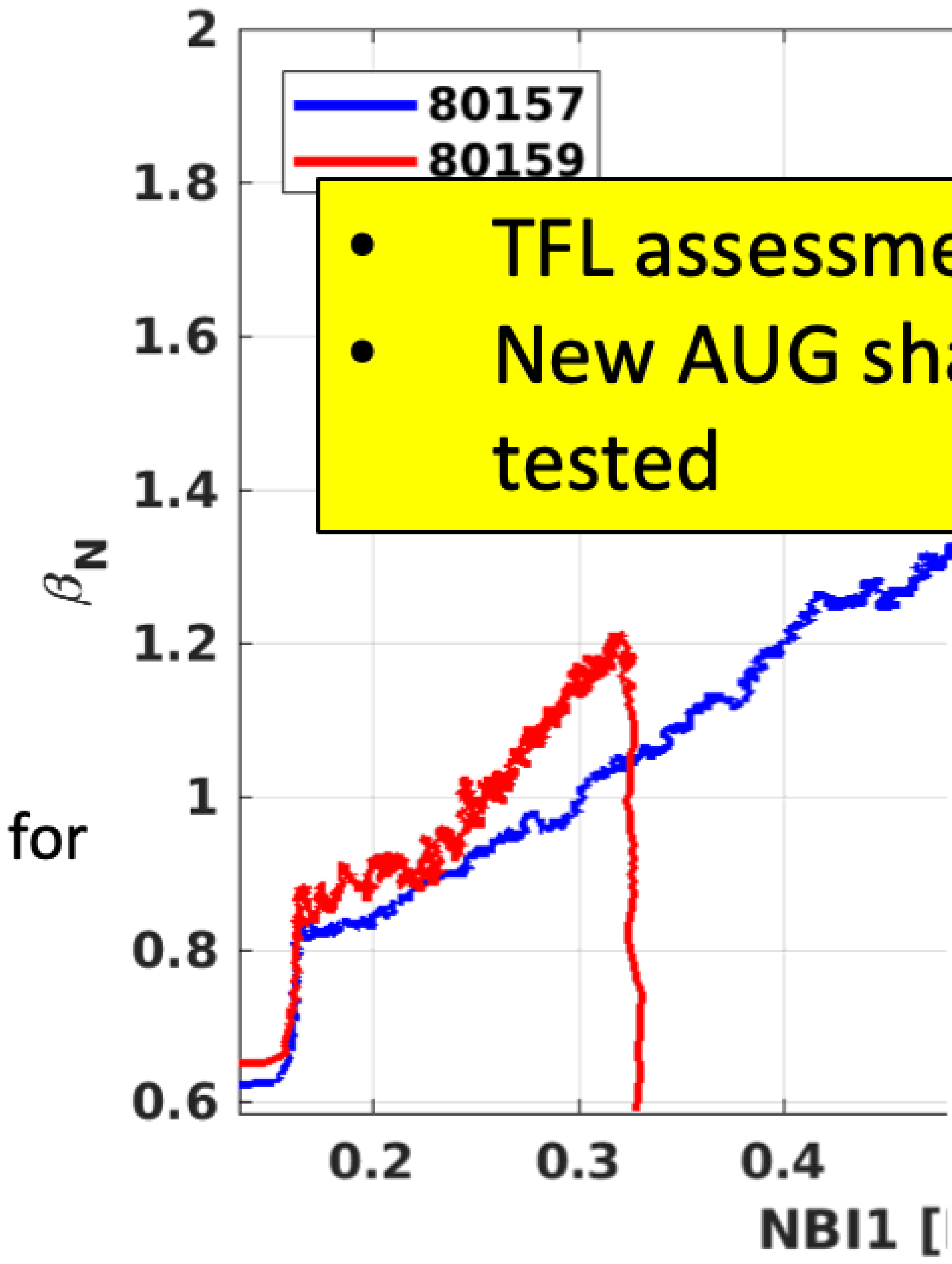
Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	30	10
WEST		

#41 Similarity experiments of NT plasmas on TCV towards DEMO

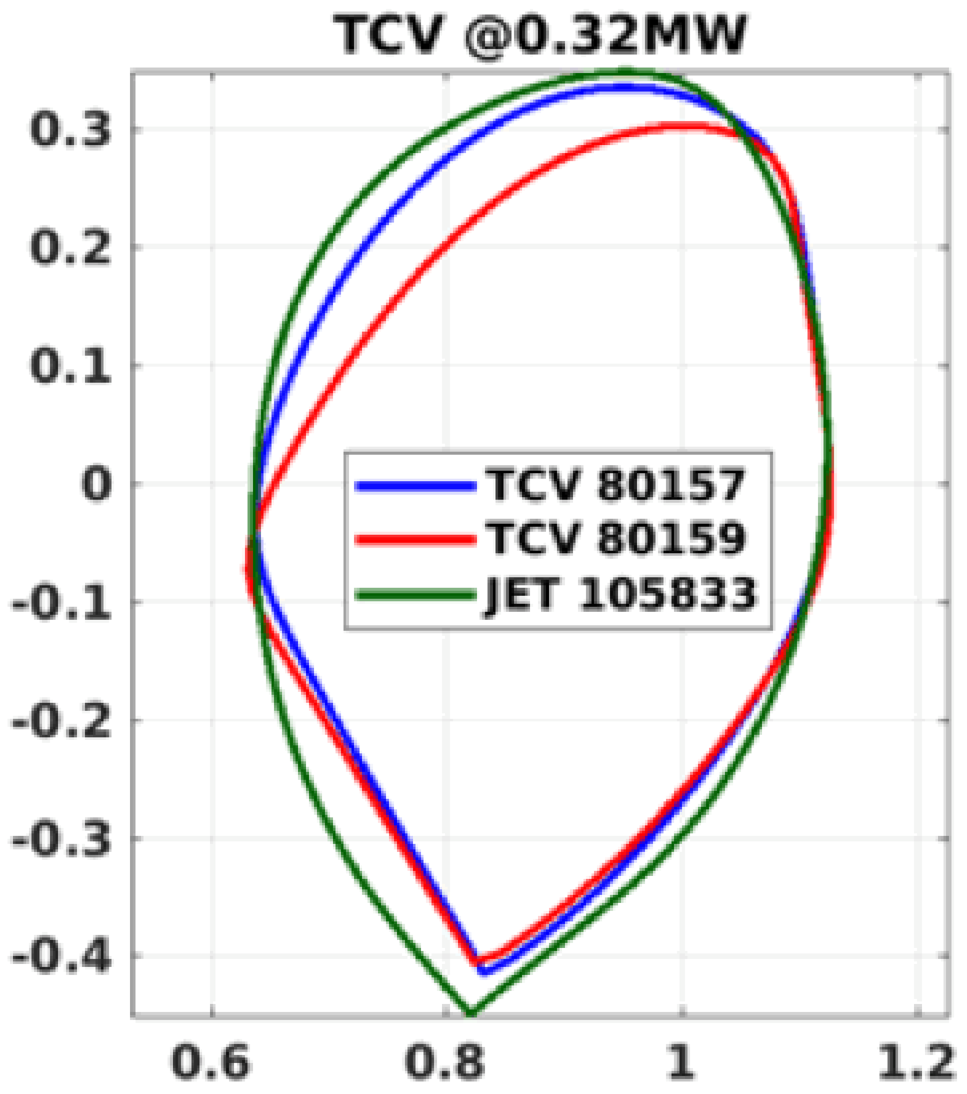
- **Proponents and contact person:**
- Olivier.Sauter@epfl.ch

- **Scientific Background & Objectives**
  - Use similarity experiments developed in 2024
  - Start with largest range for validating simulations: TCV-JET for size and TCV-MAST-U for aspect ratio
  - Aim to predict for a NT-DEMO

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - All heating
  - Standards for NT plasmas
  - May use baffles since focusing on top delta NT cases



- TFL assessment: **P1**
- New AUG shapes should be tested



Proposed pulses

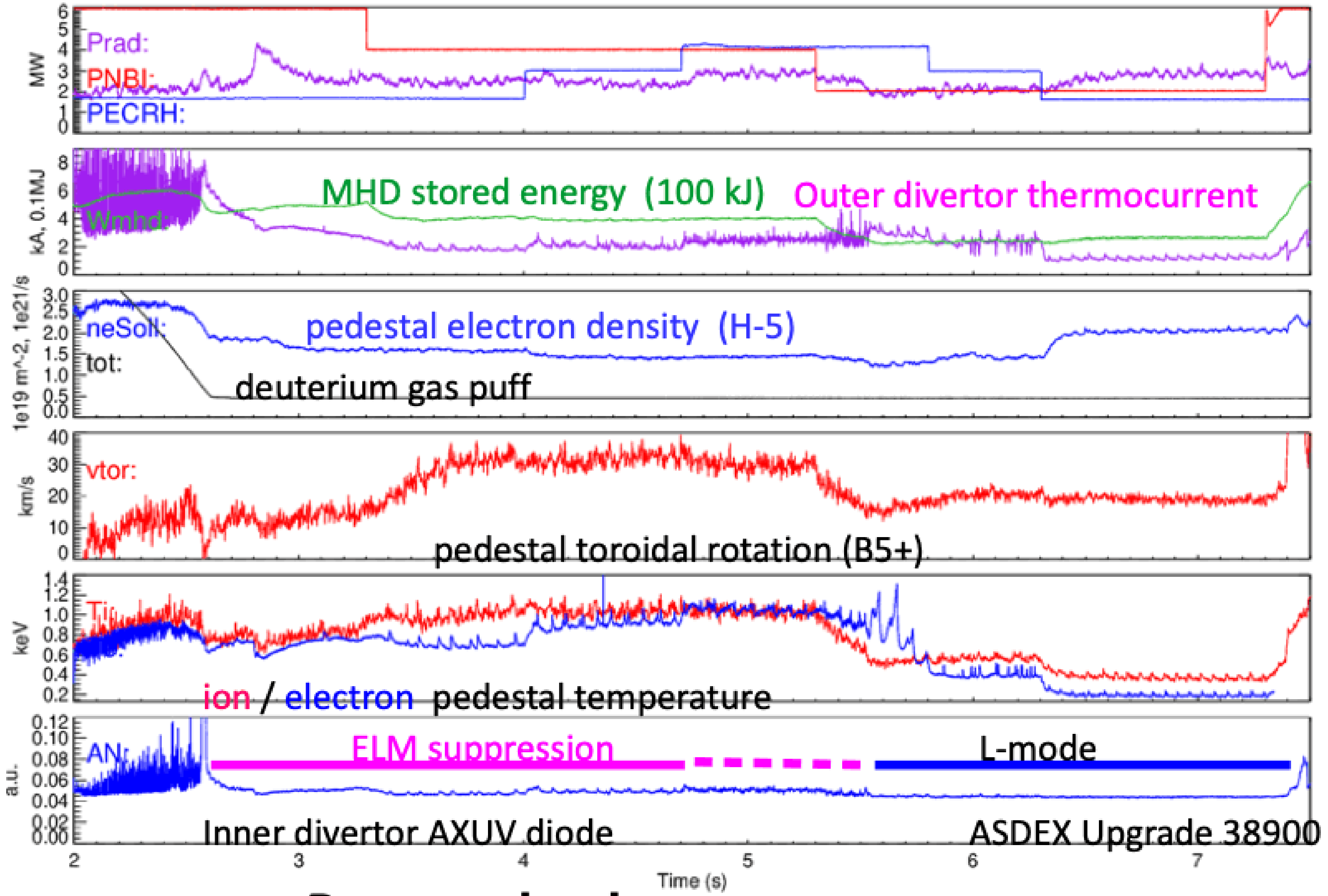
Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	30	10
WEST		

#42 Effect of heating mix on RMP ELM suppresion access

- **Proponents and contact person:**
- Wolfgang.Suttrop@ipp.mpg.de

- **Scientific Background & Objectives**
  - RMP ELM suppression can be lost above a certain fraction of electron heating (ECRH)
    - observed in DIII-D, AUG, KSTAR
  - Is this a Ti/Te effect (as pulse 38900 in AUG might suggest)?
  - Proposal tries to differentiate between Ti/Te, plasma rotation, and beta as candidate critical parameters

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Reproduce heating mix effect at different power levels
  - Challenge Ti/Te hypothesis by keeping input torque constant and raise Ti by dilution (light impurity [nitrogen] injection)
  - Challenge rotation hypothesis by changing plasma rotation without changing ion heating (NBI power) but by minute deuterium gas injection and/or RMP current
  - Need AUG with known reproducible requirements for ELM suppression:
    low recycling conditions, low He content: start 5 shots after a fresh boronisation



Proposed pulses

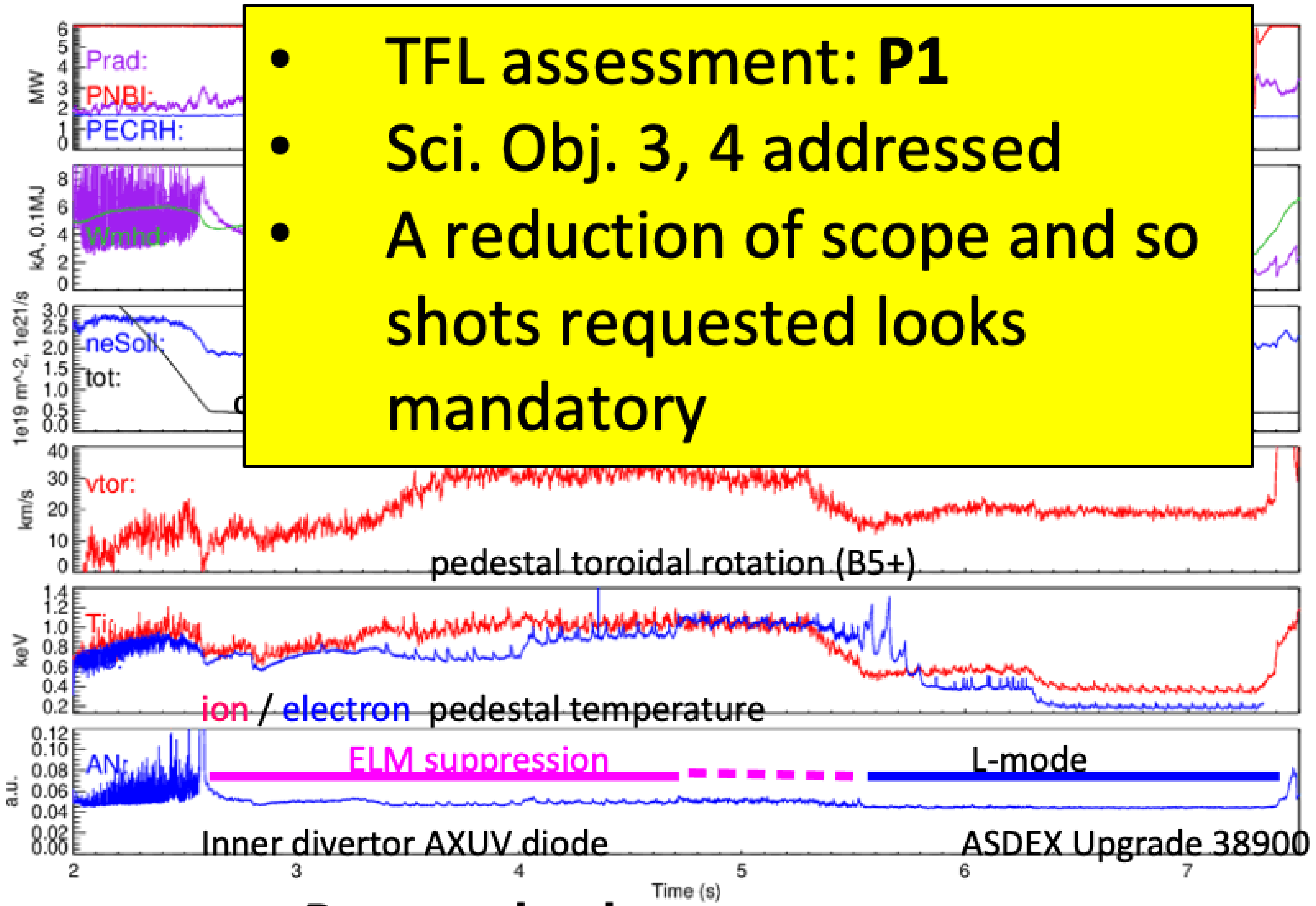
Device	# Pulses/Session	# Development
AUG	21	
MAST-U		
TCV		
WEST		

#42 Effect of heating mix on RMP ELM suppresion access

- **Proponents and contact person:**
- Wolfgang.Suttrop@ipp.mpg.de

- **Scientific Background & Objectives**
  - RMP ELM suppression can be lost above a certain fraction of electron heating (ECRH)
    - observed in DIII-D, AUG, KSTAR
  - Is this a Ti/Te effect (as pulse 38900 in AUG might suggest)?
  - Proposal tries to differentiate between Ti/Te, plasma rotation, and beta as candidate critical parameters

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Reproduce heating mix effect at different power levels
  - Challenge Ti/Te hypothesis by keeping input torque constant and raise Ti by dilution (light impurity [nitrogen] injection)
  - Challenge rotation hypothesis by changing plasma rotation without changing ion heating (NBI power) but by minute deuterium gas injection and/or RMP current
  - Need AUG with known reproducible requirements for ELM suppression:
    low recycling conditions, low He content: start 5 shots after a fresh boronisation



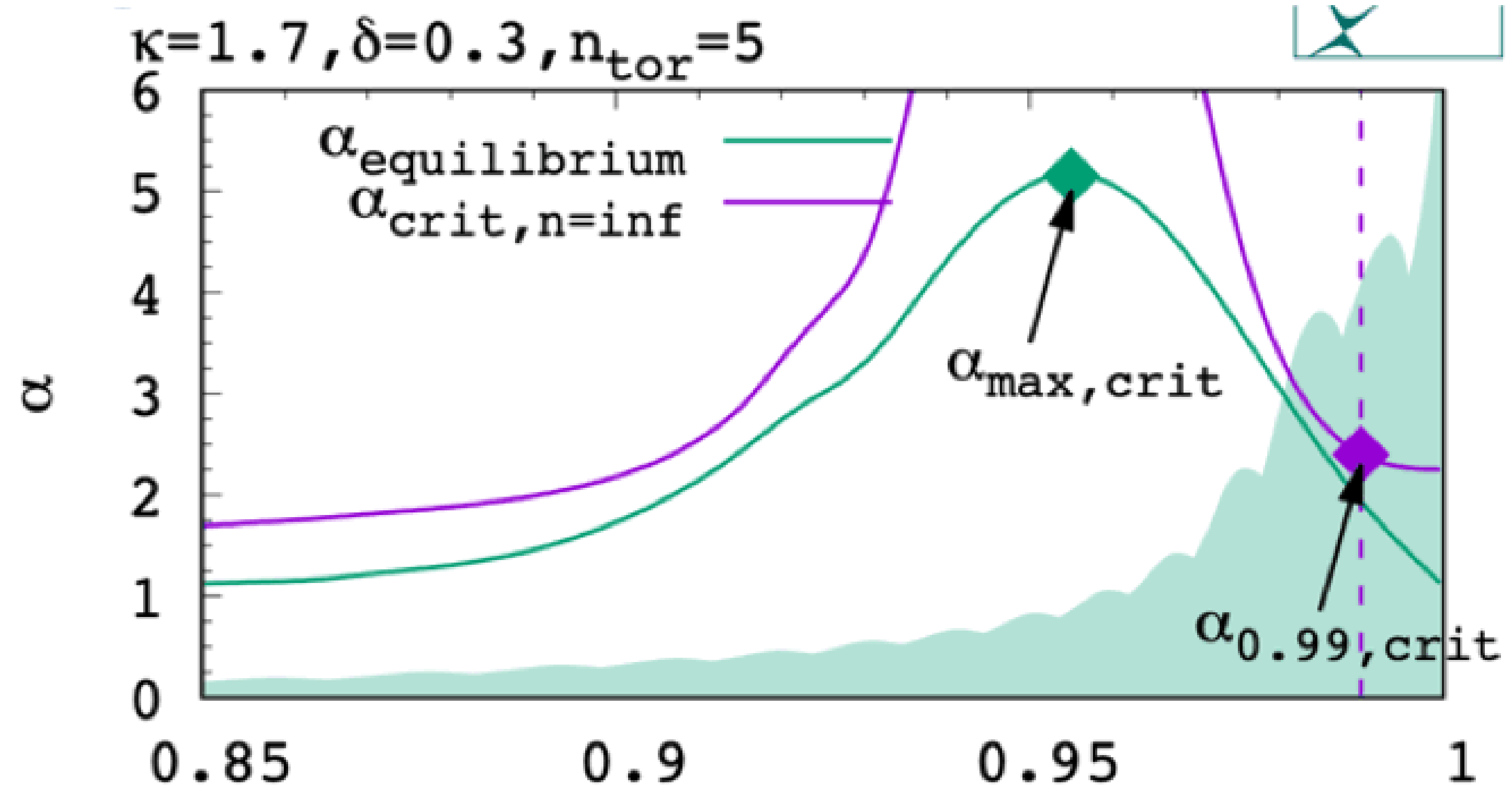
- TFL assessment: **P1**
- Sci. Obj. 3, 4 addressed
- A reduction of scope and so shots requested looks mandatory

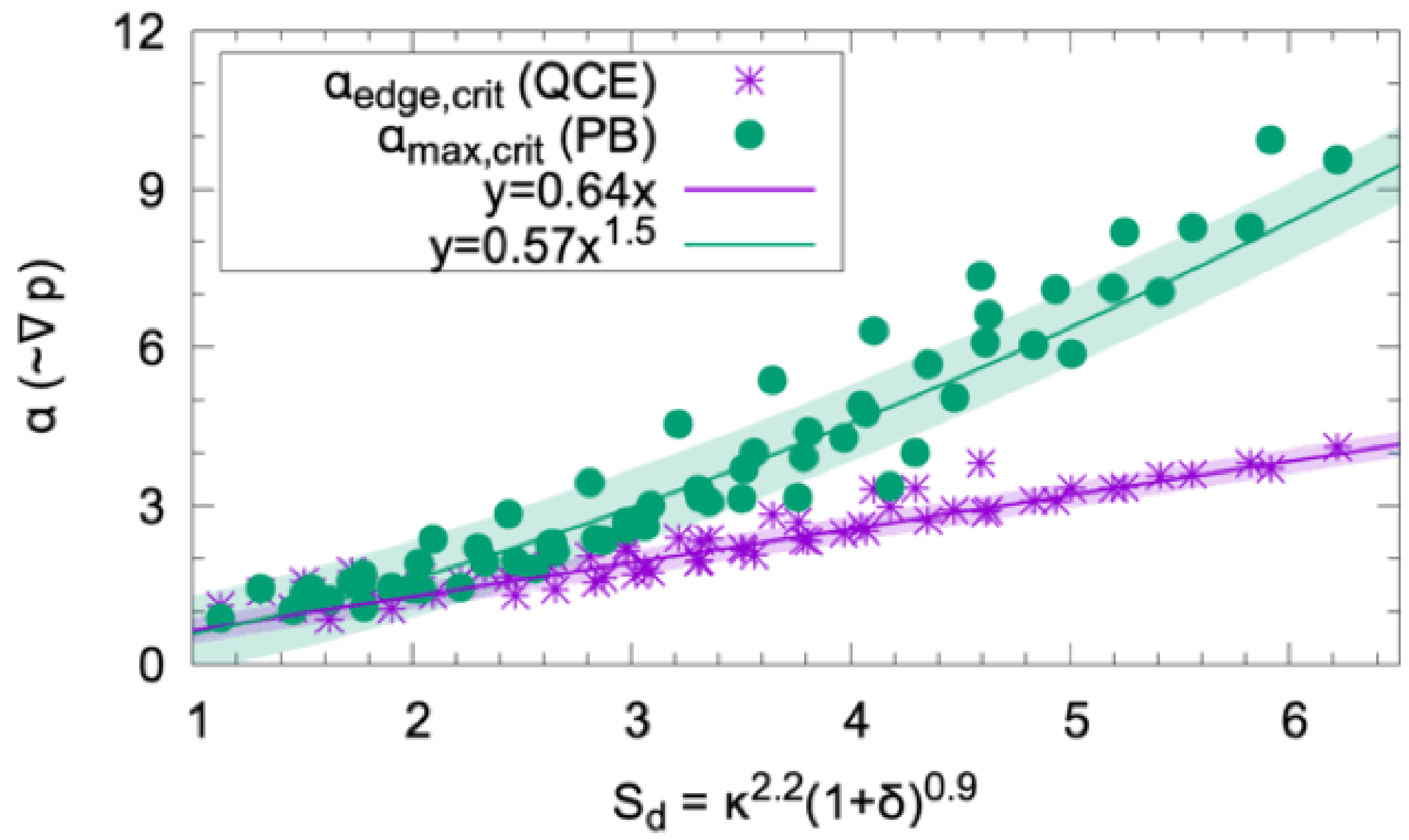
Proposed pulses

Device	# Pulses/Session	# Development
AUG	21	
MAST-U		
TCV		
WEST		

#43 Develop a QCE at q95<<4 and if not possible understand why

- **Proponents and contact person:**
  - Benoit Labit, benoit.labit@epfl.ch
- **Scientific Background & Objectives**
  - So far it has been difficult if not impossible to get QCE at q95<4 by increasing plasma current Ip.
  - QCE at low B0 have been obtained.
  - This is somehow problematic for extrapolation since confinement scales with plasma current.
  - Encountered issues: Lock modes, NTM, large ELMs, maybe short in power





M. Dunne, EPS 2024

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - The idea is to play with plasma elongation to relax the constrain on triangularity (large ELMs).
  - According to the S_d parameter to get QCE, kappa is more efficient than delta.
  - Nevertheless by increasing kappa, one also increases P_LH so we will rely on ECR heating via X3 to get more power.
  - The starting point will be the ITER shape developed on TCV at q95=6, kappa=1.7 and delta=0.5

Proposed pulses

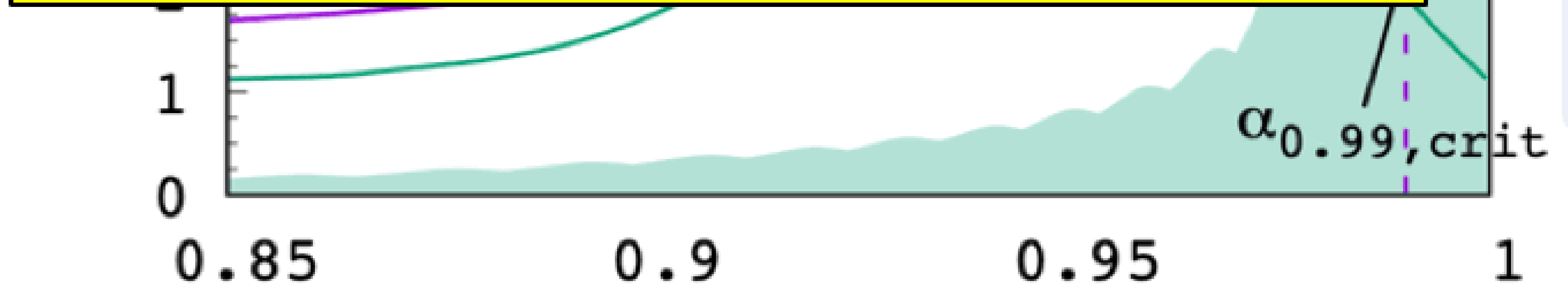
Device	# Pulses/Session	# Development
TCV	25	🡐

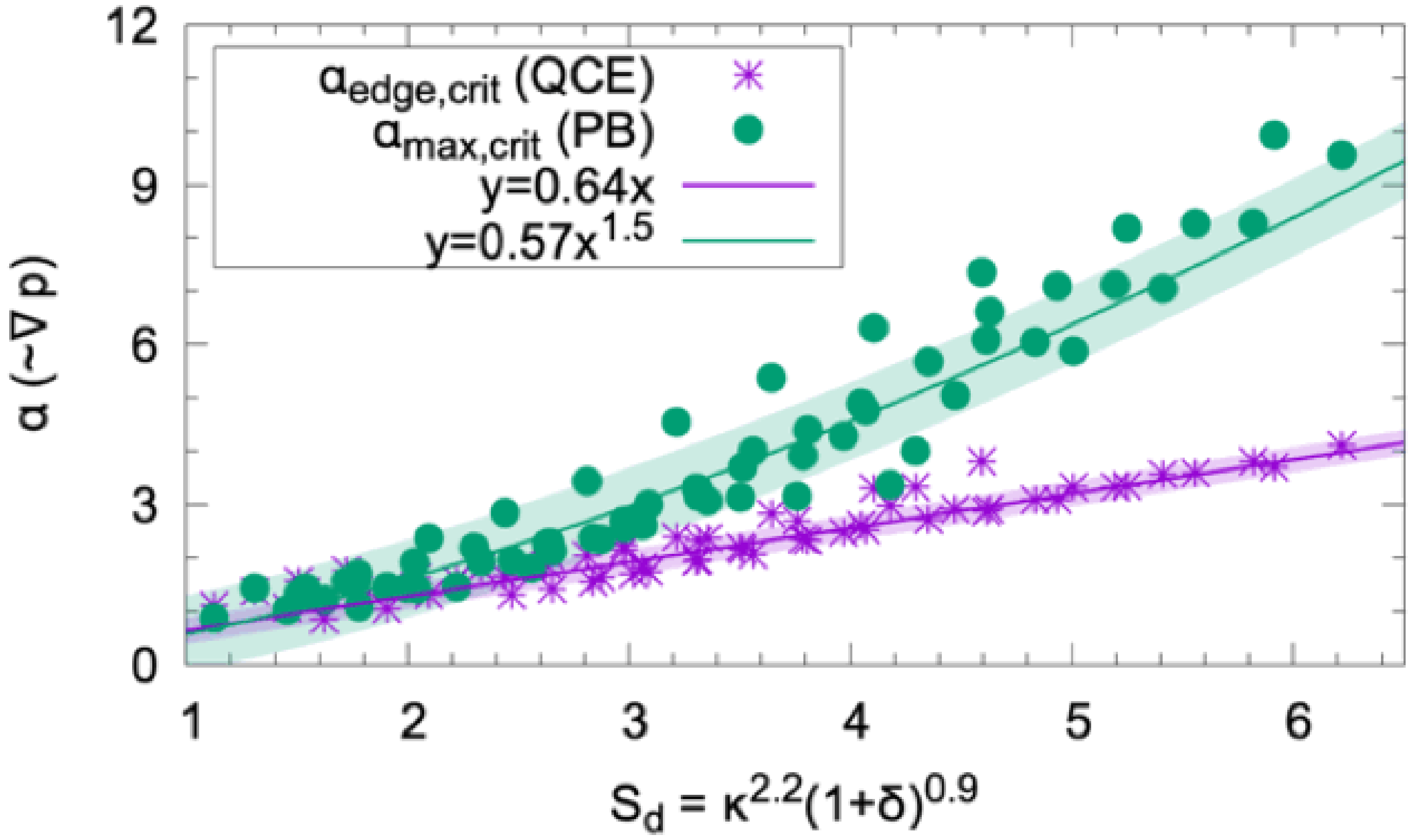
#43 Develop a QCE at q95<<4 and if not possible understand why

- TFL assessment: **P1**
- Sci. Obj. 1, 3 addressed
- Testbed for validation of QCE access conditions

- **Proponents and contact person:**
  - Benoit Labit, benoit.labit@epfl.ch
- **Scientific Background & Objectives**
  - So far it has been difficult if not impossible to get QCE at q95<4 by increasing plasma current Ip.
  - QCE at low B0 have been obtained.
  - This is somehow problematic for extrapolation since confinement scales with plasma current.
  - Encountered issues: Lock modes, NTM, large ELMs, maybe short in power

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - The idea is to play with plasma elongation to relax the constrain on triangularity (large ELMs).
  - According to the S_d parameter to get QCE, kappa is more efficient than delta.
  - Nevertheless by increasing kappa, one also increases P_LH so we will rely on ECR heating via X3 to get more power.
  - The starting point will be the ITER shape developed on TCV at q95=6, kappa=1.7 and delta=0.5





M. Dunne, EPS 2024

Proposed pulses

Device	# Pulses/Session	# Development
TCV	25	🡐

#185: Fast-ion transport in negative triangularity (P1-2025)

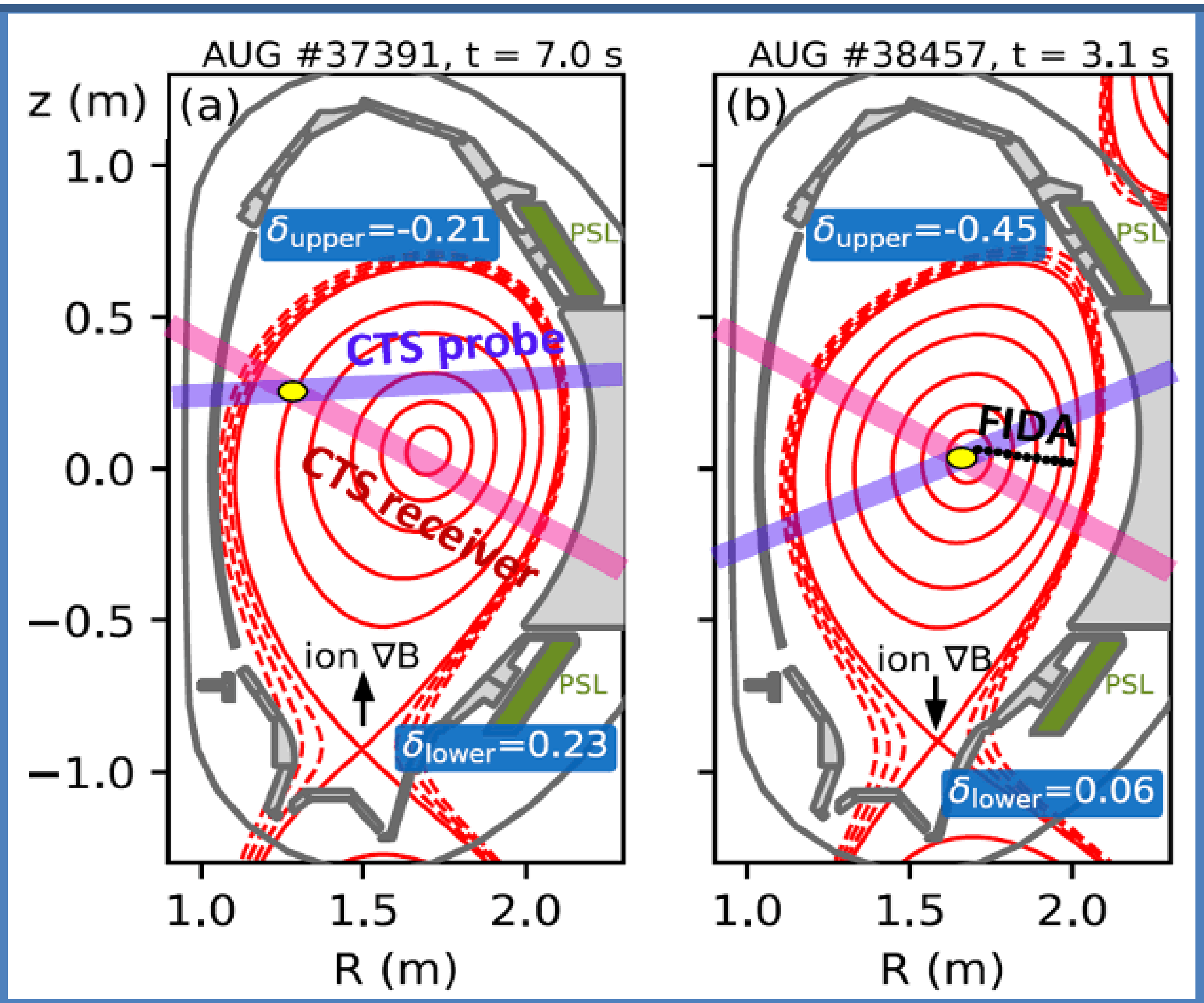
- **Proponents and contact person:**

J. Rasmussen (DTU), T. Happel (IPP), M. Salewski, S. K. Nielsen (DTU) et al. jeras@fysik.dtu.dk

- **Scientific Background & Objectives**

Recent results from DIII-D, TCV, and AUG show conflicting or inconclusive results on fast-ion transport in $\delta < 0$ plasmas. It is critical to get a better understanding of this as part of assessing neg. triangularity as a contender for DEMO operation. To aid this, we will:

- Quantify fast-ion transport at $\delta < 0$ across the AUG minor radius using full suite of confined+lost fast-ion diagnostics – including CTS profile measurements (Figure)
- Identify evidence of anomalous transport and impact of Alfven Eigenmodes using fast-ion velocity-space tomography
- Scan I_p – i.e. vary shaping possibilities and confinement – to evaluate the impact of δ and τ_E on the above.



Possible CTS geometries for (left) edge and (right) core measurements in AUG $\delta < 0$ plasmas [T. Happel+ 2023 NF] and comparison to one of the AUG FIDA views (with angle to ***B*** of $\varphi \approx 12^0$).

- **Experimental Strategy & constraints**

- Bt = 2.65 T for CTS, I_p scan (400, 600, 800 kA) at $\delta < 0$ with NBI Q3 (for FIDA) + Q6/Q8
- ICRH to help drive AEs unstable. Low density for low v* and high fast-ion content
- FIDA, NPA, FILD if available for confined/lost fast ions
- Gyr 6, 7, 8 for CTS at 105 GHz, with new CTS fast digitizer for continuous fast-ion measurements

Proposed pulses

Device	# Pulses/Session	# Development
AUG	3	3

#185: Fast-ion transport in negative triangularity (P1-2025)

- **Proponents and contact person:**

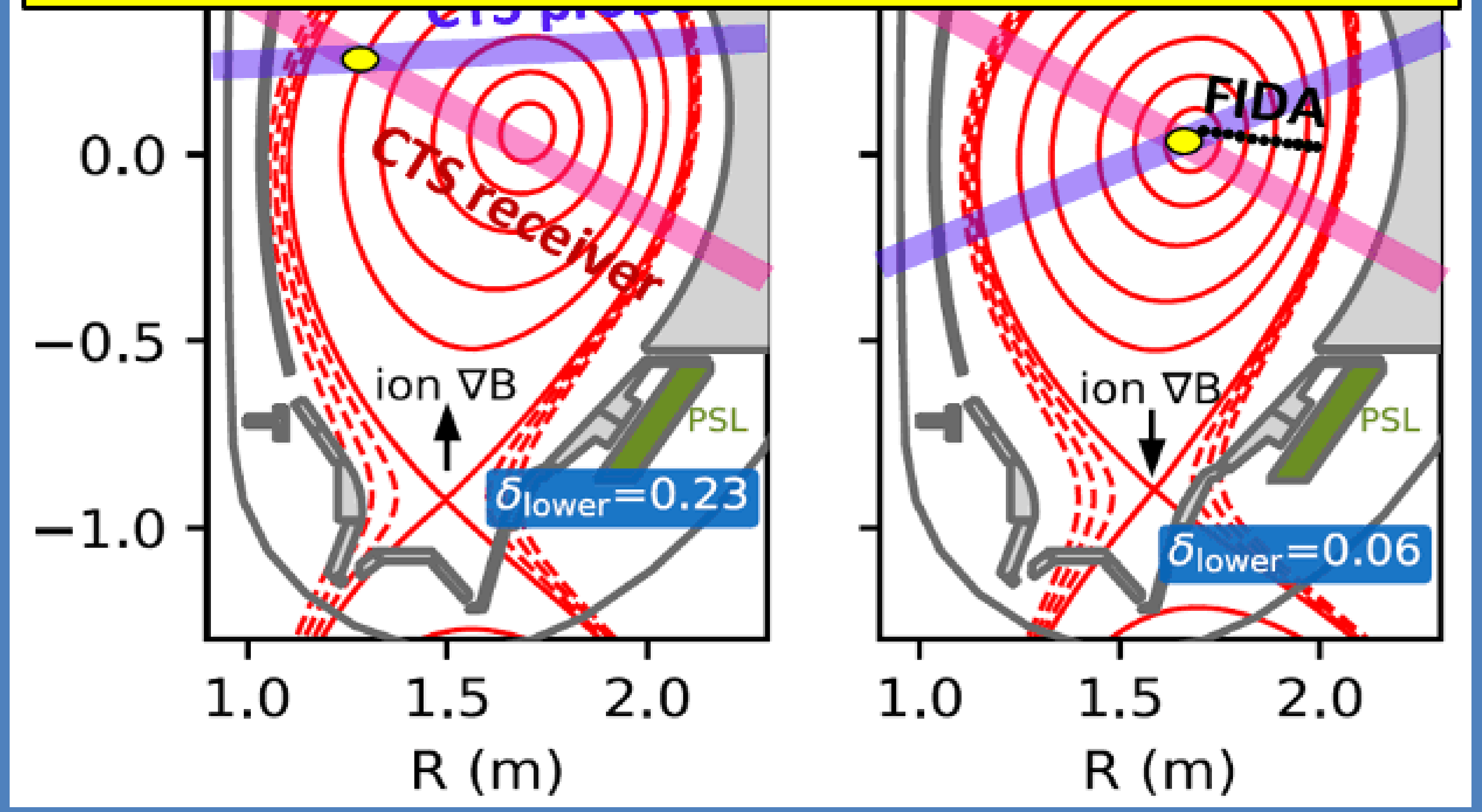
J. Rasmussen (DTU), T. Happel (IPP), M. Salewski, S. K. Nielsen (DTU) et al. jeras@fysik.dtu.dk

- **Scientific Background & Objectives**

Recent results from DIII-D, TCV, and AUG show conflicting or inconclusive results on fast-ion transport in $\delta < 0$ plasmas. It is critical to get a better understanding of this as part of assessing neg. triangularity as a contender for DEMO operation. To aid this, we will:

- Quantify fast-ion transport at $\delta < 0$ across the AUG minor radius using full suite of confined+lost fast-ion diagnostics – including CTS profile measurements (Figure)
- Identify evidence of anomalous transport and impact of Alfven Eigenmodes using fast-ion velocity-space tomography
- Scan I_p – i.e. vary shaping possibilities and confinement – to evaluate the impact of δ and τ_E on the above.

- **TFL assessment: P2**
- **Better evaluate constrains on gyrotrons**



Possible CTS geometries for (left) edge and (right) core measurements in AUG $\delta < 0$ plasmas [T. Happel+ 2023 NF] and comparison to one of the AUG FIDA views (with angle to ***B*** of $\varphi \approx 12^0$).

- **Experimental Strategy & constraints**

- Bt = 2.65 T for CTS, I_p scan (400, 600, 800 kA) at $\delta < 0$ with NBI Q3 (for FIDA) + Q6/Q8
- ICRH to help drive AEs unstable. Low density for low ν* and high fast-ion content
- FIDA, NPA, FILD if available for confined/lost fast ions
- Gyr 6, 7, 8 for CTS at 105 GHz, with new CTS fast digitizer for continuous fast-ion measurements

Proposed pulses

Device	# Pulses/Session	# Development
AUG	3	3

Summary of proposals (28)

No	Proposal name	Proposer	Priority	Comment
17	Characterization of edge fluctuations for NT plasmas with ballooning modes	Margherita Ugoletti et al.	P1/PB	
18	Turbulent Edge/SOL Transport in EDA Regimes in TCV	Miriam La Matina et al.	P1	
19	Turbulence Properties in the Edge of NT Plasmas	Thomas Pütterich	P1	
20	Continued development of RMP ELM suppression scenario in tight aspect ratio geometry	David Ryan	P1	
21	Exploration of the QCE regime in ASDEX Upgrade	Michael Faitsch, Mike Dunne	P1	
22	Exploration of the QCE regime in MAST-U	Jessica Stobbs, Mike Dunne	P1	Reduce shot number
23	EDA H-mode in AUG and TCV	Luís Gil	P2	P2 for AUG / P1 for TCV
24	Impact of resonant field amplification (RFA) on edge magnetic structure and ELM control in high-beta plasmas	Yunfeng Liang	P2	MAST-U: combination with #20
25	Investigating possible reasons of different NT performance in AUG and TCV in view of iDTT NT scenarios	P. Mantica	P1	
28	The role of the QCM in EDA H mode and its relation to the QCE regime in AUG	Gustavo Grenfell, et al.	P2	P1/PB for QCE part
29	I-mode access, power thresholds and confinement on WEST	Amanda Hubbard, Laure Vermare, et al.	P1	
30	Investigations of the first wall power loads at different midplane separatrix positions in AUG	Andreas Redl	P1	PB whenever possible

Summary of proposals (28)

No	Proposal name	Proposer	Priority	Comment
31	Detachment in high-power L-mode NT plasmas and comparison with H-mode PT plasmas	Garance Durr-Legoupil-Nicoud, et al.	P1	Assessment of missing parts needed
32	Development of a stationary QH-mode scenario	Eleonora Viezzer, Samuli Saarelma	P1	Reduce shot number
33	Negative triangularity in conventional vs spherical tokamaks	Diego Jose Cruz Zabala, et al.	P2	
34	Impurity transport in ELM-free scenarios in AUG	Mike Dunne, et al.	P1	If not done in 2024
35	Power threshold density minimum in I-mode and edge ion heat flux scaling	Jan Cecrdle et al.	P2	
36	Advanced scenarios in negative triangularity	Antonia Frank	P1	Top priority for NT-TCV
37	Study of supershot-like scenario confinement on a ST	Francesco Paolo Orsitto	P3	
38	Expansion of the stable beta_N negative-triangularity L-mode existence domain	Stefano Coda	P1	Proposal should be streamlined
39	Using strongly negative triangularities on ASDEX Upgrade	Jörg Hobirk	P1	
40	Development of NT on WEST and comparison with TCV	Olivier Sauter	P2	Experiments in 2024
41	Similarity experiments of NT plasmas on TCV towards DEMO	Olivier Sauter	P1	
42	Heating mix effect on RMP ELM suppression	Wolfgang Suttrop, et al.	P2	Scope should be reduced
43	Why it is difficult to have a QCE at q95<4.5?	Benoit Labit, O. Sauter, et al.	P1	
185	Fast-ion transport in negative triangularity	J. Rasmussen	P2	Impact of special setting for gyrotrons needs to be better assessed

Summary of P1 proposals

	AUG	TCV	MAST-U	WEST
QH	#32	#32	#32	
QCE	#21, #30, #28, #34	#43	#22	
NT	#19, #39, #25	#17, #25, #31, #36, #38, #41		
EDA	#34	#18, #23		
I-mode				#29
RMP	#34, #42		#20	
Provisional shot allocation	45	120	48	15

🡐 1 shot-day requested for RT02-NT-AUG

JET Analysis & Modelling Needs for RT02

	Ongoing activities to continue	New activities
JET-QCE	• TRANSP • SOLPS-TER • Fluxes estimates at first wall	• ERO.2.0 • Pedestal GK analysis • JINTRAC Coconut • Target heat loads? Profiles?
JET-EDA	• Data validation: HRTS, Ti, LPs, IR, bolo	• TRANSP • JINTRAC Coconut
JET-NT	• TRANSP	• Core GK analysis • Edge GK analysis • JINTRAC Coconut • SOLPS-ITER
JET-SE	• Pedestal structure & stability • Explore I-mode-like scenarios ('no-gas' baseline, M21-11 pulses)	• Explore similarities with Q=10 ITER pedestal, in collaboration with ITER (edge ∇P is primarily driven by temperature gradients rather than ∇n_e)