EUROfusion

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RT-09: Physics understanding of energetic particles confinement and their interplay with thermal plasma

D. Keeling

On behalf of WPTE TFLs

E. Tsitrone, N. Vianello, M. Baruzzo, V. Igochine, D. Keeling, A. Hakola, B. Labit

Research Topic Coordinators

Y. Kazakov, J. Galdon-Quiroga, A. Jansen van Vuuren, R. Ochoukov

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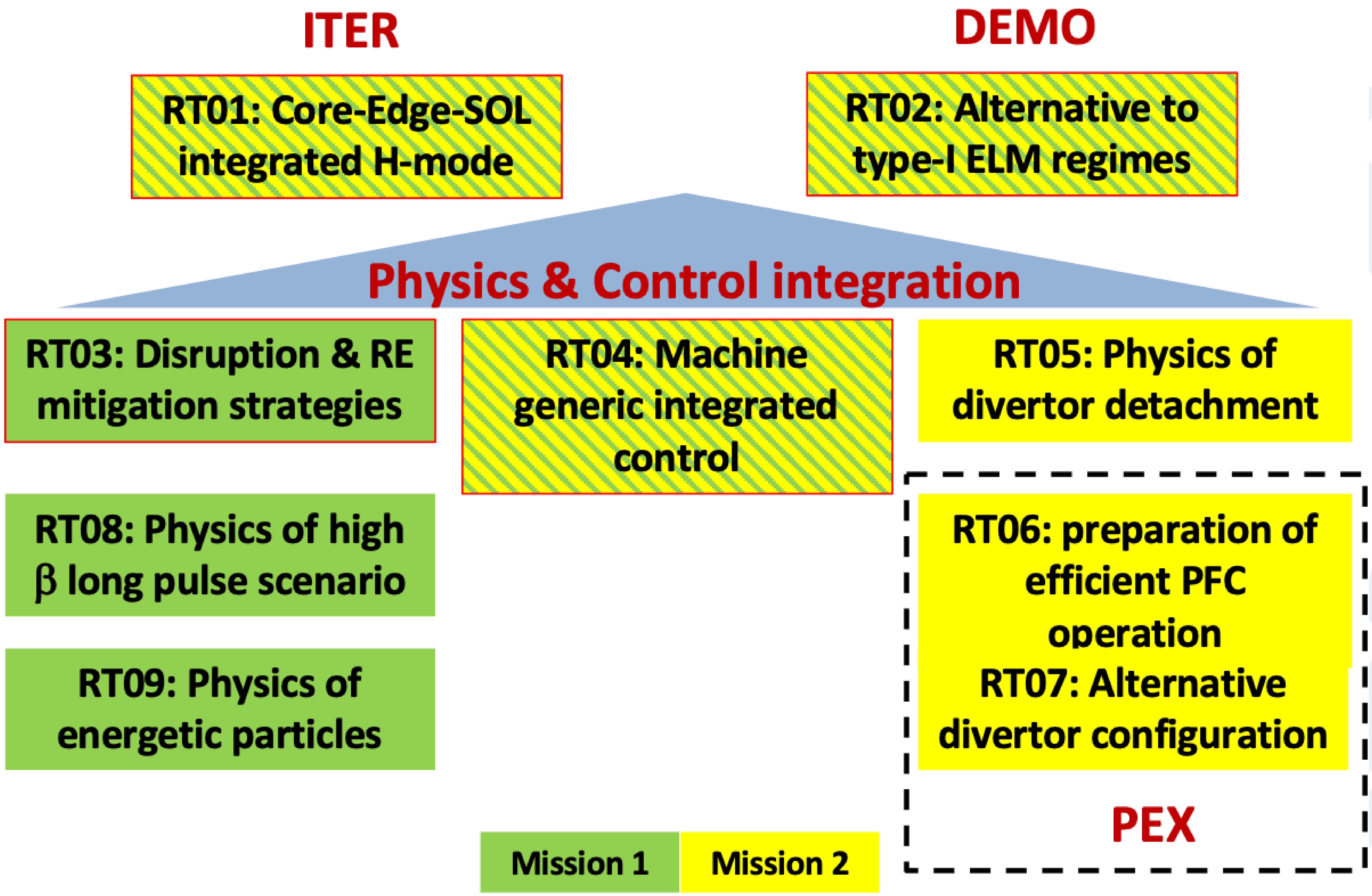
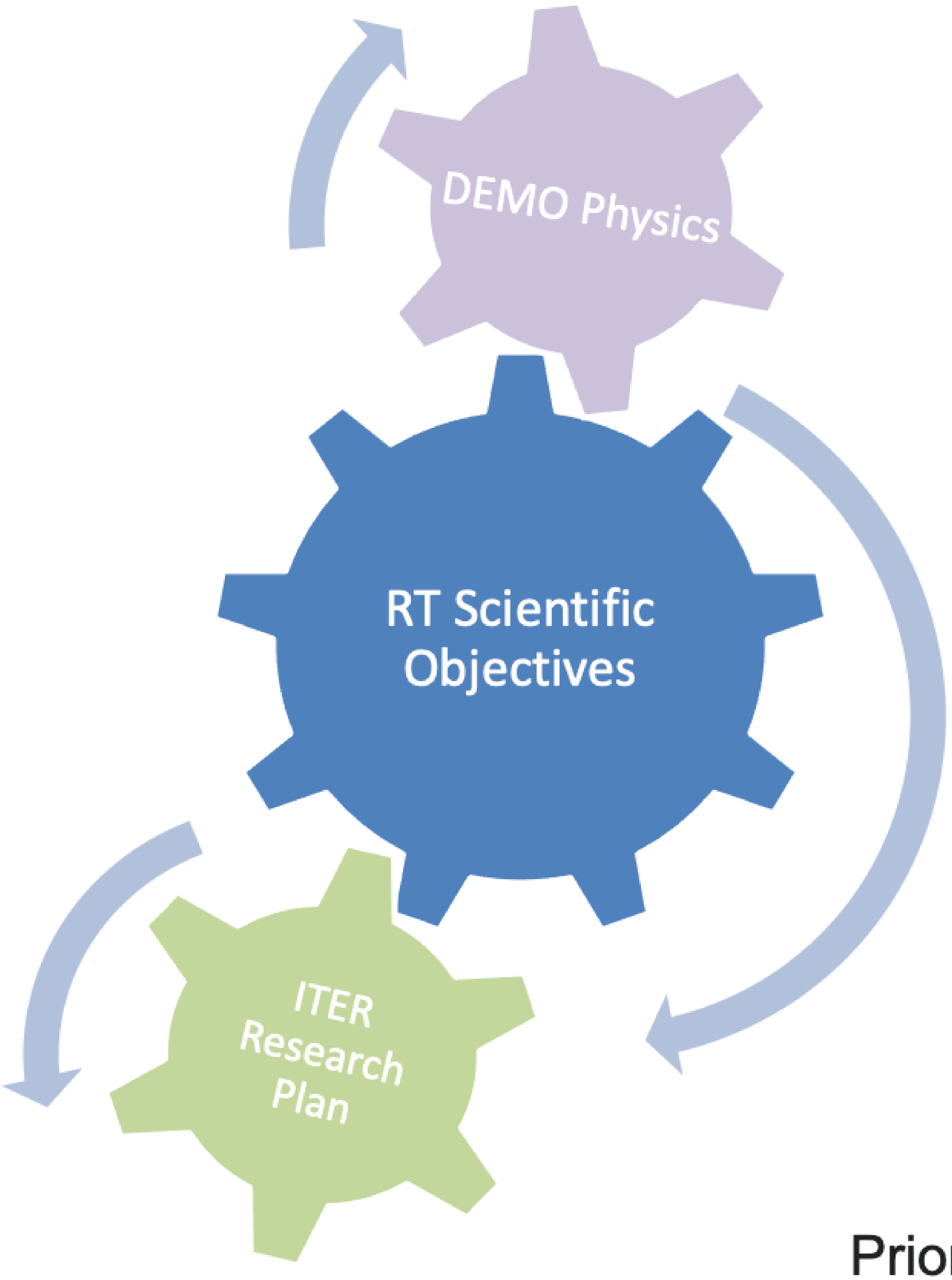
Introduction

- RT09 is intended to provide a robust strategy to optimise alpha-heating on ITER and control or mitigate detrimental effects due to the presence of a significant FI population, both from heating and confined alphas.



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

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

P3: back-up programme

PB: piggy-back experiment/pure analysis proposal

Priorities assessed in terms of absolute importance to the RT → Choices of shot allocation will need to be made even amongst P1 (esp. AUG!)

Scientific objectives

- D1: Provide high quality diagnostic information and qualify diagnostic analysis techniques for the characterization of confined and lost fast ions with fast ion characteristics relevant for ITER and JT-60SA
- D2: Quantify ion and electron heating and core-turbulence stabilisation by fast ions (FI) in view of the JT-60SA, ITER and DEMO including tailored FI energy profiles and radial locations relevant to JT-60SA.
- D3: Quantify the impact of fast ions and fast ion MHD driven instabilities on transport in various scenarios including those relevant to JT-60SA in view of ITER and DEMO.
- D4: Integrate the available heating, fast-ion and transport modelling tools for interpretation of experimental results in view of ITER and DEMO
- D5: Quantify fast-ion losses and associated heat load from edge perturbations (ELMs and RMPs)
- D6: Quantify neutral beam current drive and make predictions for ITER
- D7: Identification of AE control actuators and preliminary assessment for ITER, using JT-60SA relevant scenarios where appropriate for eventual experimental testing

Proposals

Proposal #	Title	Proponent(s)
185	Fast-ion transport in real- and velocity-space in negative triangularity	J. Rasmussen
186	Interplay between supra Alfvénic fast ions and Alfvén eigenmodes on TCV	A.N.Karpushov, S.Sharapov
187	Impact of Toroidal Alfvén Eigenmodes on Plasma Core Turbulence and Confinement	Samuele Mazzi
188	Investigation of fast-ion confinement in MHD active negative triangularity plasmas in TCV	Anton Jansen van Vuuren
189	Alfven Eigenmode mitigation and control by ECCD and ECRH in TCV	Anton Jansen van Vuuren
190	Characterization of neutral beam current drive in TCV	Anton Jansen van Vuuren
191	Investigation of high frequency Alfvén eigenmode properties in plasmas with ITER and DEMO relevant ion mixtures	Roman Ochoukov
192	Investigation of core ICE mode properties on TCV with ITER and JT-60SA relevant actuators	Roman Ochoukov
193	Investigation of stability and space structure of n=0 modes driven by energetic particles	Mykola Dreval
194	RSAE activities in TCV	Sergei Sharapov
195	Transport and losses induced by high frequency Alfven Eigenmodes	Juan F Rivero-Rodriguez
196	Development of alpha-particle measurements on AUG in support of ITER rebaseline	Yevgen Kazakov, Massimo Nocente
197	Optimization of fast-ion confinement in tokamaks with externally applied 3D fields	Joaquin Galdon-Quiroga
198	Fast-ion losses induced by edge instabilities across different confinement regimes	Joaquin Galdon-Quiroga
199	Effects of ICRF-generated fast-ions on core turbulence at different ion to electron fluxes	Roberto Bilato
200	ICRF-generated fast-ion effects on the L-H transition	Roberto Bilato
Move to RT-03 201	Study of runaway losses	Jesús Poley Sanjuán
202	Interplay of fast ions with MHD activity and ELMs	Jesús Poley Sanjuán, Marina Jiménez Cómez
203	Investigation of fast-ion phase-space flows induced by TAEs in ICRH heated plasmas	Alex Reyner Viñolas
204	Optimization of active control of Alfvén Eigenmodes with externally applied 3D fields	Javier Gonzalez Martin

Summary of pulse requests

	TCV (Scientific)	TCV (Sce dev.)	TCV (Total)	AUG	AUG (Pulse for Sce Dev)	AUG (Session total)	MAST-U (Scientific)	MAST-U (Sce dev.)	MAST-U (Total)	WEST (Scientific)	WEST (Sc. Dev)	WEST (Total)
Tot. Requested	205	120	**325**	136	38	**174**	71	5	**76**	40	(20)	**40**
Prov. Alloc.			**100**			**30**			**40**			**0**
Factor			**3.25**			**5.8**			**1.9**			**Inf**

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

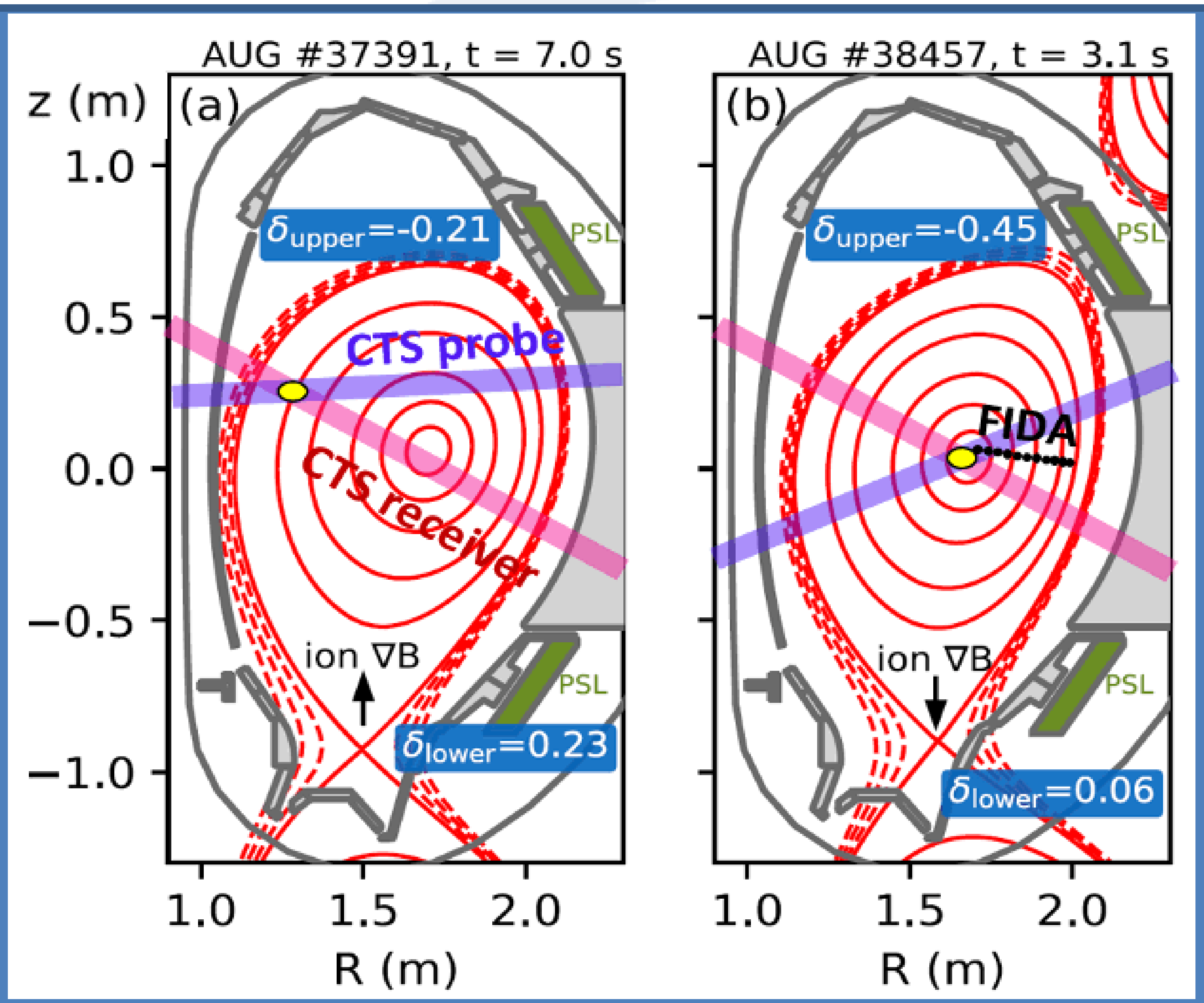
- **Proponents and contact person:**

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 $\boldsymbol{B}$ of $\varphi \approx 12^o$).

- **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

Note: This is a resubmitted WPTE 2024 proposal that was ranked P1-25

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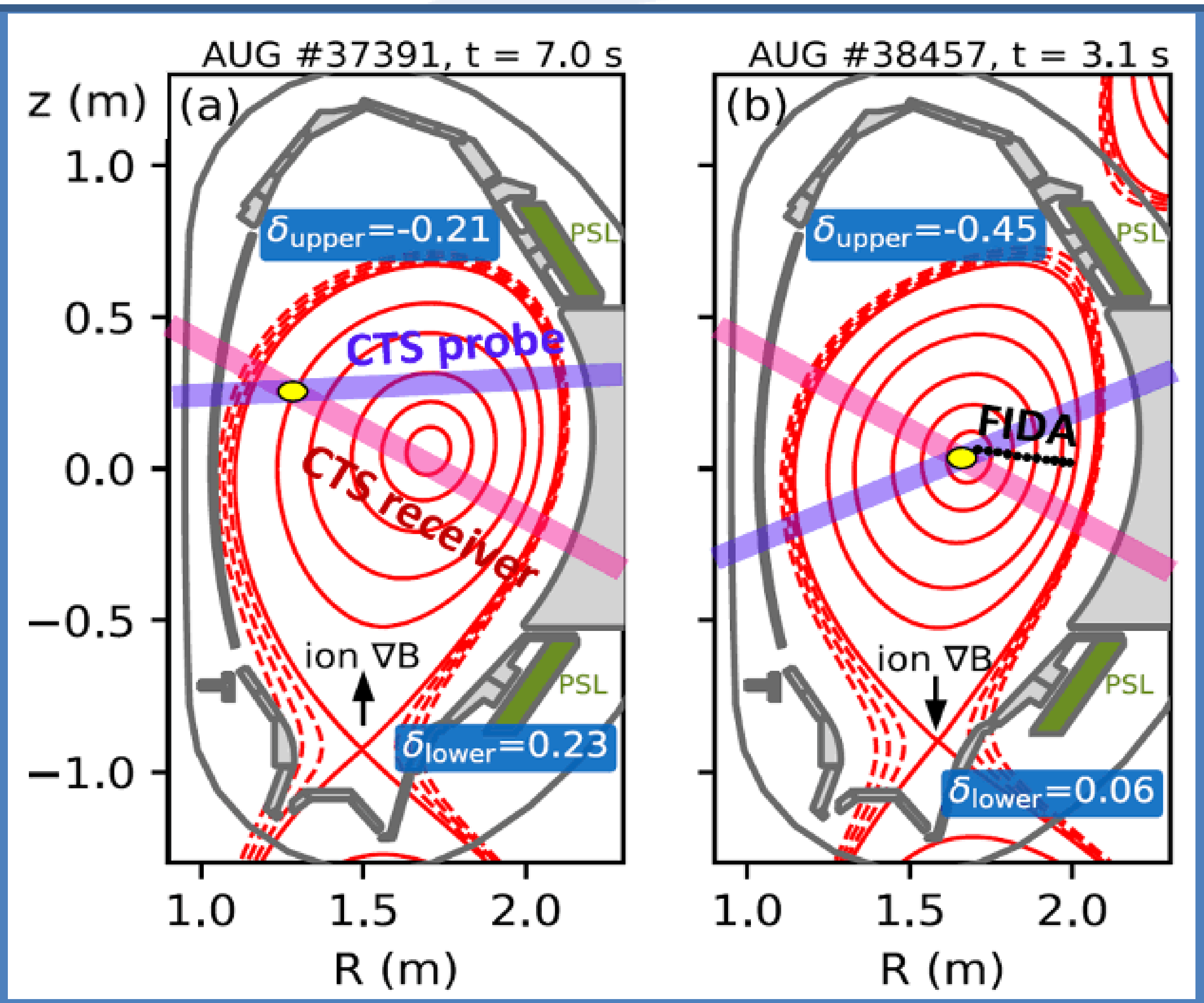
- TFL assessment: P1
- Re-submitted P1_2025 proposal
- Extends Negative delta work carried out on TCV to AUG
- NT on AUG will be 1 day only. Proposal needs to be included with RT-02 NT prog.



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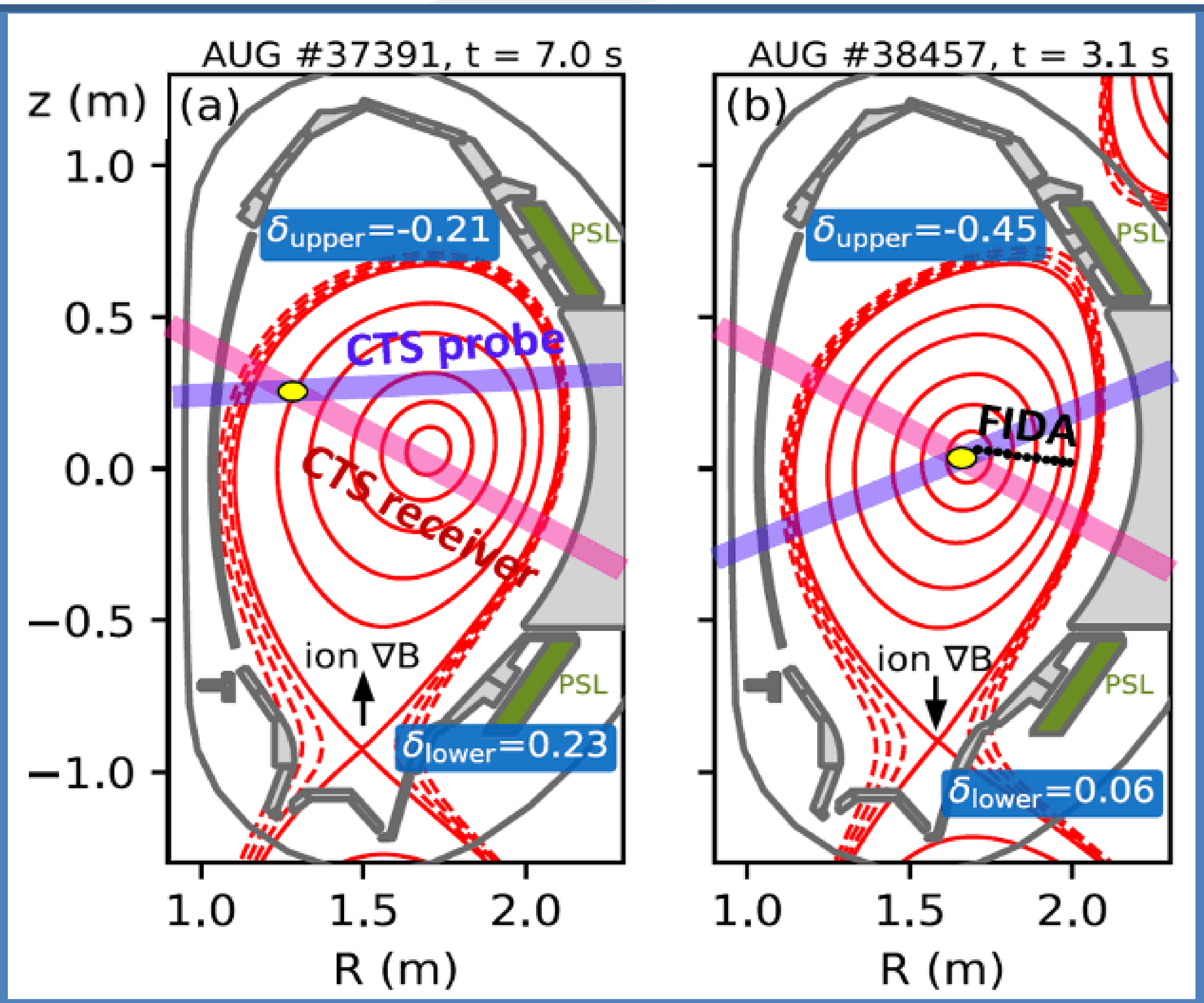
Moved to RT-02



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Proposed pulses

Device	# Pulses/Session	# Development
AUG	3	3

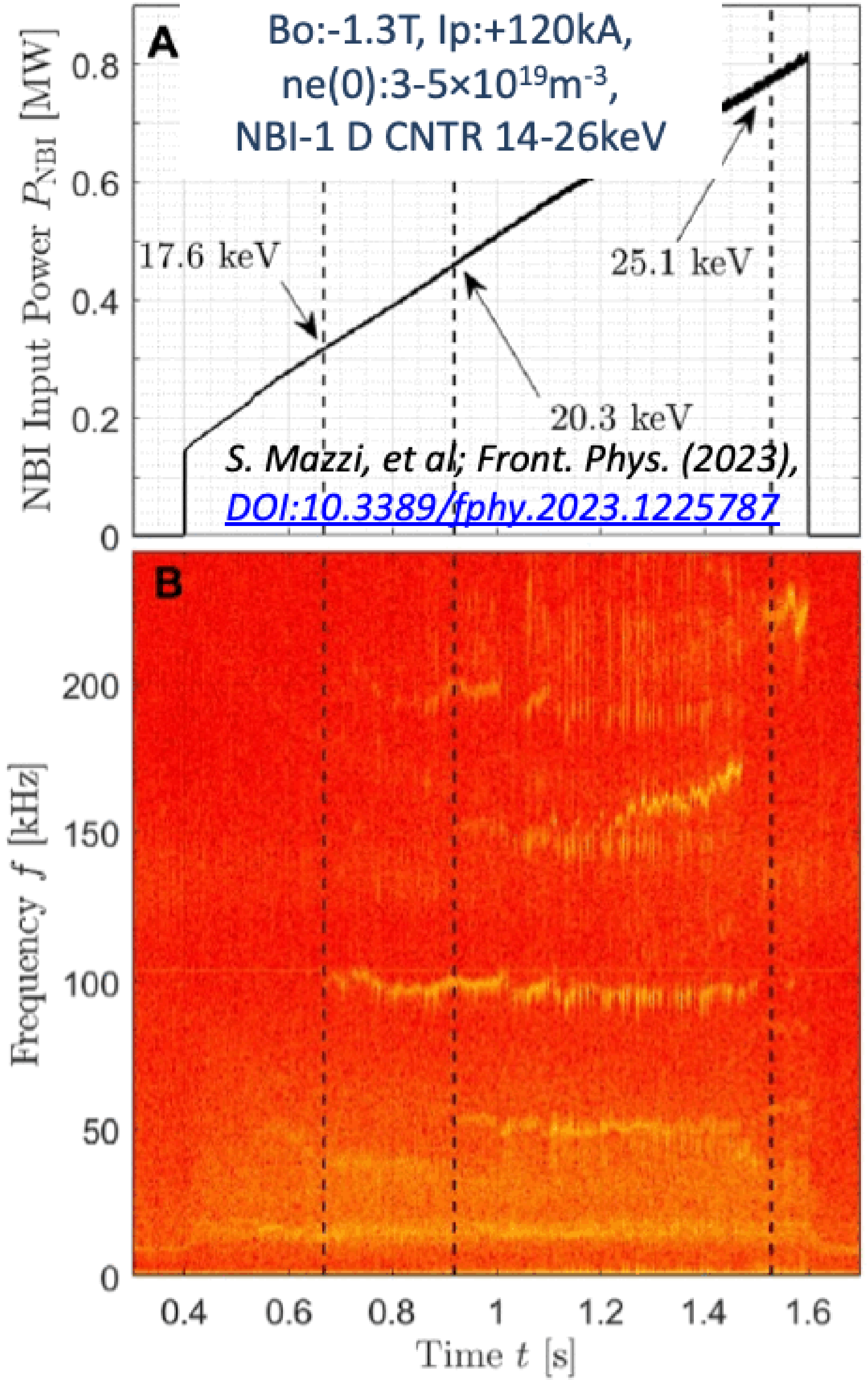
Note: This is a resubmitted WPTE 2024 proposal that was ranked P1-25

186: Interplay between supra Alfvénic fast ions and Alfvén eigenmodes on TCV

- **Proponents and contact person:**
  - A.N.Karpushov, S.Sharapov et al.
- **Scientific Background & Objectives**
  - AEs can cause a degradation of fusion performance and loss of energetic ions. In the case of fusion devices (ITER/DEMO,) AEs modes could be detrimental for alpha particle confinement. Characterization and control of such modes are key to efficient fusion plasmas.
  - TCV fast ion & AEs studies up to now: mostly with NBI-1 (upto 28keV) and Bo:1.3-1.45T. AEs on TCV are excited by fast ions with velocity greater than one third of Alfven velocity and sufficient gradients in FI distribution function (see figure).
  - About an order of magnitude higher particle-to-wave power transfer for super-Alfvenic (V_{beam}~V_{Alfven}) FIs in comparison with sub-Alfvenic (V_{Alfven}/3)

    H.L.Berk, et al; Physics Letters A, 162/6 (1992), 475; DOI:10.1016/0375-9601(92)90009-B
  - By lowering the magnetic field and use of high energy NBI-2 (upto 52keV), we could be able to run the beam in the super-Alfvenic regime like JET, NSTX, MAST and NSTX and alpha particles in ITER & DEMO.
  - This proposal focused on development of low magnetic field plasma scenarios with AEs and injection of high velocity (energy) NBI-2.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Development of low magnetic field Bo:0.8-1T AEs scenarios with NBI-2
  - Comparison of FI-AE interaction with super- and sub-Alfvenic fast ions, comparison of FI confinement and losses with modeling prediction (TRANSP/NUBEAM, ASCOT, …)
  - Scan of Bo, beam energy, plasma density, plasma current (q-profiles), H/D beams
  - Deuterium plasma with Zo:0…+12cm, Ip:120kA, ne(0):3…7×10^{19}m^{-3}
  - Diagnostics for kinetic profiles (TS, CXRS), fast ions (FIDA, FILD, CNPA, …), fluctuation diagnostics (magnetics, SXR, MPX, TPCI, …)

TCV#76180 (2022)



S. Mazzi, et al; Front. Phys. (2023), DOI:10.3389/fphy.2023.1225787

Device	# Pulses/Session	# Development
TCV	30	30

Proposed pulses

186: Interplay between supra Alfvénic fast ions and Alfvén eigenmodes on TCV

- **Proponents and contact person:**
  - A.N.Karpushov, S.Sharapov et al.
- **Scientific Background & Objectives**

- TFL assessment: P2
- Development of low BT plasmas required, not within scope of general RT-09 programme
- Can this be combined into a BT scan with other proposals?
- Note that this proposal connected to several ITPA tasks

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particle confinement.

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0375-9601(92)90009-B
e could be able to run
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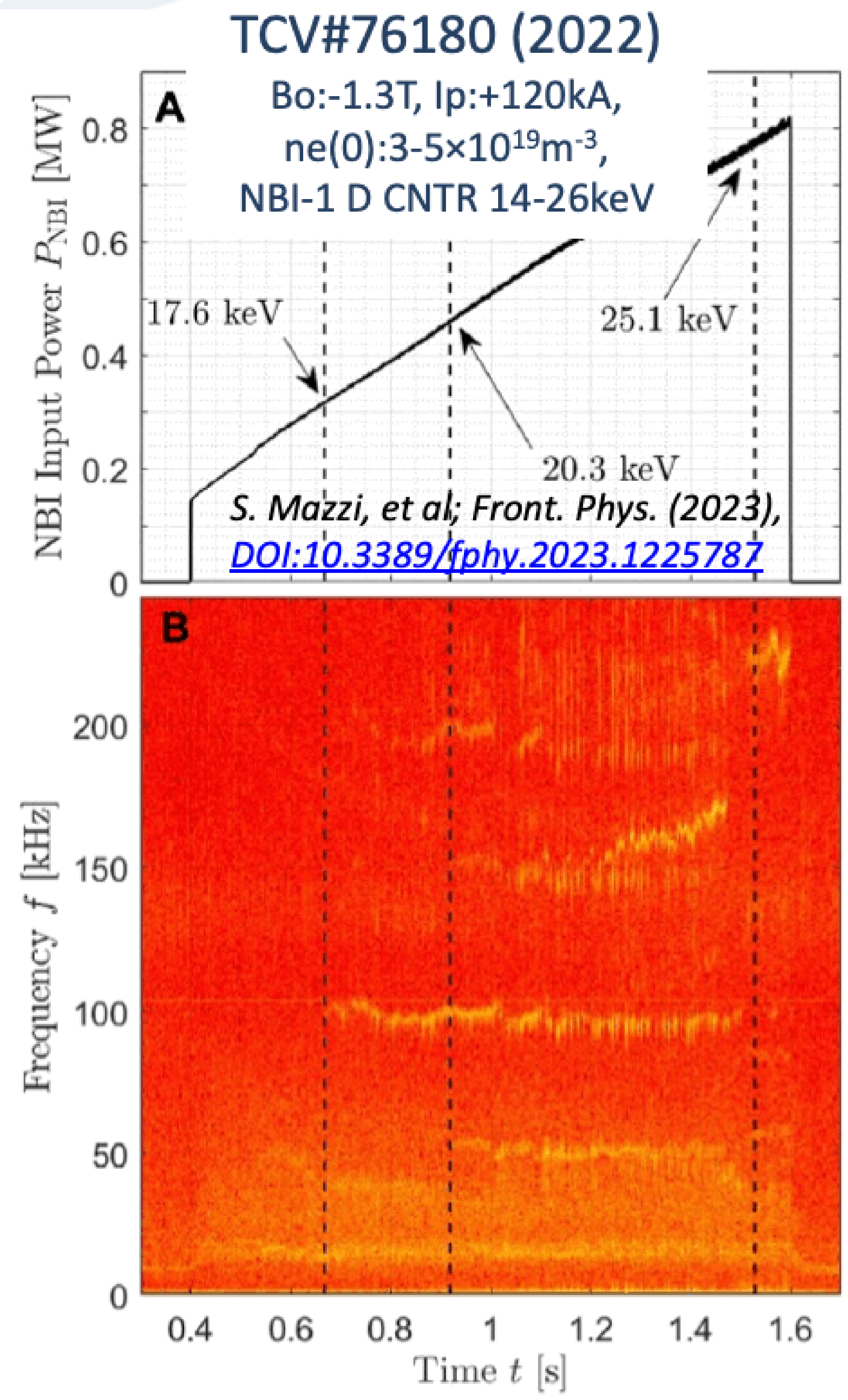
with AEs and injection



- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Development of low magnetic field Bo:0.8-1T AEs scenarios with NBI-2
  - Comparison of FI-AE interaction with super- and sub-Alfvenic fast ions, comparison of FI confinement and losses with modeling prediction (TRANSP/NUBEAM, ASCOT, …)
  - Scan of Bo, beam energy, plasma density, plasma current (q-profiles), H/D beams
  - Deuterium plasma with Zo:0…+12cm, Ip:120kA, ne(0):3…7×$10^{19}m^{-3}$
  - Diagnostics for kinetic profiles (TS, CXRS), fast ions (FIDA, FILD, CNPA, …), fluctuation diagnostics (magnetics, SXR, MPX, TPCI, …)

Device	# Pulses/Session	# Development
TCV	30	30

Proposed pulses

187: Impact of Toroidal Alfvén Eigenmodes on Plasma Core Turbulence and Confinement

- **Proponents and contact person:**
  - Paulo Puglia (paulo.puglia@cea.fr), Samuele Mazzi (samuele.mazzi@cea.fr), Jesùs Poley (jesus.poley@epfl.ch), Anton Jansen van Vuuren (anton.jansenvanvuuren@epfl.ch)
    - Alexander Karpushov, Rémi Dumont, Jeronimo Garcia, Mykola Dreval, Jorge Morales, Julien Hillairet, Laurent Colas, Roland Sabot, Philippe Huynh, Riccardo Ragona, Pierre Manas, Patrick Maget, Mario Podestà, Sergei Sharapov, Sergei Sharapov
- **Scientific Background & Objectives**
  - Goal: Explore effects of Toroidal Alfvén Eigenmodes (TAEs) on plasma performance, particularly on microturbulence driven by the thermal plasma.
  - Based on recent JET results showing improved core confinement in D-D and D-T plasmas through ITG turbulence stabilization by TAEs.
  - Fast ions driven by ICRH waves trigger MHD modes, including core-TAEs, which stabilize microturbulence.
  - Recent evidence suggests increased zonal perturbations in the presence of TAEs, but questions remain regarding optimal TAE parameters and control in long-pulse scenarios.
- **Scientific Objectives:**
  - Measure the impact of core-TAEs on thermal ion turbulence using advanced diagnostics.
  - Compare NBI (TCV) vs. ICRH (WEST) systems in triggering TAE-driven beneficial effects.
  - Assess TAE amplitude and position's role in turbulence stabilization.
  - Explore control mechanisms for long-pulse integration.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - **TCV:**
    - Use reference scenario with unstable TAEs, move TAE position towards core via ECRH/ECCD.
    - Flip current direction for counter NB2 injection (higher fast ion energy).
    - Optimize density profile with NBI modulation/gas puffing for SPR measurements.
    - Configure plasma for turbulence diagnostics (Correlation-ECE, TPCI).
  - **WEST:**
    - Develop low magnetic field scenario for 2nd harmonic ICRH heating with H-minority.
    - Perform scenario scans with 20 pulses, adjusting H-minority concentration and ICRH power.
    - Use ECE/C-ECE diagnostics to measure core turbulence affected by TAEs.

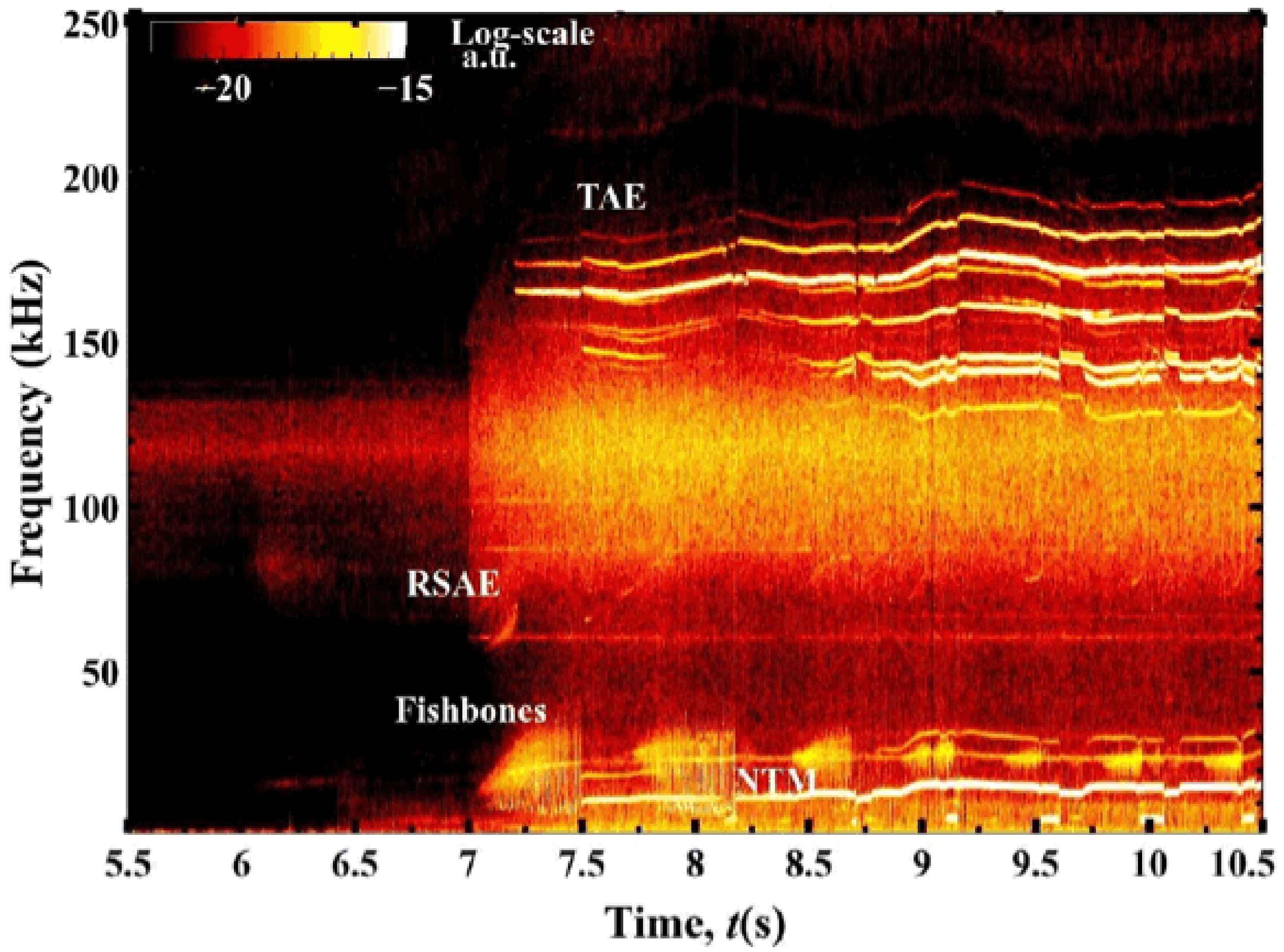


Figure: Magnetic spectrogram of a JET pulse with fast-ion-driven TAEs unstable and confinement improvement

[Garcia Nat. Comm. 2024]

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	30 / 2	
WEST	40 / 2	20 (within the 40 proposed)

187: Impact of Toroidal Alfvén Eigenmodes on Plasma Core Turbulence and Confinement

- TFL assessment: P1
- Requires shots to be allocated on WEST – interesting to extend RT-09 to this machine
- Adds a long-pulse element to the RT not present elsewhere directly addressing D2
- Relies on standard diagnostics rather than specific FI diags – therefore possible on WEST
- Note this is linked to a specific ITPA task
- Could bring in comparison with JET if suitable pulses can be found through data mining?
- Clarified with proponent: can be done in WEST using H-minority ICRH scheme. If 2nd harmonic developed (by int. campaign)before this work might be scheduled, can assess which scheme gives best chance of success.

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  - **WEST:**
    - Develop low magnetic field scenario for 2nd harmonic ICRH heating with H-minority.
    - Perform scenario scans with 20 pulses, adjusting H-minority concentration and ICRH power.
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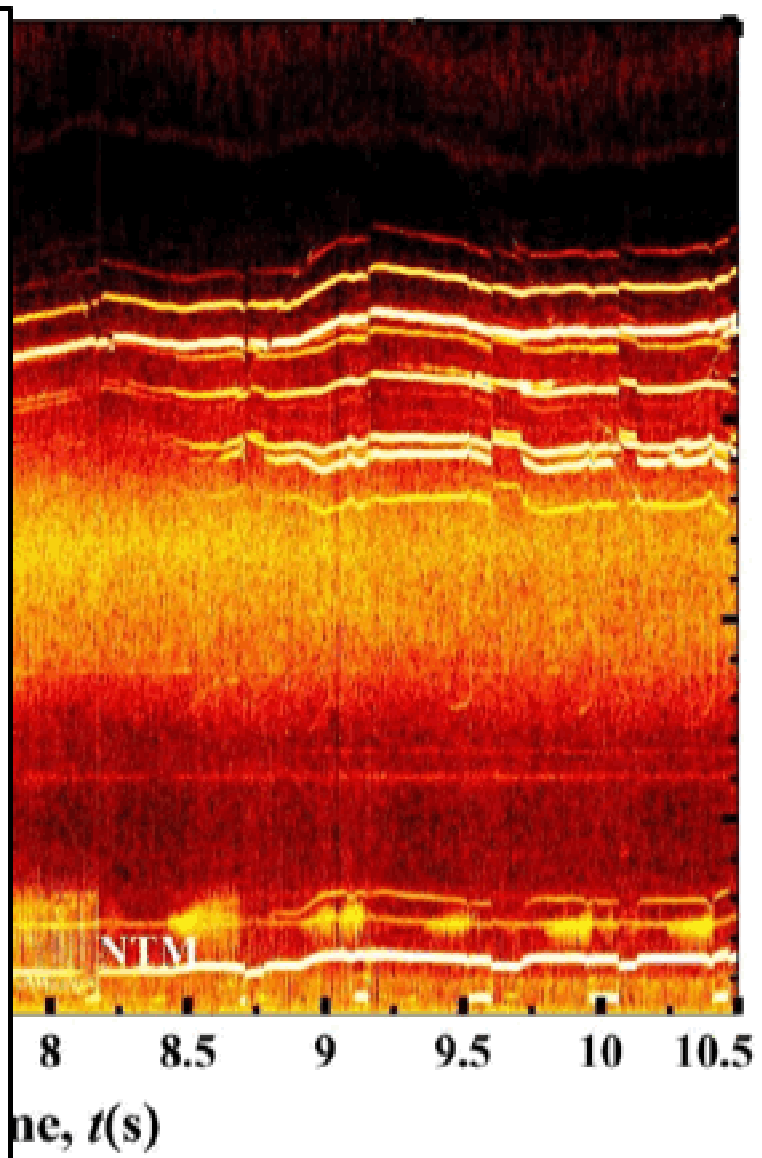


of a JET pulse with fast-ion-
inement improvement

[Garcia Nat. Comm. 2024]

	n	# Development
TCV	30 / 2	
WEST	40 / 2	20 (within the 40 proposed)

188: Fast-ion confinement in MHD active negative triangularity plasmas in TCV

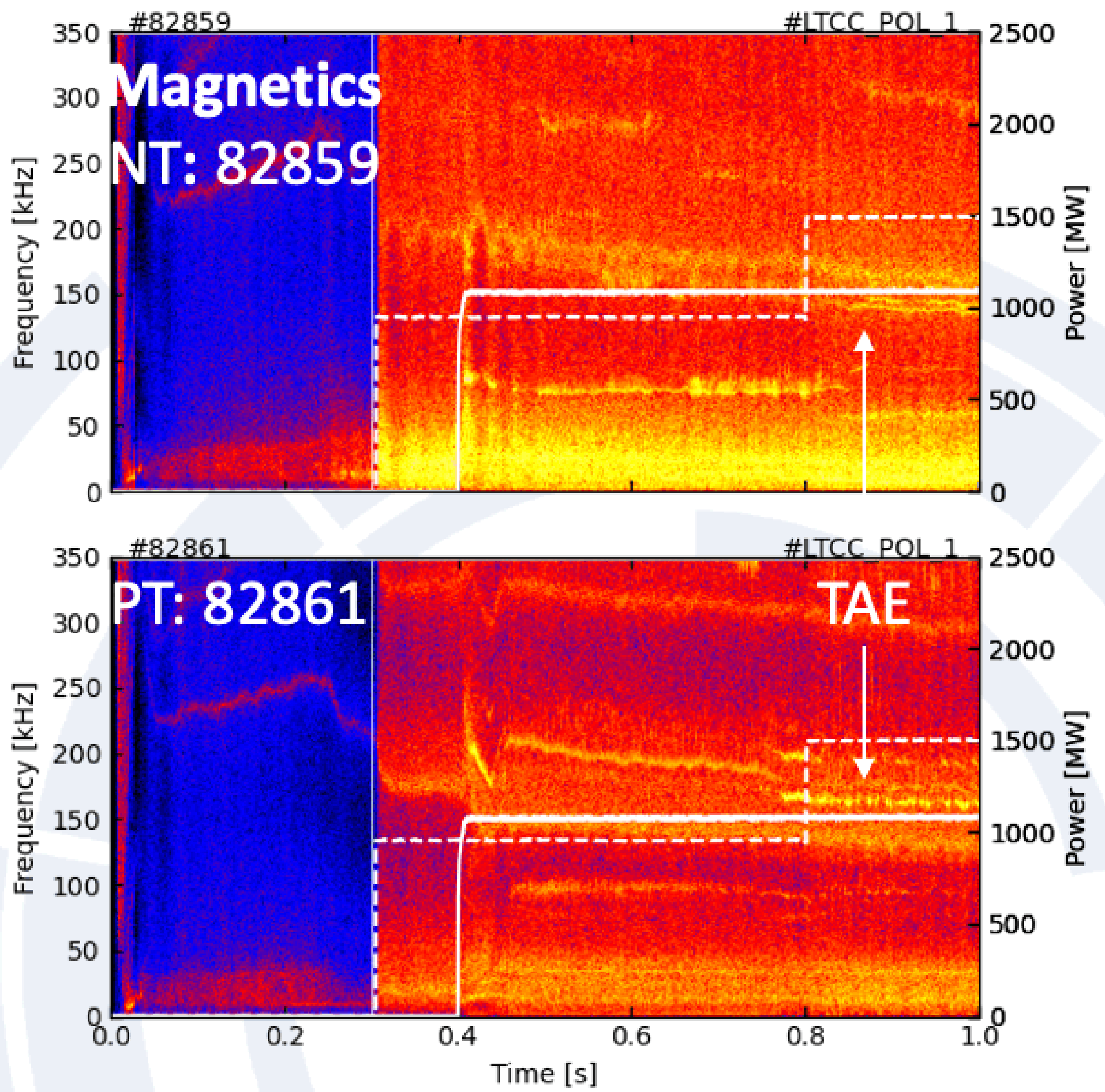
- **Proponents and contact person:**

  Anton Jansen van Vuuren, Samuele Mazzi, Jesús Poley, Alexander Karpushov, Sergei Sharapov, Mykola Dreval Duccio Testa

- **Scientific Background & Objectives**

  Negative triangularity (NT) plasmas have shown enhanced thermal confinement compared to positive triangularity (PT) plasmas, making them promising for future fusion reactors. While NT plasmas exhibit improved confinement, they can also exhibit **Alfvén eigenmodes (AEs)** and geodesic acoustic modes (GAMs), potentially impacting **fast-ion confinement.** Initial studies on TCV have shown comparable fast-ion confinement between MHD quiescent NT and PT plasmas, but the effect of AE activity in NT plasmas needs to investigated further.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Leverage 2024 scenarios (#82589 NT, #82861 PT) and test GAM suppression with ECRH.
  - Optimize ECRH power to suppress GAMs while maintaining FILD operation.
  - Localize TAEs with fluctuation diagnostics (pick-up coils, reflectometry) and analyze fast-ion losses (FILD, FIDA).
  - Investigate chirping AE modes and their impact (e.g., shot #79177).
  - -Study fishbone modes and their effect on fast-ion transport.
  - Essential diagnostics: FILD, FIDA, cNPA, ECE, magnetics, Reflectometer



Proposed pulses

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

188: Fast-ion confinement in MHD active negative triangularity plasmas in TCV

- **Proponents and contact person:**

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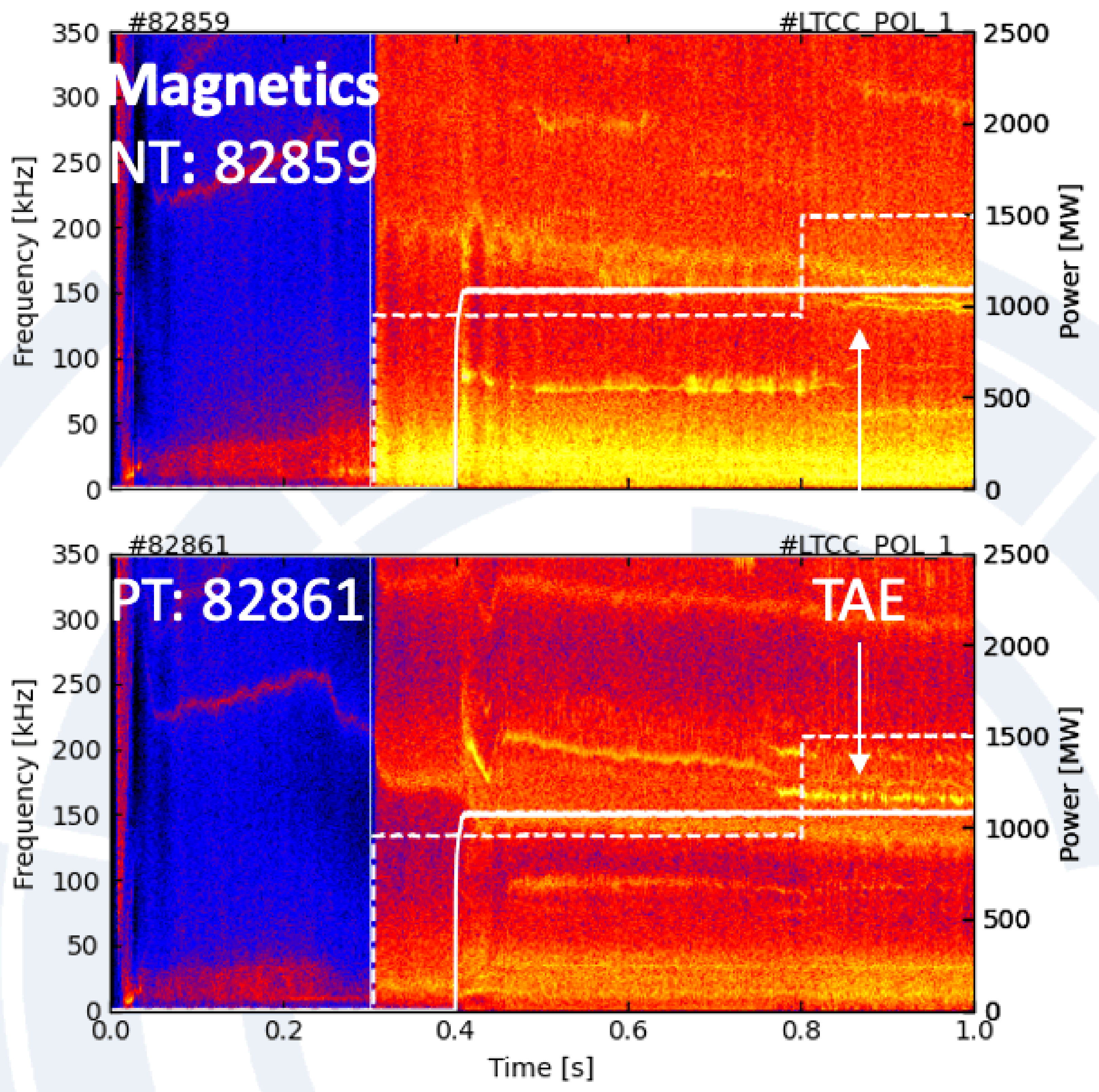
- TFL assessment: P1
- Continues on from work started in 2024 – natural progression of investigation in 2025
- Partners P185 (moved to RT-02) for cross-machine comparison.



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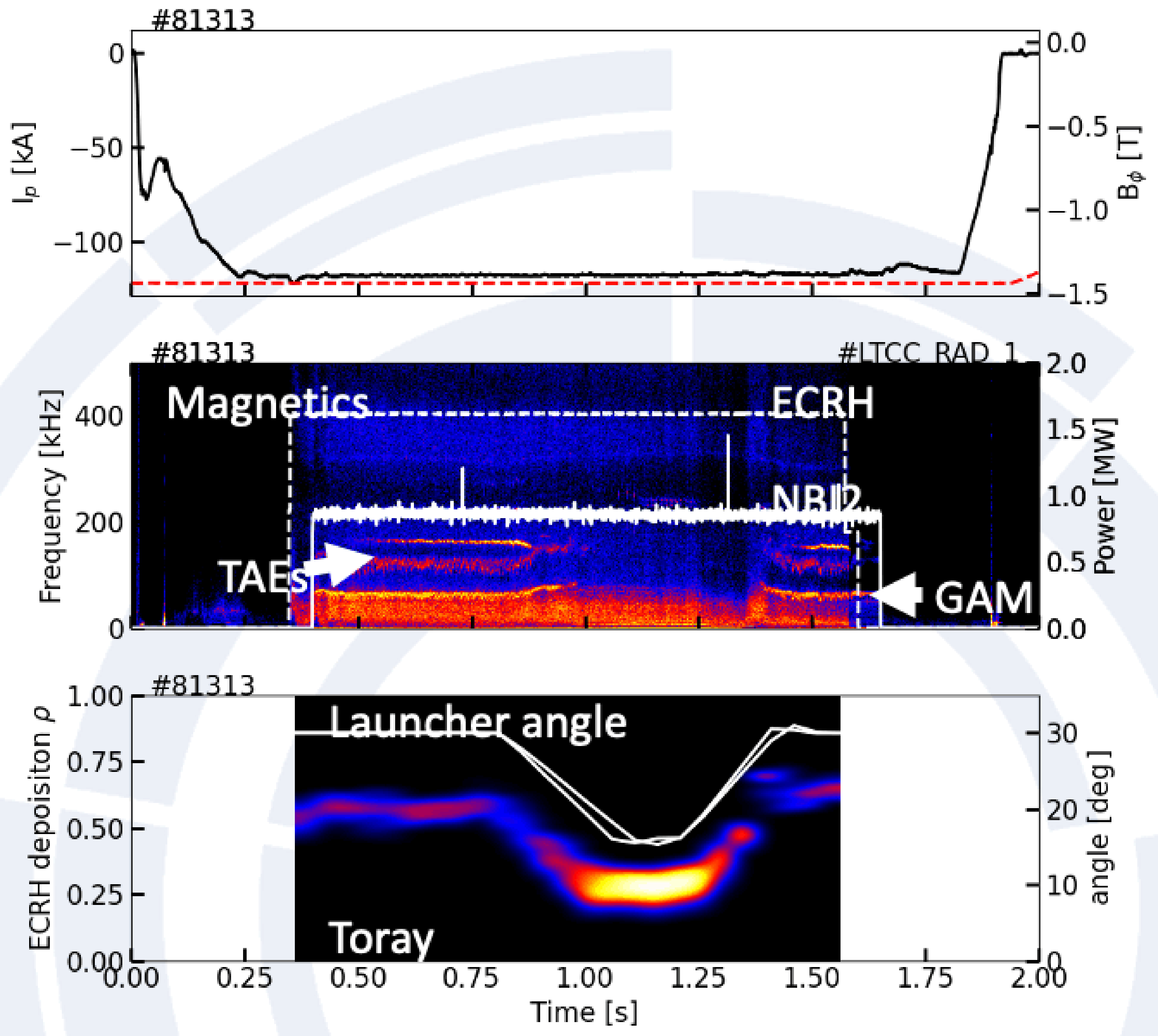
Proposed pulses

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

189: Alfven Eigenmode mitigation and control by ECCD in TCV (P1-2025)



- **Proponents and contact person:**

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- **Scientific Background & Objectives**

  Alfvén Eigenmode (AE) instabilities, driven by energetic fusion-born alpha particles, pose significant risks to future fusion reactors such as ITER. These instabilities can expel energetic particles and reduce ion heating efficiency, compromising machine safety and plasma performance. Effective suppression and control of AEs are essential to ensure reliable energy transfer to the plasma core.

  Objectives
  1. Demonstrate Robustness of AE Suppression
  2. Investigate Magnetic Shear Role
  3. Optimize ECCD Parameters
  4. Enhance Understanding of Fast-Ion Dynamics

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Base Experiments on 2024 Campaign: Use discharge #81313 to inform AE control methods.
  - Optimize ECRH Angles: Adjust launcher angles for improved current drive.
  - ECCD Scanning: Vary ECCD locations and power with additional launchers (L1/4, L5).
  - Current Direction Study: Examine co-current vs. counter-current ECCD effects.
  - Radially Separated ECCD: Apply both current drives in small, separated regions.
  - Evaluate Robustness: Test reliability by inverting scan orders and changing NBI setups.
  - Essential diagnostics: FILD, MSE, FIDA, cNPA, neutrons, Magnetics

Proposed pulses

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

189: Alfven Eigenmode mitigation and control by ECCD in TCV

(P1-2025)

- **Proponents and contact person:**

Anton Jansen van Vuuren, Samuele Mazzi, Jesús Poley, Alexander Karpushov, Sergei Sharapov, Mykola Dreval Duccio Testa

- **Scientific Background & Objectives**

Alfvén Eigenmod… t
risks to future fu… uce
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and control of AE…

Objectives

1. Demonstra…
2. Investigate…
3. Optimize E…
4. Enhance U…

- TFL assessment: P1
- Re-submitted P1_2025 proposal
- Directly addresses D2+D7 utilising development carried out during 2024 campaigns

- **Experimen… diagnostic**
  - Base Experiments on 2024 Campaign: Use discharge #81313 to inform AE control methods.
  - Optimize ECRH Angles: Adjust launcher angles for improved current drive.
  - ECCD Scanning: Vary ECCD locations and power with additional launchers (L1/4, L5).
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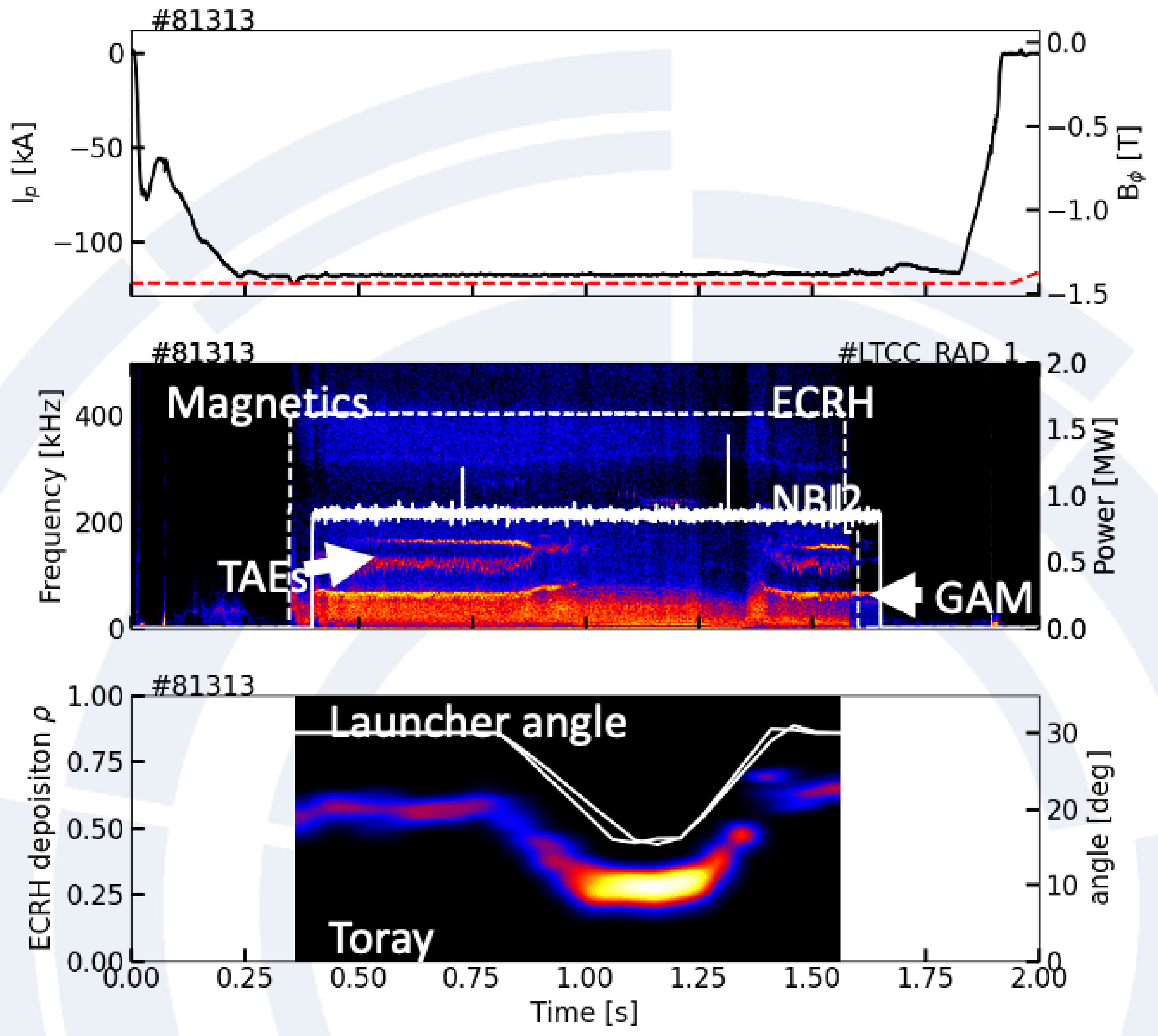


Proposed pulses

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

190: Characterization of neutral beam current drive in TCV

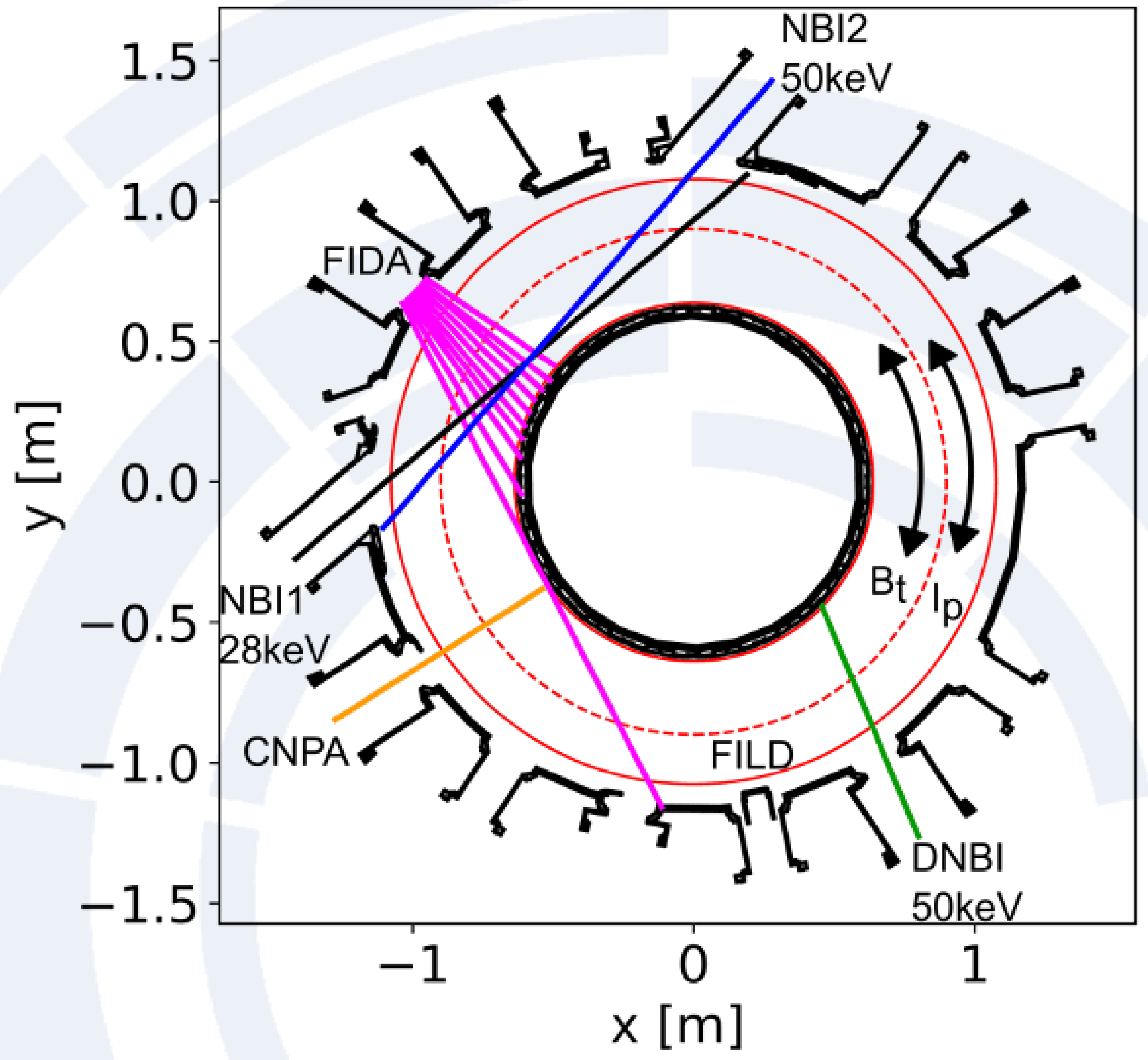
- **Proponents and contact person:**

Anton Jansen van Vuuren, Alexander Karpushov, Stefano Coda, Jesús Poley, Duccio Testa

- **Scientific Background & Objectives**

This proposal aims understand the unexpectedly low Neutral Beam Current Drive (NBCD) achieved with NBI1 in previous campaigns, by conducting a systematic study using the higher-energy NBI2. The goal is to characterize NBCD efficiency as a function of key plasma parameters (density, temperature, beam energy/power) and compare the results with NBI1 to better understand the factors limiting NBCD performance. The study will also explore integrating NBCD with Electron Cyclotron Current Drive (ECCD) to achieve low loop voltage conditions, using ASTRA or TRANSP modeling for data interpretation and predictions. The ultimate objective is to enhance our understanding of NBCD and inform future current drive strategies, including predictions for ITER.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Identify (with modeling) a regime with adequate NBCD from NBH2 and carry out small parameter scans (density, power/energy of the beam, temperature through use of ECRH - probably X3). Determine the dependence of NBCD on these parameters and compare with theoretical predictions.
  - Depending on results, more ambitious attempts at sufficiently low density to use ECCD and NBCD can be performed (lower-priority experiment). One option is to establish a fully non-inductive ECCD scenario and replace (part of) ECCD with NBCD



Proposed pulses

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

190: Characterization of neutral beam current drive in TCV

- **Proponents and contact person:**

  Anton Jansen van Vuuren, Alexander Karpushov, Stefano Coda, Jesús Poley, Duccio Testa

- **Scien**

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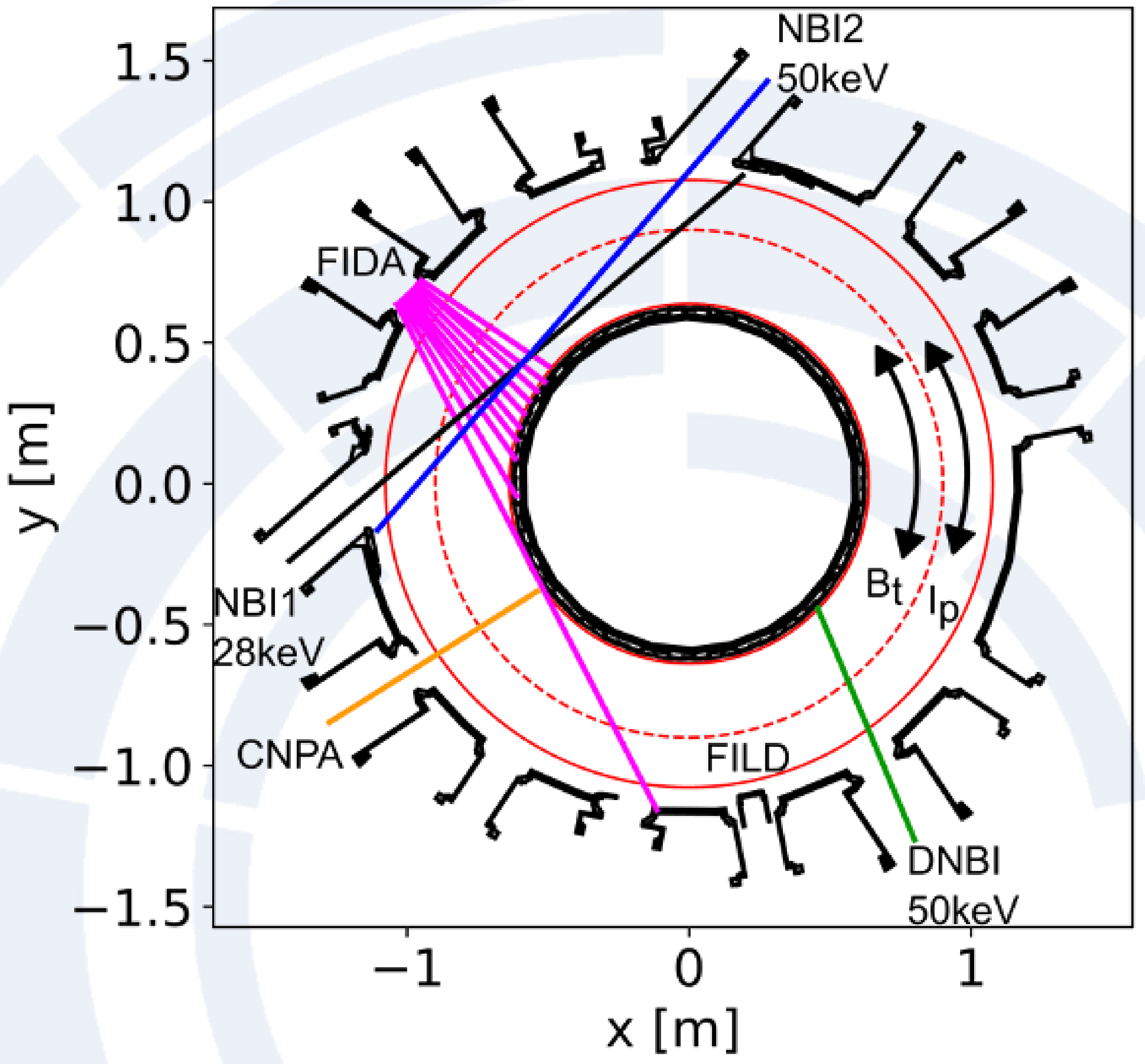
- **Exper essen**

- Identify ll parameter scans (density, power/energy of the beam, temperature through use of ECRH - probably X3). Determine the dependence of NBCD on these parameters and compare with theoretical predictions.
- Depending on results, more ambitious attempts at sufficiently low density to use ECCD and NBCD can be performed (lower-priority experiment). One option is to establish a fully non-inductive ECCD scenario and replace (part of) ECCD with NBCD

- TFL assessment: P2
- Addresses D6 in the sense of determining factors limiting NBCD
- Associated lower priority part aims at establishing fully NI operation.
- Can this be done in PB with RT-08 – to be explored.
- Lots of data can be collected on NBCD in PB – also bring in results from MAST-U



Proposed pulses

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

191: (P1-2025)

Investigation of high frequency Alfvén eigenmode properties in plasmas with ITER and DEMO relevant ion mixtures

Proponents and contact person:
Roman Ochoukov et al;
rochouko@ipp.mpg.de

- **Scientific Background & Objectives**
  High frequency Alfvénic eigenmodes can provide information on average ion mass in plasma core (Fig. 1)
  - Continue developing ICE as a fast ion diagnostic for ITER/DEMO relevant plasmas
  - Determine high frequency Alfven eigenmode properties in ITER/DEMO relevant plasma ion mix
  - Continue developing beam ion RF-acceleration and core ECCD as Alfvénic mode actuators

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Establish reference shot with significant (30-50%) H/H+D: 2 shots
  - Perform He and N impurity scans: 4 shots
  - Perform T_e/T_i scan with ECRH power: 2 shots
  - Perform ECCD scans to modulate q_o: 5 shots
  - Perform beam ion RF-acceleration at 3rd harmonic as Alfvenic mode actuation: 2 shots

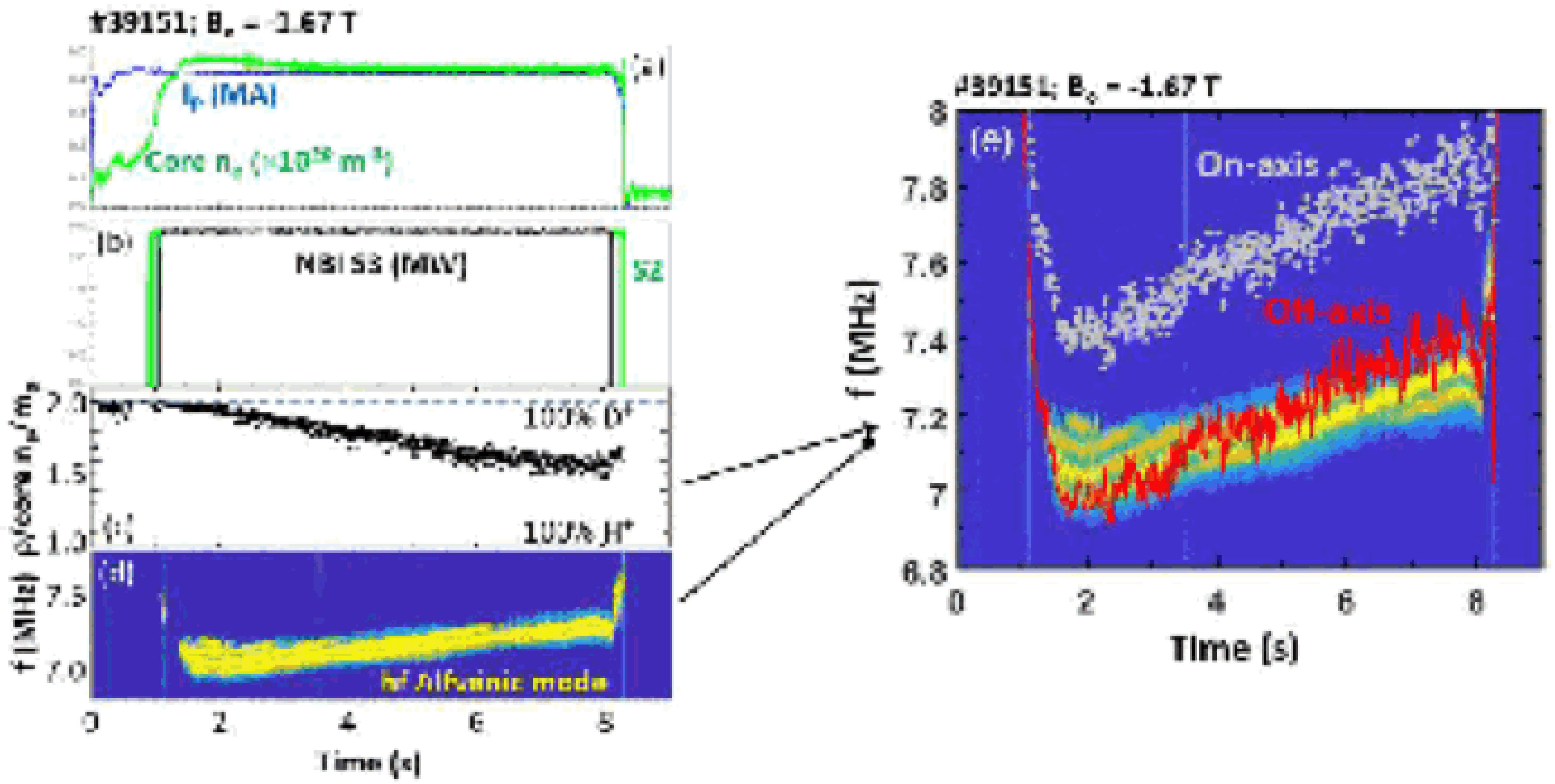


Fig. 1: Demonstration of Alfvénic dependence between high frequency Alfvén eigenmode and bulk ion mass density in AUG discharge with a significant H/H+D change.

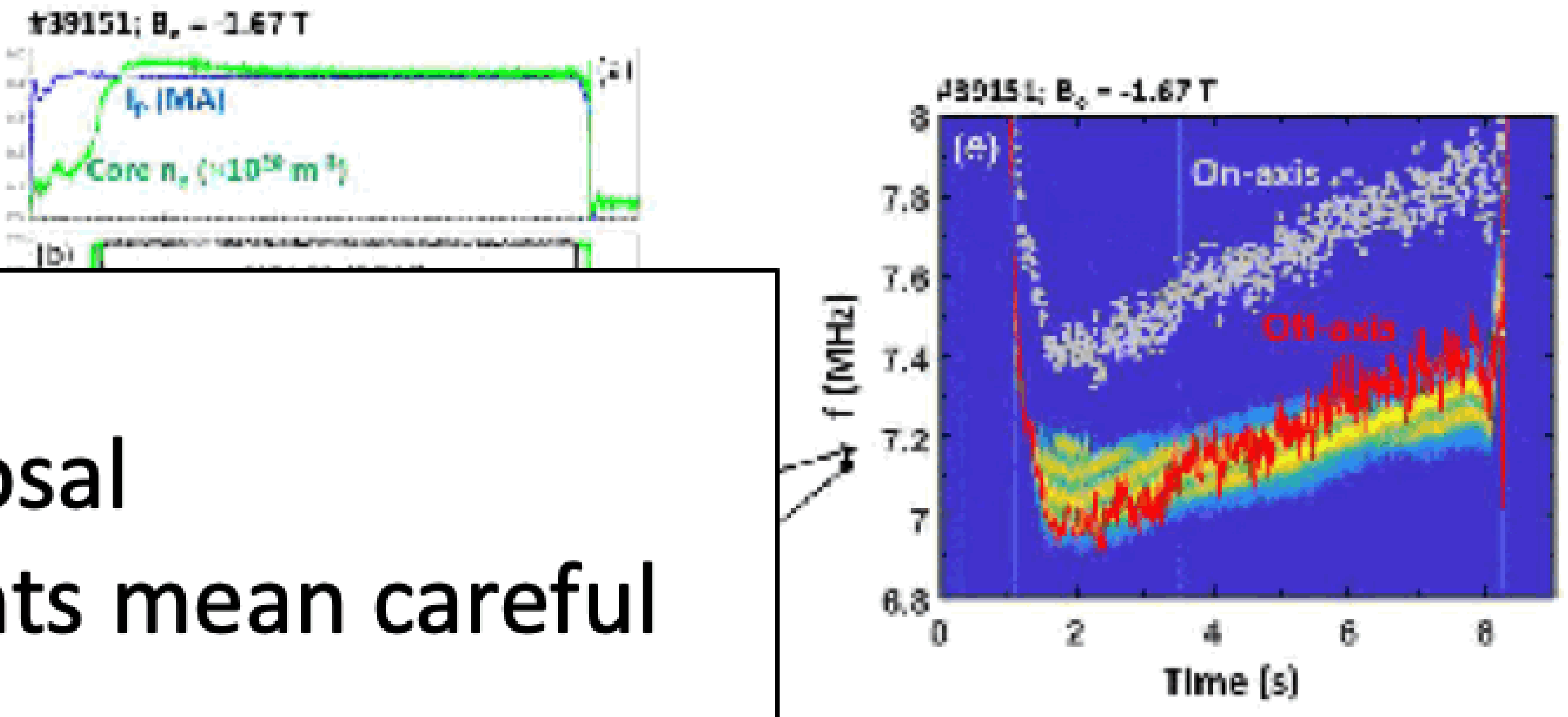
Proposed pulses

Device	# Pulses/Session	# Development
AUG	15	3
MAST-U		
TCV		
WEST		

191: (P1-2025)

Investigation of high frequency Alfvén eigenmode properties in plasmas with ITER and DEMO relevant ion mixtures

Proponents and contact person:
Roman Ochoukov et al;
rochouko@ipp.mpg.de



- TFL assessment: P1
- Re-submitted P1_2025 proposal
- Isotope/impurity requirements mean careful scheduling
- No He phase on ITER any more – re-focus proposal away from the Helium impurity
- Note Install/exploit of ICE supported by ITPA-EP
- Partners P192

- Sc

c dependence between high
d bulk ion mass density in
t H/H+D change.

- Ex
Co

30%) H/H+D: 2 shots
- Perform He and N impurity scans: 4 shots
- Perform T_e/T_i scan with ECRH power: 2 shots
- Perform ECCD scans to modulate q_o: 5 shots
- Perform beam ion RF-acceleration at 3rd harmonic as Alfvenic mode actuation: 2 shots

	on	# Development
		3
TCV		
WEST		

192: Investigation of core ICE mode properties on TCV with ITER and JT-60SA relevant actuators

- **Proponents and contact person:**
  Roman Ochoukov et al;
  rochouko@ipp.mpg.de

- **Scientific Background & Objectives**
  High frequency Alfvénic eigenmodes can provide information on average ion mass in plasma core (Fig. 1)
  - Continue developing ICE as a fast ion diagnostic for ITER/DEMO relevant plasmas
  - Determine high frequency Alfven eigenmode properties in ITER/DEMO relevant plasma ion mix
  - Continue developing beam ion RF-acceleration as Alfvénic mode actuator

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Establish stable scenario with several (3 or more) I_p plateaus: 2 shots
  - Explore co- and counter-I_p ECCD during Ip plateaus: 2 shots
  - Interchange ECCD with ECRH: 2 shots
  - Perform Bt scans + reversal: 4 shots
  - Repeat shots above with H NBI: 5 shots

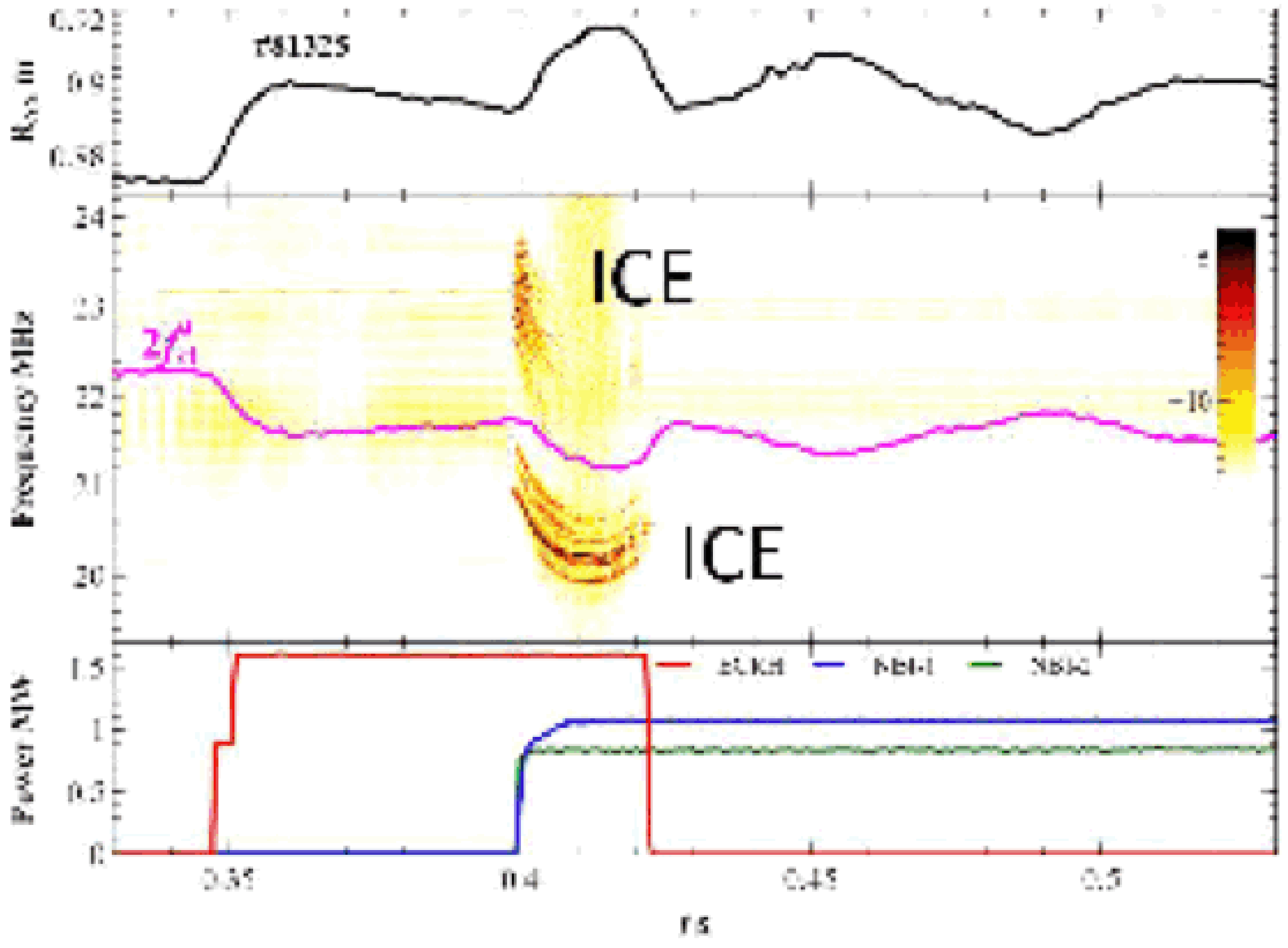


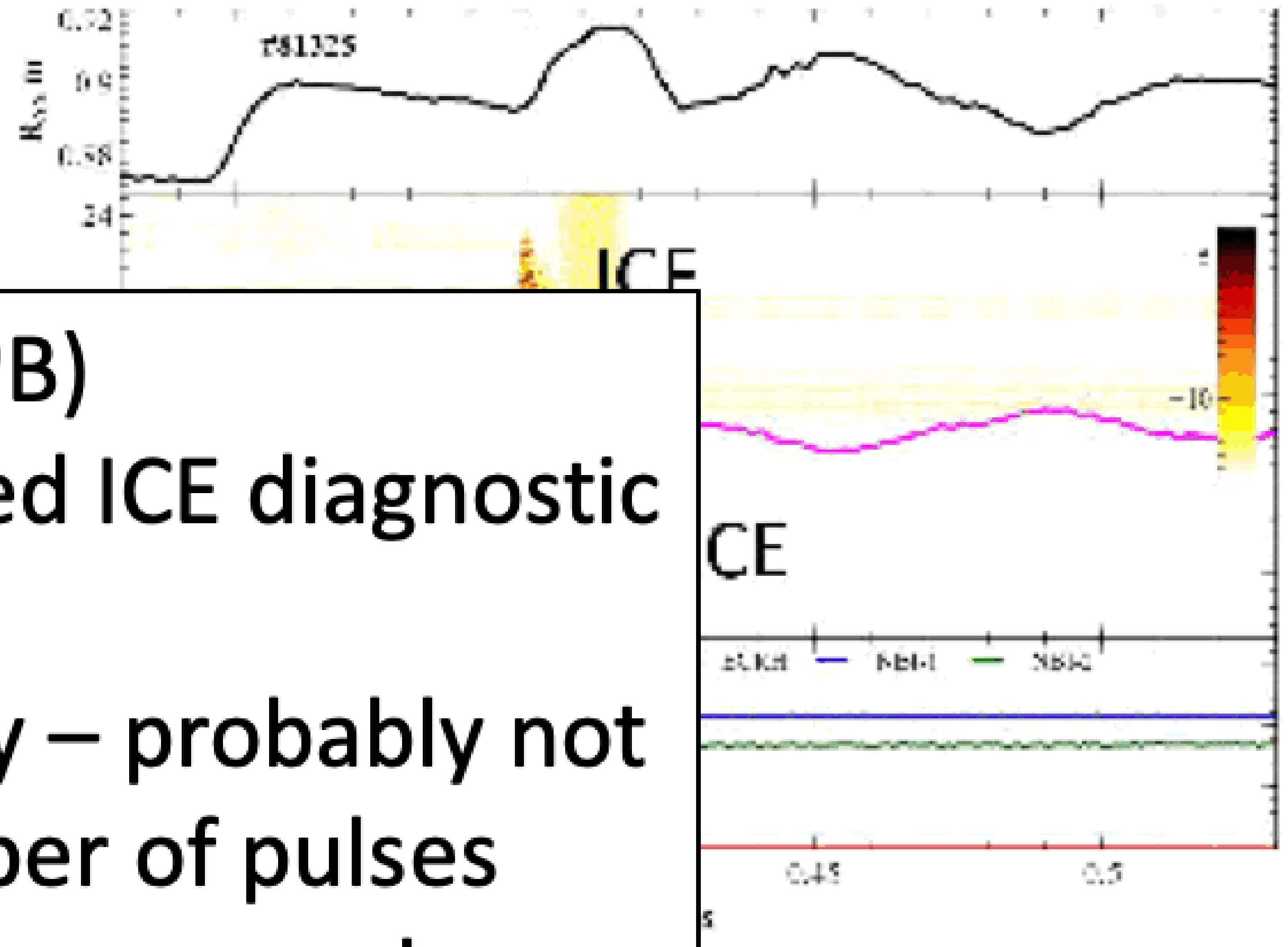
Fig. 1: Observation of core ICE in the simultaneous presence of NBI-1 and NBI-2 fast ion sources.

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	15	5
WEST		

192: Investigation of core ICE mode properties on TCV with ITER and JT-60SA relevant actuators

- **Proponents and contact person:**
  Roman Ochoukov et al;
  rochouko@ipp.mpg.de



- TFL assessment: P1 (partially PB)
- Exploitation of recently installed ICE diagnostic in support of D1, 4, 7
- Complex experimental strategy – probably not feasible within proposed number of pulses
- Much of proposed parameter scans can be collected in PB in well-designed program
- Partners P191 for multi-machine comparison
- ICE supported by ITPA-EP

- Sci…
  H… p… n… -… IT… -… p… -… A…

…the simultaneous presence of

- Exp… Co…
  - … more) I_p plateaus: 2 shots
  - Explore co- and counter-I_p ECCD during Ip plateaus: 2 shots
  - Interchange ECCD with ECRH: 2 shots
  - Perform Bt scans + reversal: 4 shots
  - Repeat shots above with H NBI: 5 shots

	…n	# Development
MAST-U		
TCV	15	5
WEST		

193: Investigation of stability and space structure of n=0 modes driven by energetic particles.

- **Proponents and contact person:**
  - Mykola Dreval
  - mdreval@kipt.kharkov.ua

- **Scientific Background & Objectives**
  - Clarify which experimental conditions lead to the observation of two unstable EGAMs simultaneously
  - Clarify conditions of excitation of EGAM at half frequency of GAM
  - Compare EGAM and GAM space structure
  - Clarify which experimental conditions lead to the observation of VDOM modes

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

-Vertical plasma position (NBI deposition region) scan, elongation scan, ECRH power scan
-Mirnov coils (LTCC, poloidal array) used for *n* and magnetic field structure
-SXR (RADCAM, MPX) used for spatial structure of mode density perturbations
- FILD, neutrons, ICE, FIDA, CNPA, (C-)ECE, (I-)MSE

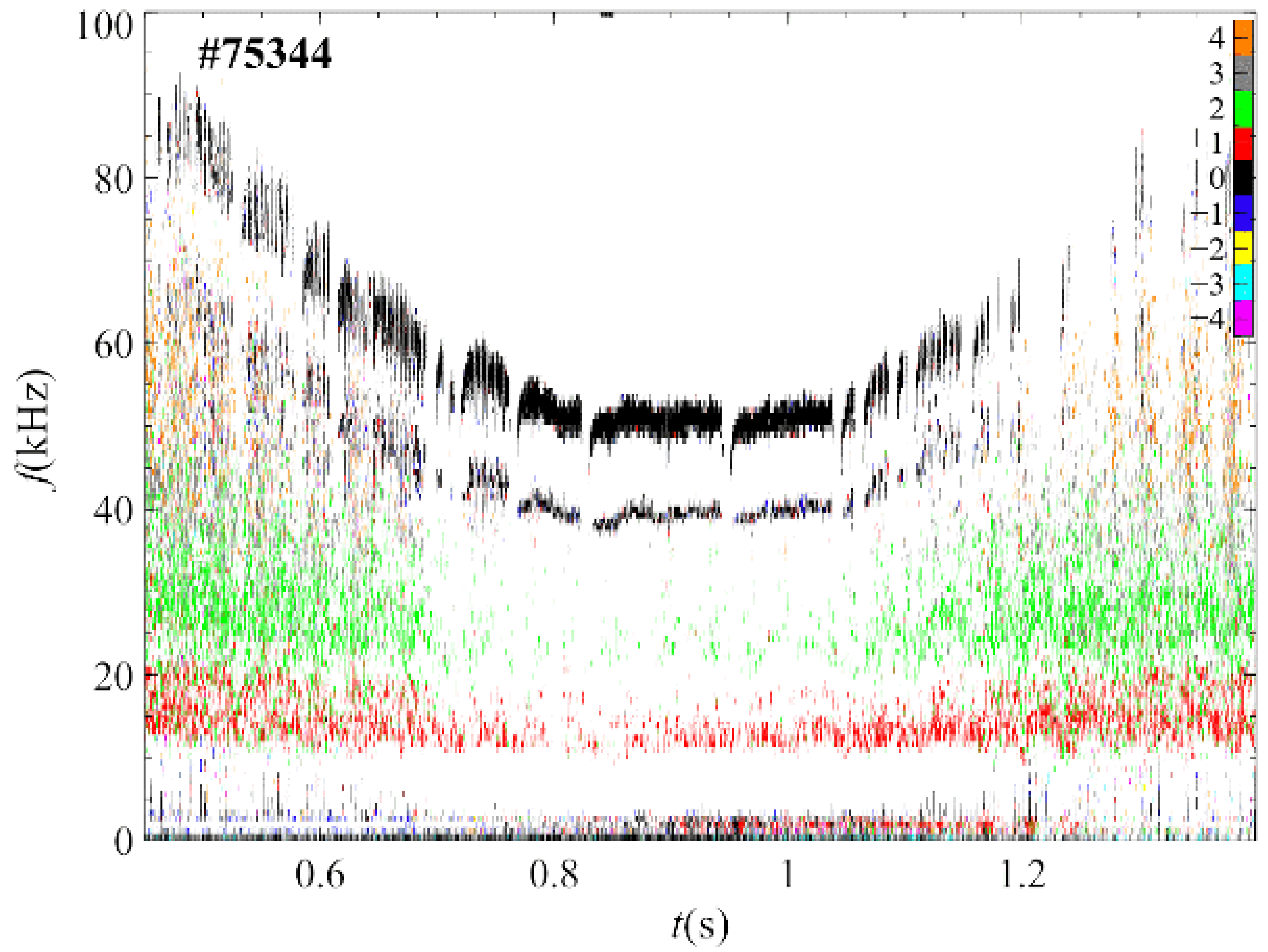


Fig. 1: Two coexisting EGAMs in TCV

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	30	15
WEST		

193: Investigation of stability and space structure of n=0 modes driven by energetic particles.

- **Proponents and contact person:**
  - Mykola Dreval
  - mdreval@kipt.kharkov.ua

- **Scientifi**
  - Clarify which unstable EGA
  - Clarify condit
  - Compare EGA
  - Clarify which modes

- **Experime essential diagnostic**

- TFL assessment: P2
- Supports D1, 2 (core turbulence stabilisation)
- Quite specific MHD regime under investigation
- Can proposed scans be combined into general TCV programme?
- Note EGAM studies of interest to ITPA-EP group

-Vertical plasma position (NBI deposition region) scan, elongation scan, ECRH power scan
-Mirnov coils (LTCC, poloidal array) used for *n* and magnetic field structure
-SXR (RADCAM, MPX) used for spatial structure of mode density perturbations
- FILD, neutrons, ICE, FIDA, CNPA, (C-)ECE, (I-)MSE

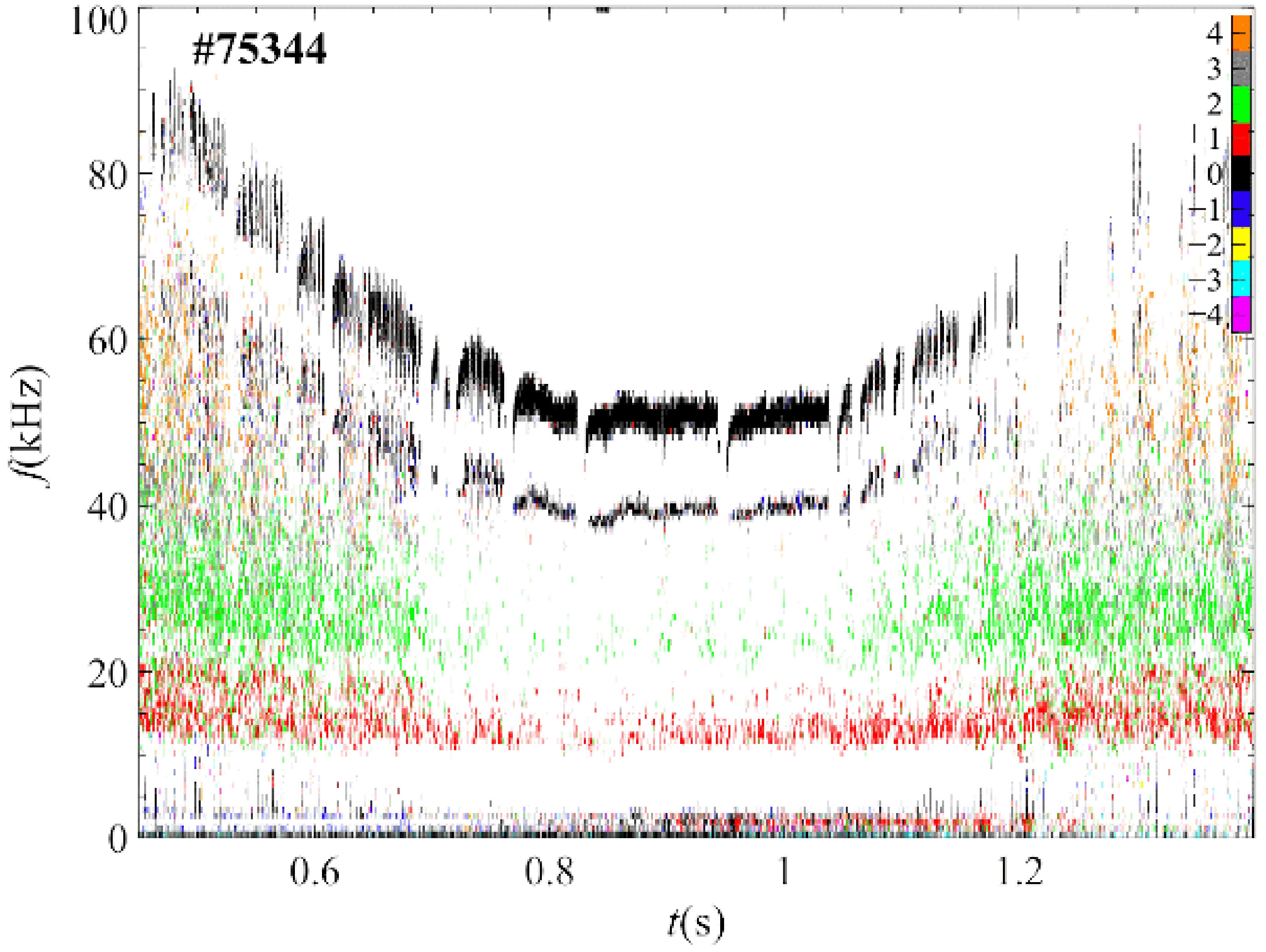


Fig. 1: Two coexisting EGAMs in TCV

Proposed pulses

Device	# Pulses/Session	# Development
AUG		
MAST-U		
TCV	30	15
WEST		

194: RSAE activities in TCV

- **Proponents and contact person:**
- Sergei Sharapov
- sergei.sharapov@ukaea.uk

- **Scientific Background & Objectives**
- - RSAEs are interesting MHD modes, important for plasma confinement, observed in the reversed-shear scenarios
- - Observed at JET. Also relevant for JT-60SA
- - TCV has the flexibility of both on-axis and off-axis scenarios by moving the plasma and applying ECCD
- - Document RSAEs in the on- and off-axis scenarios on TCV
- - Apply ECCD to obtain the stationary reversed shear plasmas
- - Develop RSAEs scenario using NB2
- - Constrain the q-profile by the MHD spectroscopy

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Low density scenario (ref. #81558)
  - ECRH/ECCD X2 at max. power (> 1MW)
  - NB1, NB2
  - Diagnostics: FIDA, FILD, neutron detectors, SXR

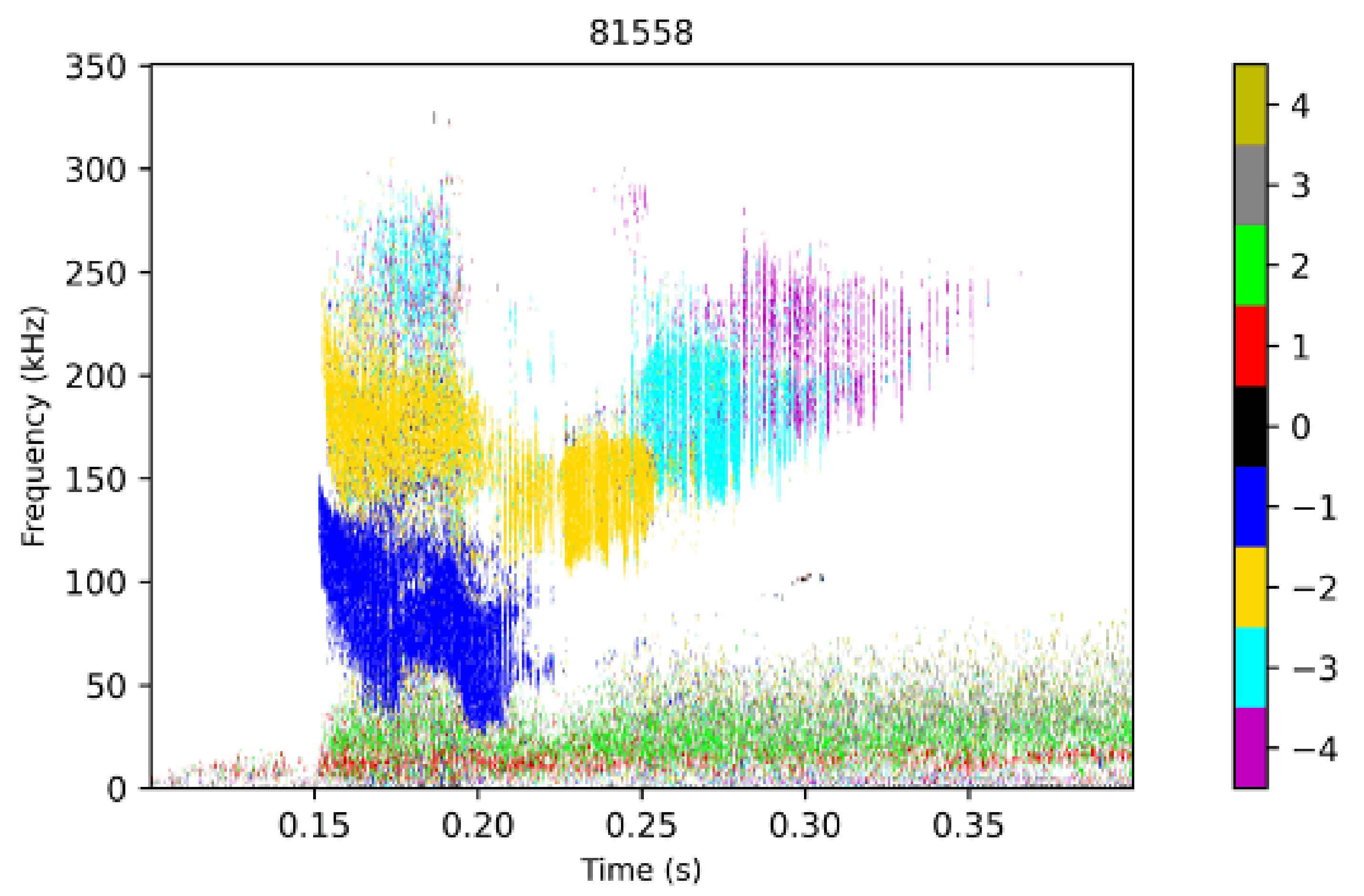


Fig. 1: RSAEs at TCV plasma startap

Proposed pulses

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

194: RSAE activities in TCV

- **Proponents and contact person:**
  - Sergei Sharapov
  - sergei.sharapov@ukaea.uk

- **Scientific Ba**
  - - RSAEs are inte
    confinement, ob
  - - Observed at JE
  - - TCV has the fle
    scenarios by mo
  - - Document RSA
  - - Apply ECCD to
  - - Develop RSAEs
  - - Constrain the q-

- TFL assessment: P1
- RSAE work fairly significant part of 2024 TCV expts, this extends the work to vary the FI DFn in presence of reversed magnetic shear
- Working from previous starting point, extensive Scen. Dev. probably not needed
- Connects to ITPA JEX:8,12

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Low density scenario (ref. #81558)
  - ECRH/ECCD X2 at max. power (> 1MW)
  - NB1, NB2
  - Diagnostics: FIDA, FILD, neutron detectors, SXR

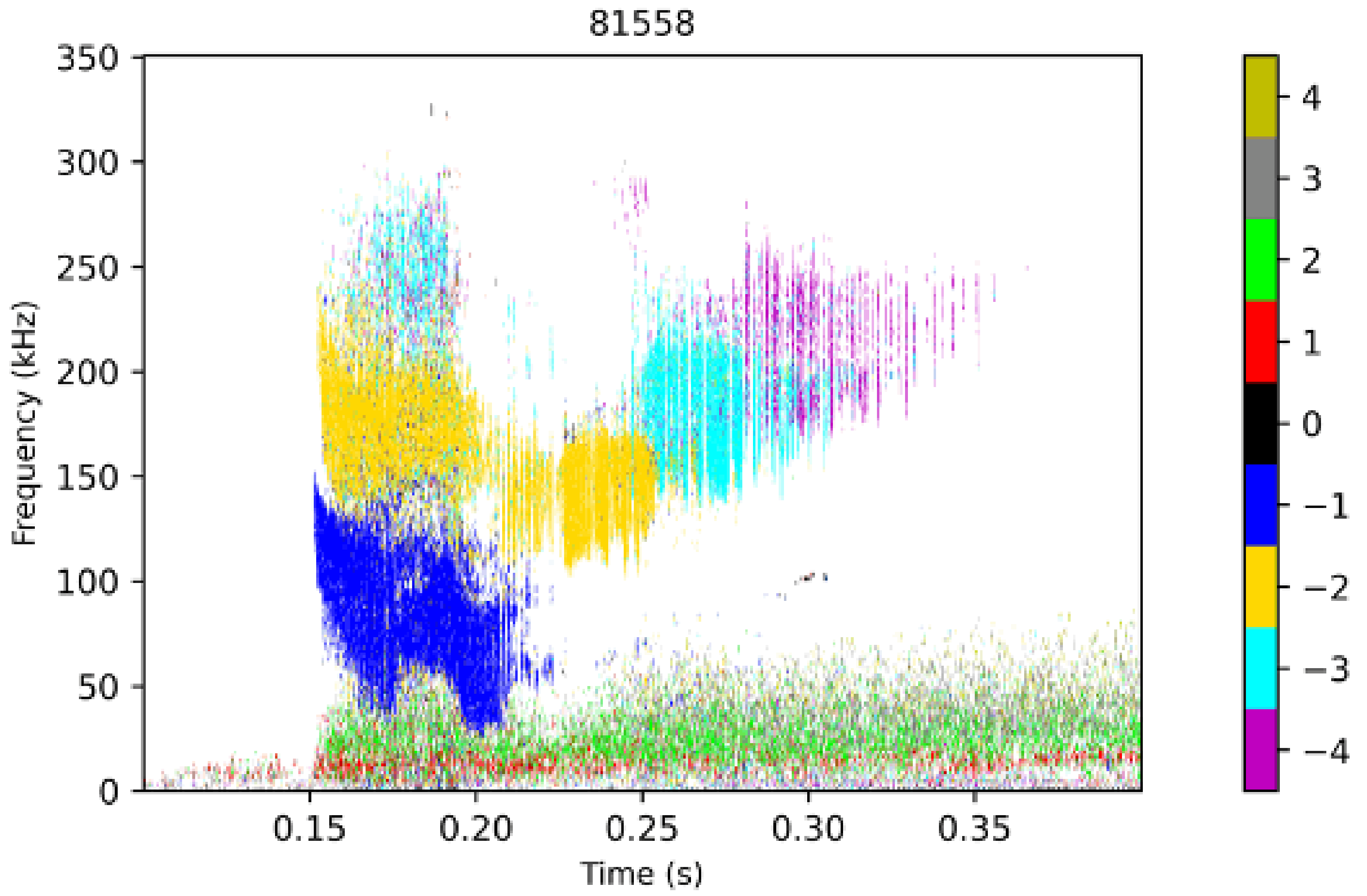


Fig. 1: RSAEs at TCV plasma startap

oposed pulses

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

195: Transport and losses induced by high frequency Alfvén Eigenmodes

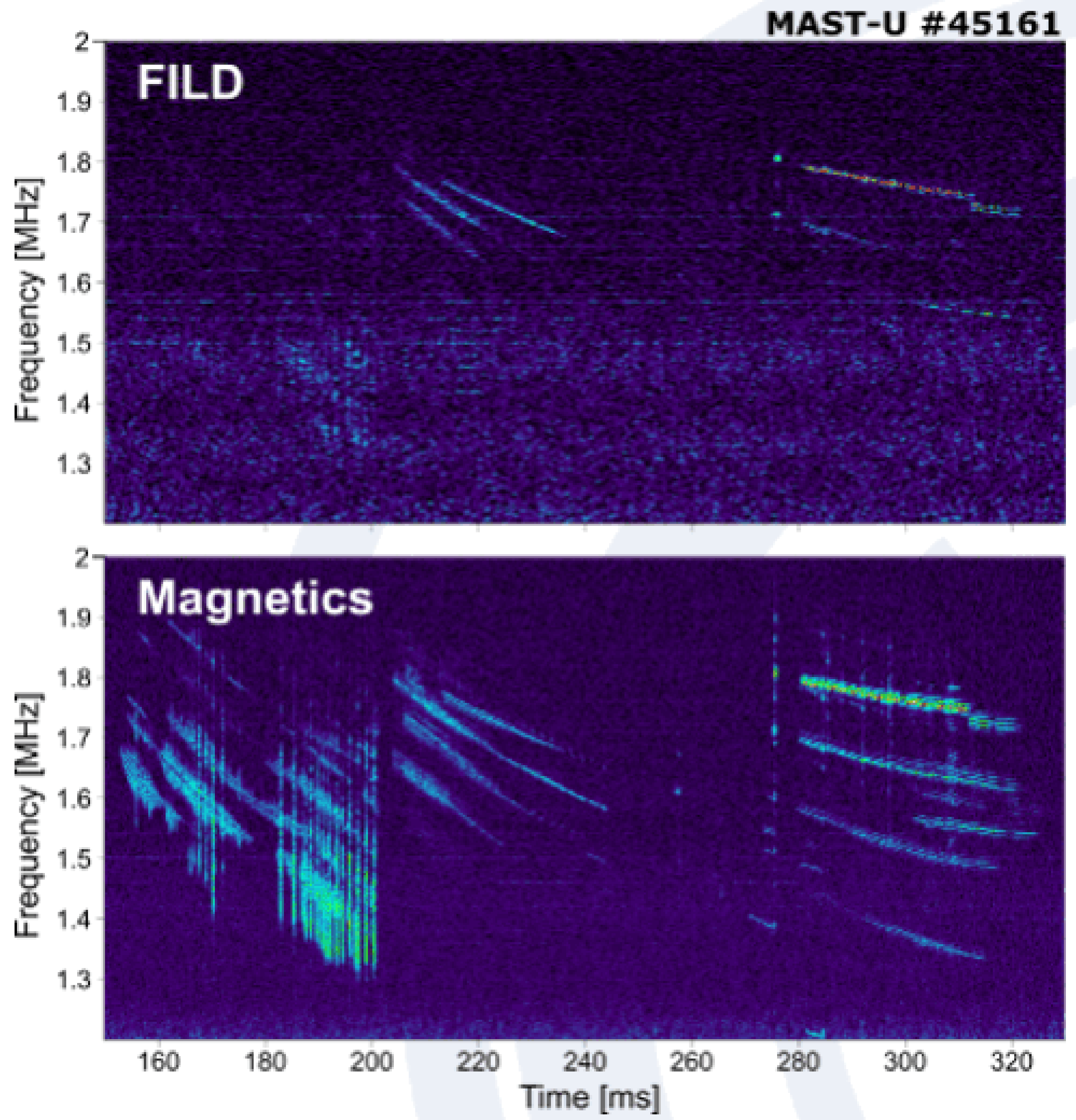
(P1-2025)

- **Proponents and contact person:**
  Juan.Rivero-Rodriguez@ukaea.uk

- **Scientific Background & Objectives**
- TAEs driven unstable in AUG & MAST-U with NBI
- GAEs driven unstable in MAST-U with NBI
- GAEs driven unstable in AUG with ICRH+NBI

  Goal:
  - Compare AE stability in AUG & MAST-U
  - Compare fast-ion redistribution and losses induced by AEs

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - AUG & MAST-U
  - ICRH (AUG) & All NBIs available
  - All fast-ion diagnostics available (FILD, INPA, FIDA, etc.)



J.F Rivero-Rodriguez et al., EPS 2022

Proposed pulses

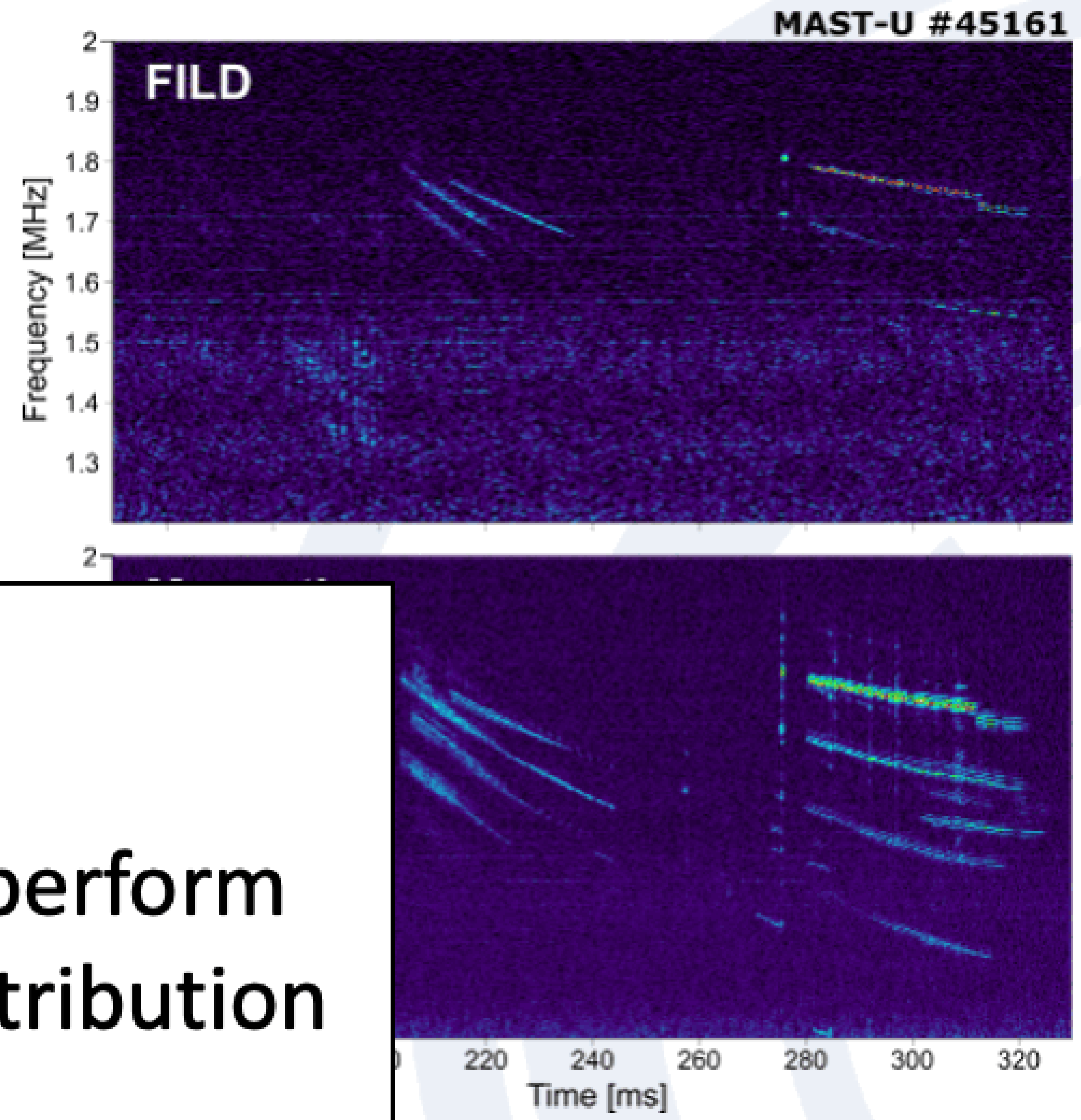
Device	# Pulses/Session	# Development
AUG	20	0
MAST-U	22	0
TCV	0	0
WEST	0	0

195: Transport and losses induced by high frequency Alfvén Eigenmodes

(P1-2025)

- **Proponents and contact person:**
  Juan.Rivero-Rodriguez@ukaea.uk

- **Scientific Background & Objectives**
- TAEs driven unstable in AUG & MAST-U with NBI
- GAEs driven unstable in MAST-U with NBI



Rodriguez et al., EPS 2022

- TFL assessment: P1
- Re-submitted P1_2025 proposal
- Key proposal to fully investigate and perform cross-machine comparison of FI redistribution and loss on AUG/MAST-U
- Linked to ITPA-EP and ITER required research B.11.5

es

	ses/Session	# Development
		0
MAST-U	22	0
TCV	0	0
WEST	0	0

- AUG & MAST-U
- ICRH (AUG) & All NBIs available
- All fast-ion diagnostics available (FILD, INPA, FIDA, etc.)

196: Development of alpha-particle measurements on AUG in support of ITER rebaseline

(P1-2025)

- **Proponents and contact person**

  Yevgen Kazakov (LPP-ERM/KMS),
  Massimo Nocente (Milano University),
  Volodymyr Bobkov (IPP-Garching)

- **Scientific Background & Objectives**
  - ITER with the full-W wall can't use the reaction ^{4}He + ^{9}Be for alpha measurements with the gamma-ray spectroscopy (validated at JET-ILW)
  - Development of new techniques important for ITER
  - Generate and measure D-^{3}He fusion-born alphas on AUG using the reaction **^{4}He + ^{10}B**
  - Test the effect of boronization and a boron dropper on the quality of alpha measurements
  - About 50% of fusion-born alphas (passing) confined
  - Impact of fast ions on AEs and ITG (piggy-back)

- **Experimental Strategy/Machine Constraints and essential diagnostics**
  - Three different ICRF scenarios for generating D-^{3}He fusion-born alphas on AUG
  - Essential diagnostics: fast-ion diagnostics, including neutrons, gammas and FILD
  - D campaign: significant amount of ^{3}He (~5-25%)
  - H campaign: 2nd harmonic hydrogen ICRF and p-^{11}B fusion for alpha production

Required fast-ion energies (ICRF): E_{fast} ~ 500keV

Alpha production:
D + ^{3}He → ^{4}He (3.6MeV) + *p* (14.7MeV)
***p* + ^{11}B → ^{4}He + ^{4}He + ^{4}He (+ 8.7 MeV)**

Alpha detection: ^{4}He + ^{10}B → *p* + ^{13}C + *gammas*

Proposed pulses

Device	# Pulses/Session	# Development
AUG	Part 1: 3rd harmonic D ICRF in D-^{3}He, 8 pulses	3 out of 8
	Part 2: 3-ion ICRF scheme in D-^{3}He, 10 pulses	4 out of 10
	Part 3: ^{3}He minority heating, 8 pulses	3 out of 8
	Part 4 (H campaign): 2nd harmonic H, 8 pulses	3 out 8
MAST-U	n/a	n/a
TCV	n/a	n/a
WEST	n/a	n/a

196: Development of alpha-particle measurements on AUG in support of ITER rebaseline

(P1-2025)

- **Proponents and contact person**

  Yevgen Kazakov (LPP-ERM/KMS),
  Massimo
  Volodymy

- **Scientific**
  - ITER
    ^{4}He +
    the ga
  - Devel
  - Gener
    on AU
  - Test th
    on the
  - About
  - Impac

- **Experime**
  and esse
  - Three
    D-^{3}He fusion-born alphas on AUG
  - Essential diagnostics: fast-ion diagnostics, including neutrons, gammas and FILD
  - D campaign: significant amount of ^{3}He (~5-25%)
  - H campaign: 2nd harmonic hydrogen ICRF and p-^{11}B fusion for alpha production

- TFL assessment: P1
- Re-submitted P1_2025 Proposal
- Directly linked to ITER re-baselining to determine efficacy of alpha particle measurements without Be first wall – supported by ITPA-EP and -DIAG
- Will require care in scheduling for correct machine conditions.
- Proposal requires good diagnostic measurements to be available immediately the expt. starts – schedule later in campaign?

Required fast-ion energies (ICRF): E_{fast} ~ 500keV

on:
(3.6MeV) + *p* (14.7MeV)
^{4}He + ^{4}He (+ 8.7 MeV)

n: ^{4}He + ^{10}B → *p* + ^{13}C + *gammas*

ulses

	ses/Session	# Development
	1: 3rd harmonic D in D-^{3}He, 8 pulses	3 out of 8
	2: 3-ion ICRF scheme ^{3}He, 10 pulses	4 out of 10
	3: ^{3}He minority ng, 8 pulses	3 out of 8
	4 (H campaign): armonic H, 8 pulses	3 out 8
MAST-U	n/a	n/a
TCV	n/a	n/a
WEST	n/a	n/a

197: Optimization of fast-ion confinement in tokamaks with externally applied 3D fields

(P1-2025)

- **Proponents and contact person:**
  J.Galdon-Quiroga jgaldon@us.es
  (full list in the wiki)

- **Scientific Background & Objectives**

- Measure fast-ion transport as a function of $\Delta\Phi_{ul}, \Phi_0$
- Measure the scaling of fast-ion losses with MP intensity. Compare to threshold for ELM suppression, if established.

In MAST-U:

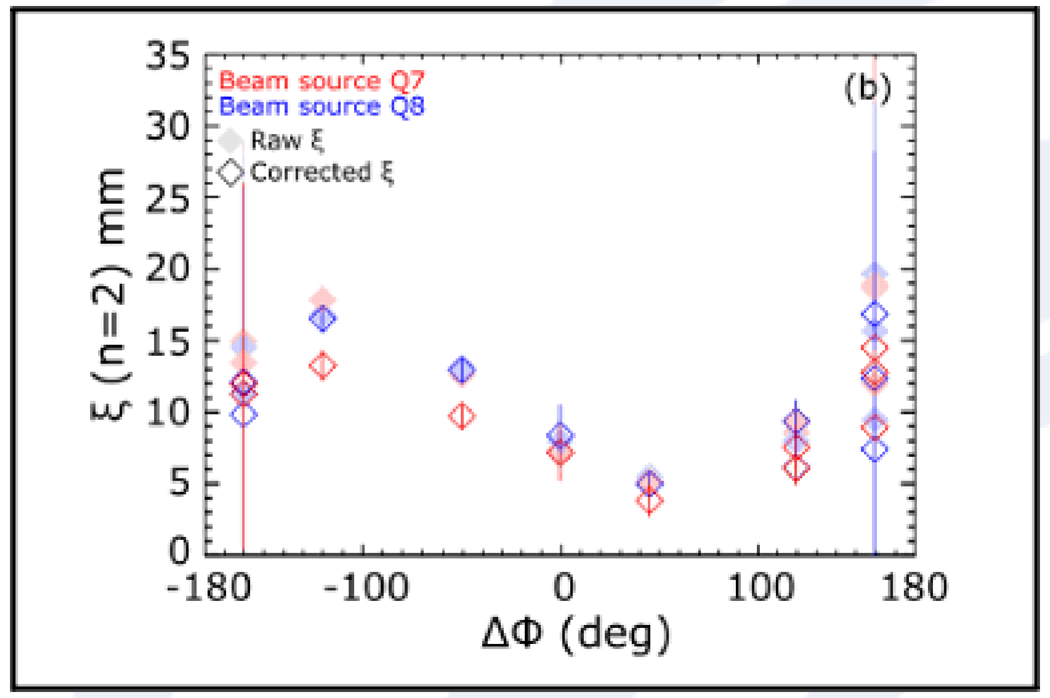
- Complete scans from MU03 (SW beam, $\Delta\Phi_{ul}$)
- Include EFCC for n=2 error field correction
- Extend to high-beta 1MA scenario

In AUG:

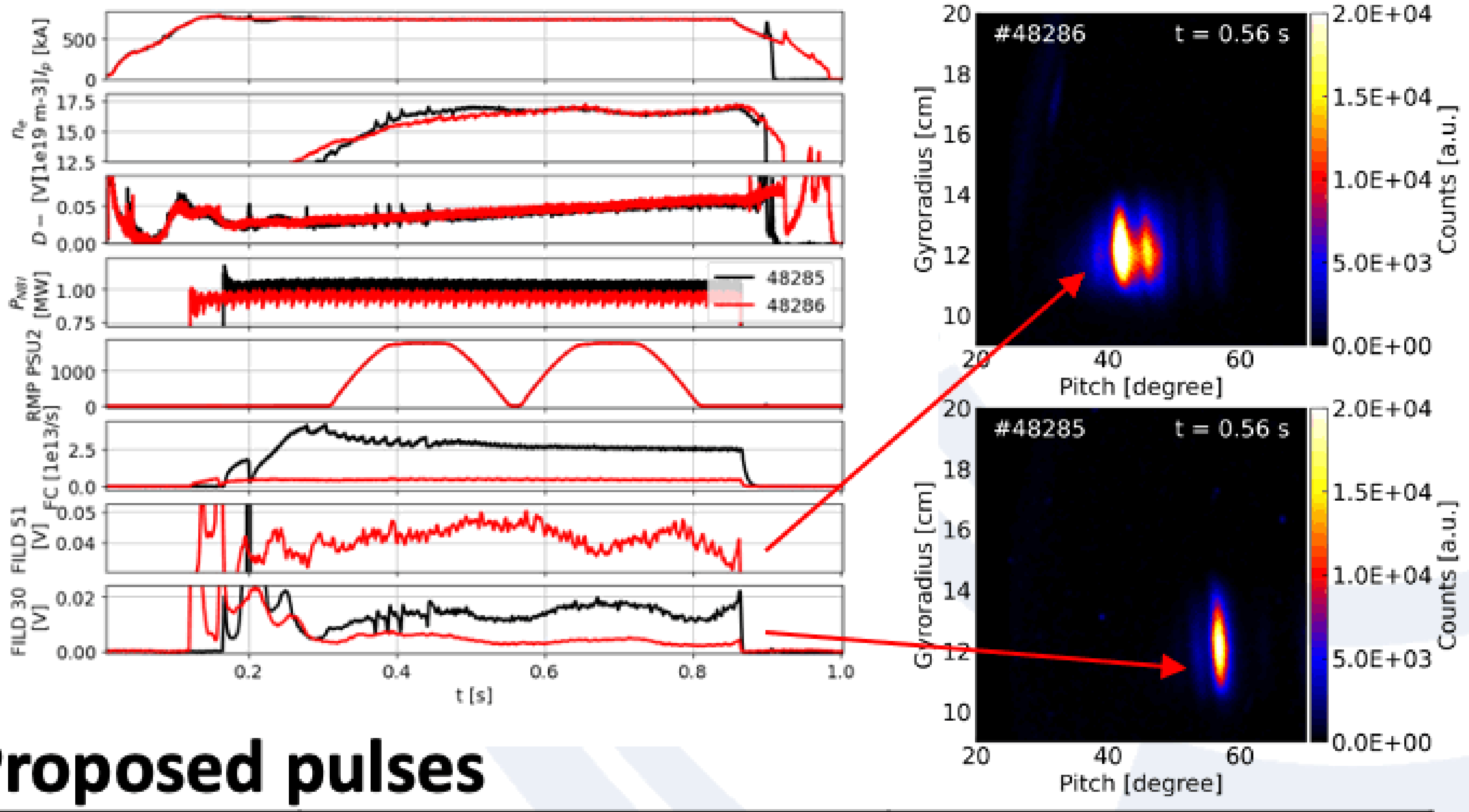
- Investigate effect of MPs on ICRF fast-ion distribution function (vs previous NBI studies)

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - FILD, FIDA and other fast-ion diagnostics are essential
  - In MU, special settings for IR thermography
  - Scans in MP differential phase and intensity

AUG: fast-ion orbit displacement vs MP spectrum [1]



MAST-U: Scan in Dphi 0→ 90 deg. SS vs SW beam



Proposed pulses

Device	# Pulses/Session	# Development
MAST-U	26 pulses	6 pulses
AUG	14	5

[1] J.Galdon-Quiroga et al., Nucl. Fusion **62** 096004 (2022)

197: Optimization of fast-ion confinement in tokamaks with externally applied 3D fields

(P1-2025)

- **Proponents and contact person:**
  J.Galdon
  (full list i

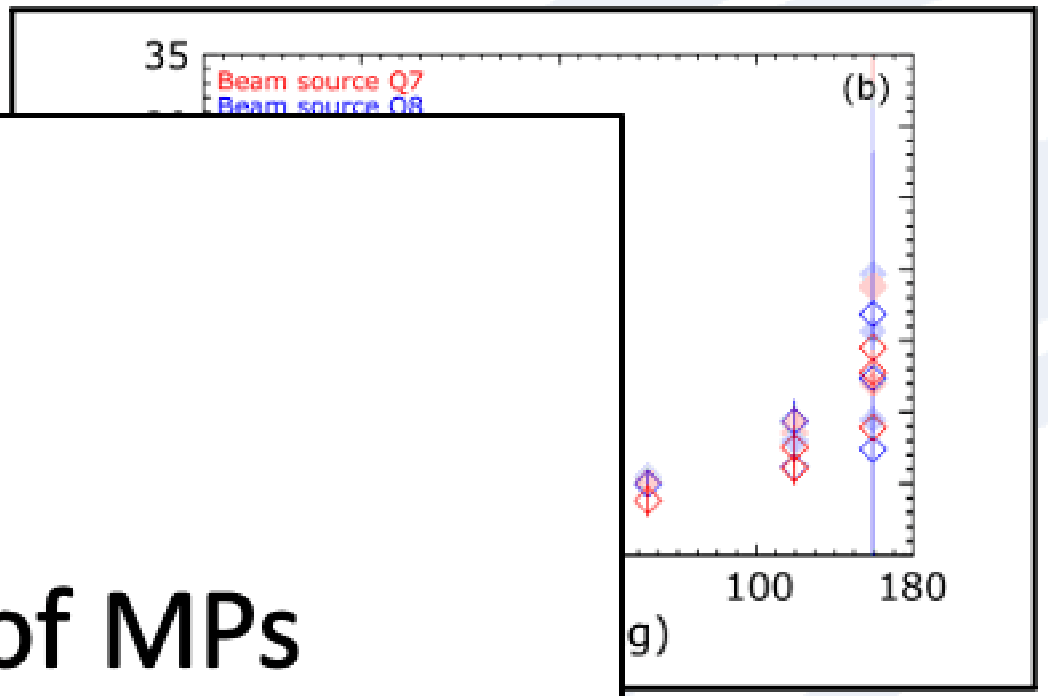
- **Scientifi**
- Measure fa
- Measure th
  Compare to

In MAST-U:
- Complete s
- Include EFC
- Extend to h

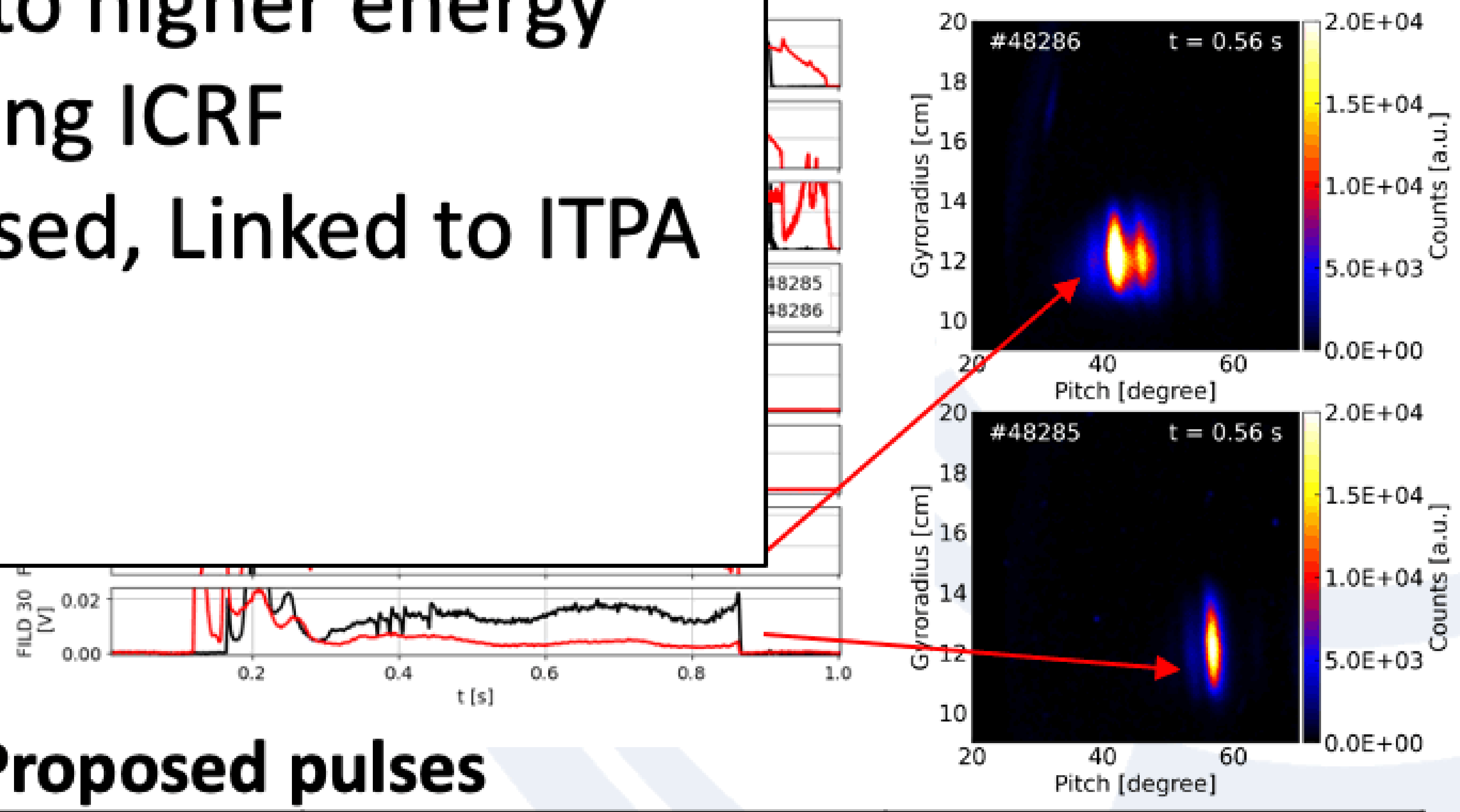
In AUG:
- Investigate
  function (vs

- TFL assessment: P1
- Re-submitted P1_2025 proposal
- Extends study in MAST-U
  - covering full 0-360 deg phase of MPs
  - To high beta and Ip
- AUG branch extends study to higher energy region of FI phase space using ICRF
- Several deliverables addressed, Linked to ITPA JEX

AUG: fast-ion orbit displacement vs MP spectrum [1]



deg. SS vs SW beam



- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - FILD, FIDA and other fast-ion diagnostics are essential
  - In MU, special settings for IR thermography
  - Scans in MP differential phase and intensity

Proposed pulses

Device	# Pulses/Session	# Development
MAST-U	26 pulses	6 pulses
AUG	14	5

[1] J.Galdon-Quiroga et al., Nucl. Fusion **62** 096004 (2022)

198: Fast-ion losses induced by edge instabilities across different confinement regimes

- **Proponents and contact person:**

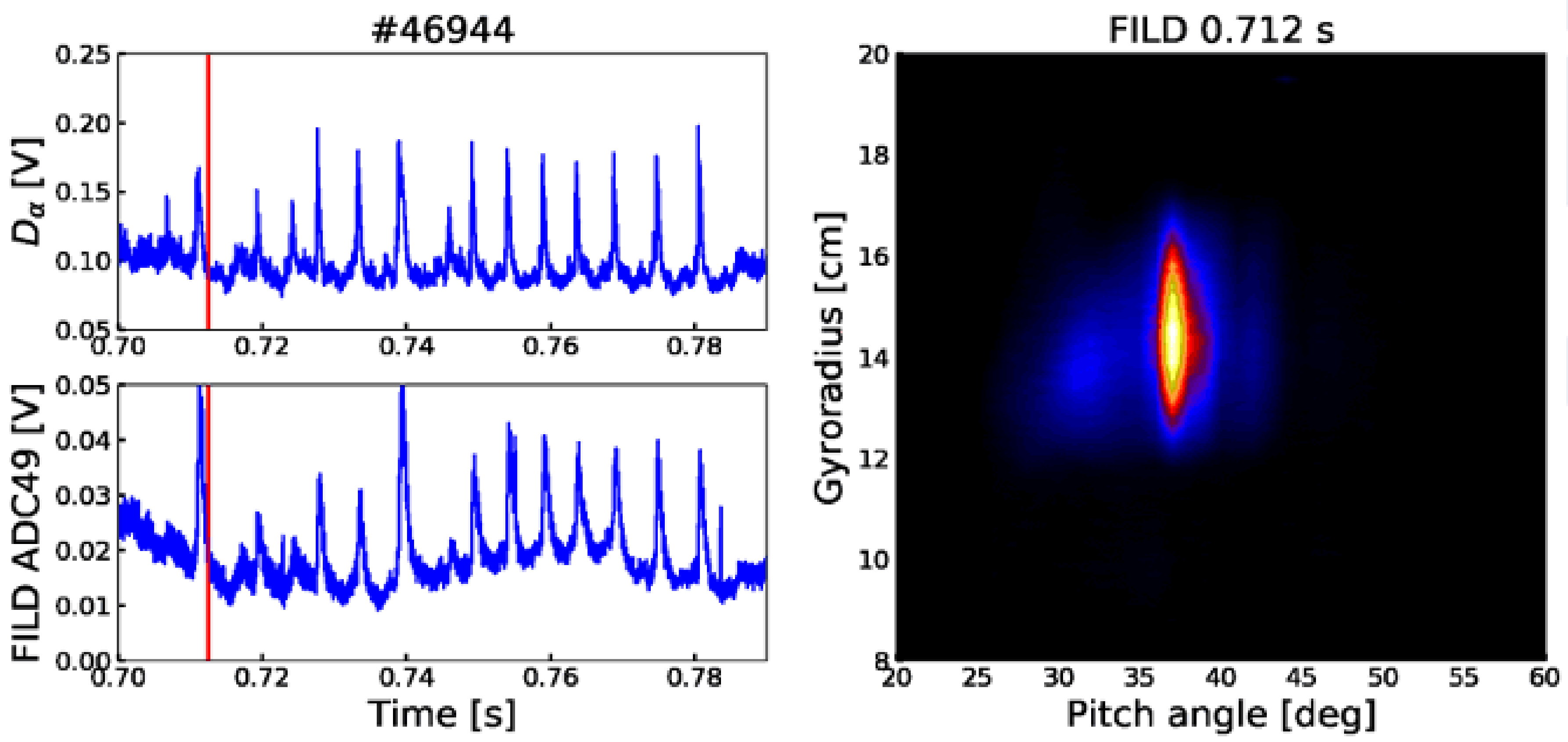
  J.Galdon-Quiroga, J.Poley-Sanjuan, J.F.Rivero , A.Jansen Van Vuuren

- **Scientific Background & Objectives**

  Background: Type-I ELMs shown to produce fast-ion losses to the first wall.

  This proposal: impact of edge instabilities on fast-ions in diff. confinement regimes and machines:

Type-III ELM induced FIL in MAST-U



Machine	Already explored	More work needed
AUG	Type-I ELMs, MP mitigated & suppressed ELMs, QCE, I-mode, QH-mode	I-mode (with PREs)
TCV	Type-I ELMs	Type-I ELMs (scans); QCE, I-mode
MAST-U	Type-I and Type-III ELMs (750 kA scen.)	Type-I ELMs (1MA scen; scans in NBI, collisionality); MP mitigated ELMs; QCE

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - FILD as essential diagnostic
  - Piggyback in experiments dedicated to I-mode, QCE, QH-mode and EDA H-mode. Only specific dedicated shots for completing scans.

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

Proposed pulses

198: Fast-ion losses induced by edge instabilities across different confinement regimes

- **Proponents and contact person:**

  J.Galdon-Quiroga, J.Poley-Sanjuan, J.F.Rivero , A.Jansen Van Vuuren

- **Scient**

  Back

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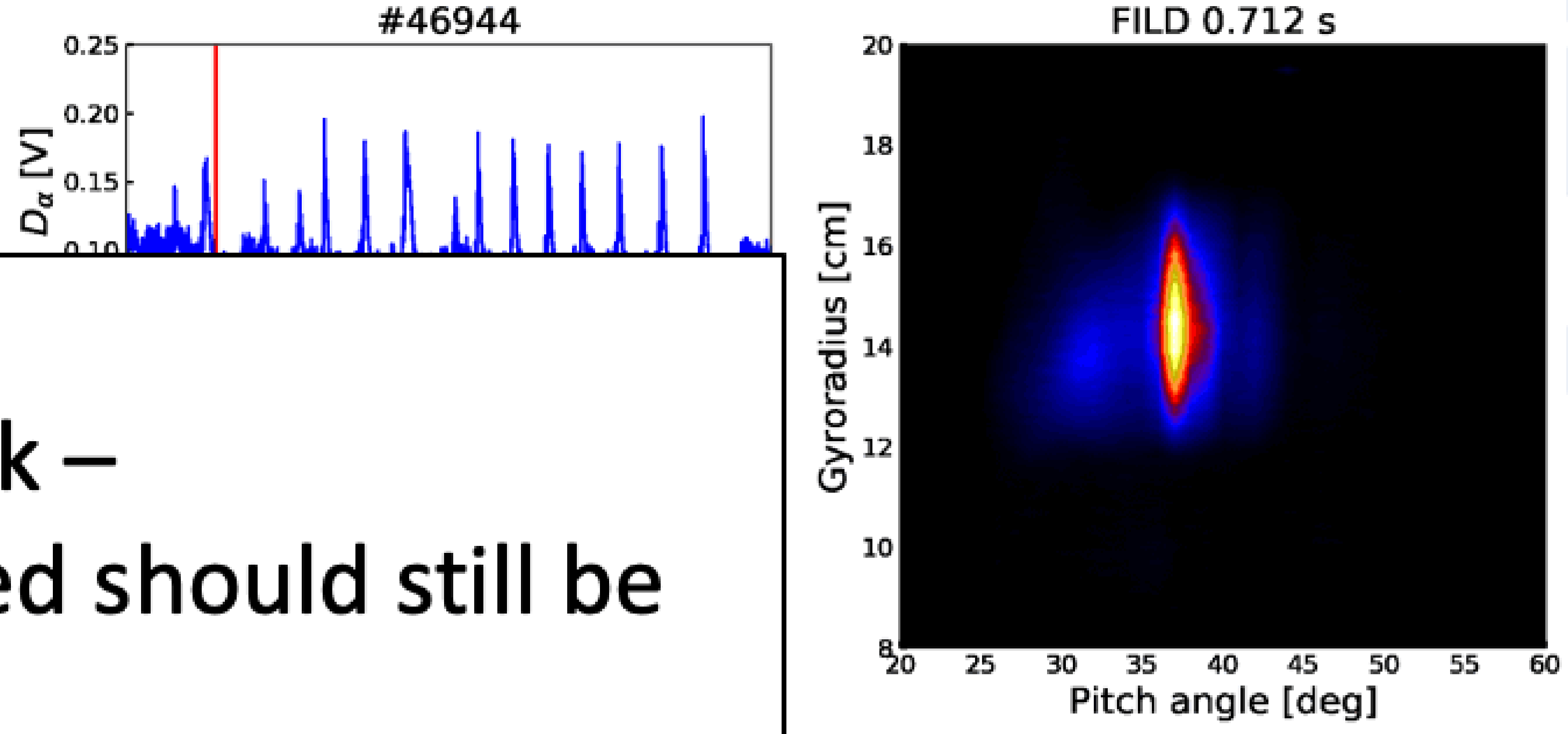
  This

  fast-i

  mach

- TFL assessment: P1/PB
- Proposal mostly in piggy-back – measurements to be collected should still be considered high priority
- Will need careful co-ordination, esp. with RT-02
- Directly addresses D5 comprehensively
- Suggest to do as much as possible in PB and only look at dedicated shots if really needed towards end of RT allocations/device

Type-III ELM induced FIL in MAST-U



eded
REs)
cans); QCE, I-mode
MA scen; scans in NBI, MP mitigated ELMs; QCE

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - FILD as essential diagnostic
  - Piggyback in experiments dedicated to I-mode, QCE, QH-mode and EDA H-mode. Only specific dedicated shots for completing scans.

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

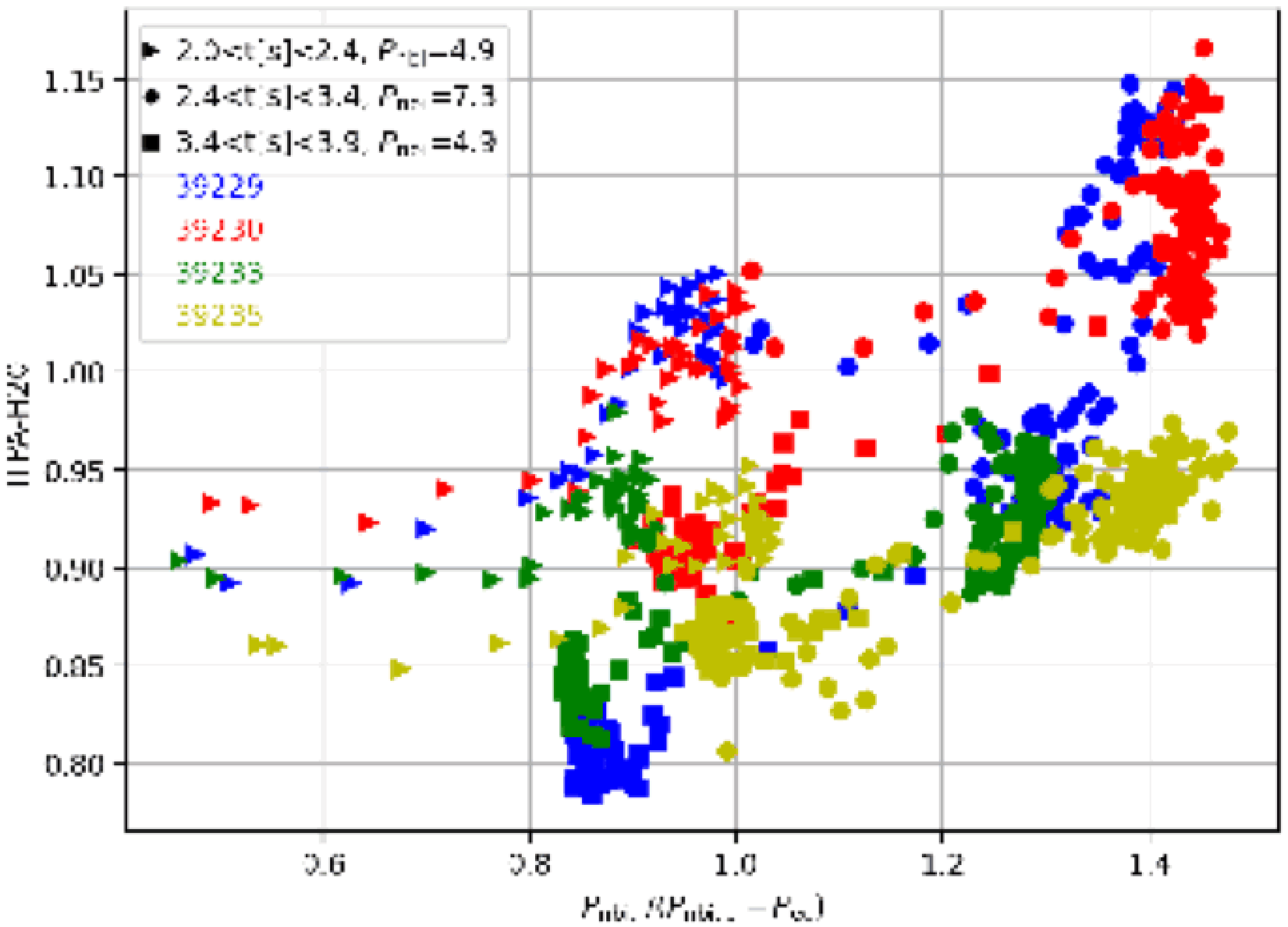
Proposed pulses

199:

(P1-2025)

Effects of ICRF-generated fast-ions on core turbulence at different ion to electron fluxes

- **Proponets and Contact person:**
  R. Bilato, C. Angioni, V. Bobkov, A. Di Siena, E. Fable, A. Kappatou, Y. Kazakov, R. Ochoukov, J. Galdón, R. Ragona, P. Schneider, S. Sipilä, A. Snicker, M. Weiland
- **Scientific Background & Objectives**
  AUG discharges dedicated to study the effects of ICRF/NBI fast ion on core turbulence have shown evidences that the dominance of ion heating favours improved confinement in the presence of fast ions. The aim of the present proposal is to experimentally characterize and theoretically understand the strength of the fast-ion effects on core turbulence at different fractions of electron to ion heat fluxes and therefore also at different ratios of Te/Ti.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  For modelling it is essential a good diagnostic coverage: Ti and vtor measurements, fast-ion characterization (FIDA, NPA, FILD, CTS), detection of Alfvén eigenmode activity (B-dot probes)
  - Each discharge has a stepwise EC power scan with 0.4s notches at the end of each step;
  - Each discharge has either NBI or ICRF power scan with notches;
  - The best discharges are repeated with different ICRF frequency (or different magnetic field) to move the IC resonance position from the core to the plasma periphery.



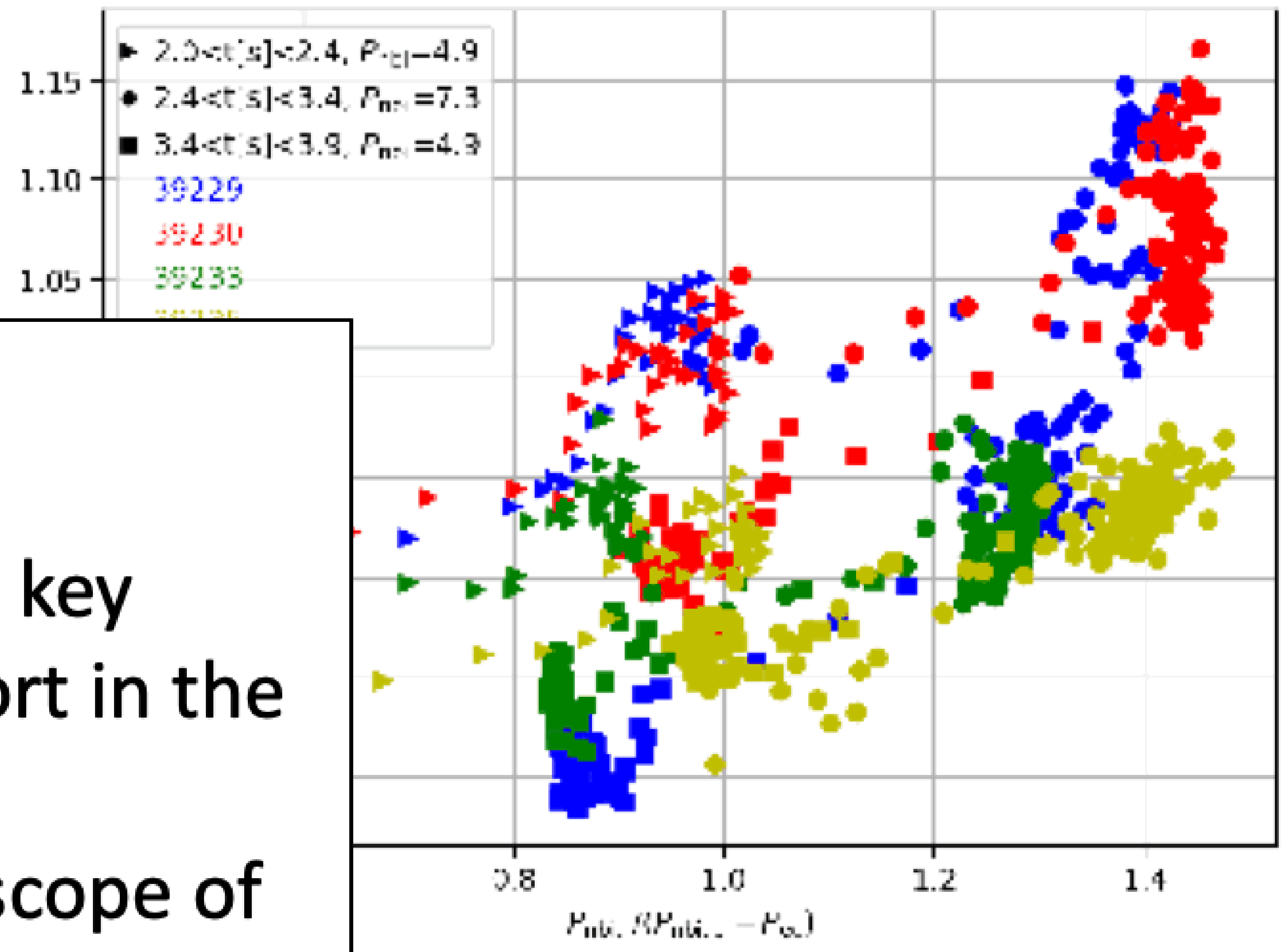
Proposed pulses

Device	# Pulses/Session	# Development
AUG	13 (9+4)	4 (CTS)
MAST-U		
TCV		
WEST		

199: (P1-2025)

Effects of ICRF-generated fast-ions on core turbulence at different ion to electron fluxes

- **Proponets and Contact person:**
  R. Bilato, C. Angioni, V. Bobkov, A. Di Siena, E. Fable, A. Kappatou, Y. Kazakov, R. Ochoukov, J. Galdón, R. Ragona, P. Schneider, S. Sipilä, A. Snicker, M. Weiland
- **Scientific Background & Objectives**



- TFL assessment: P1
- Re-submitted P1_2025 proposal
- Directly addresses D2 in AUG and is a key proposal to form the basis of this effort in the AUG device.
- Many deliverables addressed within scope of proposal
- (Attempted to start in AUG last week, no pulses yet)

scan with notches;

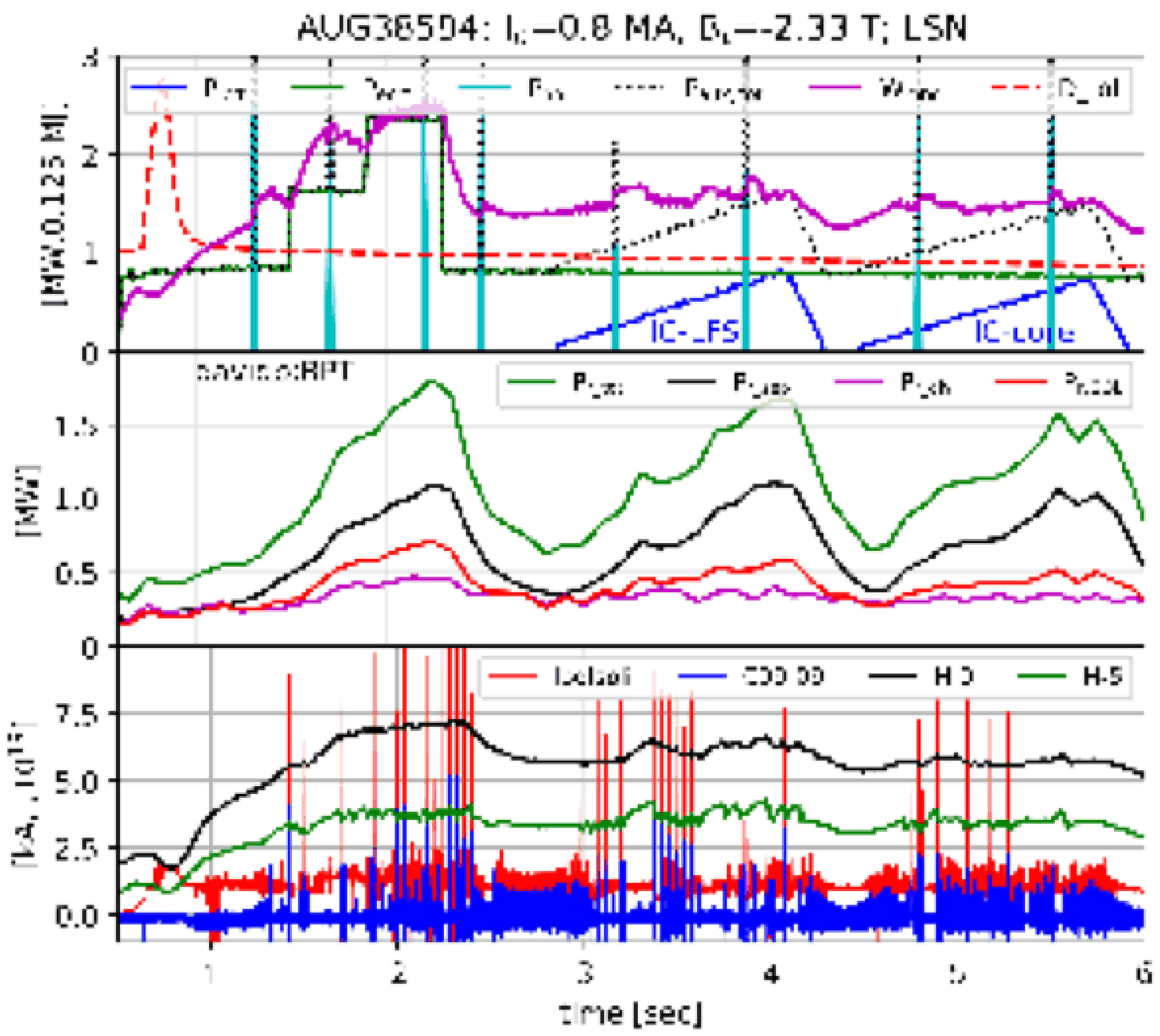
- The best discharges are repeated with different ICRF frequency (or different magnetic field) to move the IC resonance position from the core to the plasma periphery.

pulses

	# Pulses/Session	# Development
	13 (9+4)	4 (CTS)
TCV		
WEST		

200: ICRF-generated fast-ion effects on the L-H transition

- **Proponets and Contact person:**
  R. Bilato, C. Angioni, V. Bobkov, E. Fable, J. Galdón, A. Kappatou, R. Ochoukov, U. Plank, P. Schneider, S. Sipilä, A. Snicker, M. Weiland
- **Scientific Background & Objectives**
  ICRF-generated fast ions (FIs) can help to shed light on the role of FI losses in the L-H transition, and in particular on their role in the L-H power threshold, since the amount of losses of ICRF-generated FIs depends on the ICRF power and on the IC resonance location, which can be varied by changing the ratio of ICRF frequency to the confining magnetic field.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - USN (ref. discharge AUG38594): in USN the L-H power threshold is higher than in LSN and this gives a larger power window; additionally, the new upper divertor make these experiments “cleaner” than in the past;
  - In each discharge an initial EC power ramp-up is performed to establish the L-H and H-L power thresholds with dominant electron heating and w/o fast ions;
  - Two ICRF power ramp-ups at different IC frequency are performed (IC resonance on axis and on the LFS): either in the same discharge or in separate discharges;
  - repeat the discharges at different magnetic field and ICRF frequencies;
  - T_i and v_{tor} measurements with NBI blips or low NBI power if close to boronization; NPA, FIDA and FILD for the fast-ions.



Proposed pulses

Device	# Pulses/Session	# Development
AUG	8 (6+2)	2
MAST-U		
TCV		
WEST		

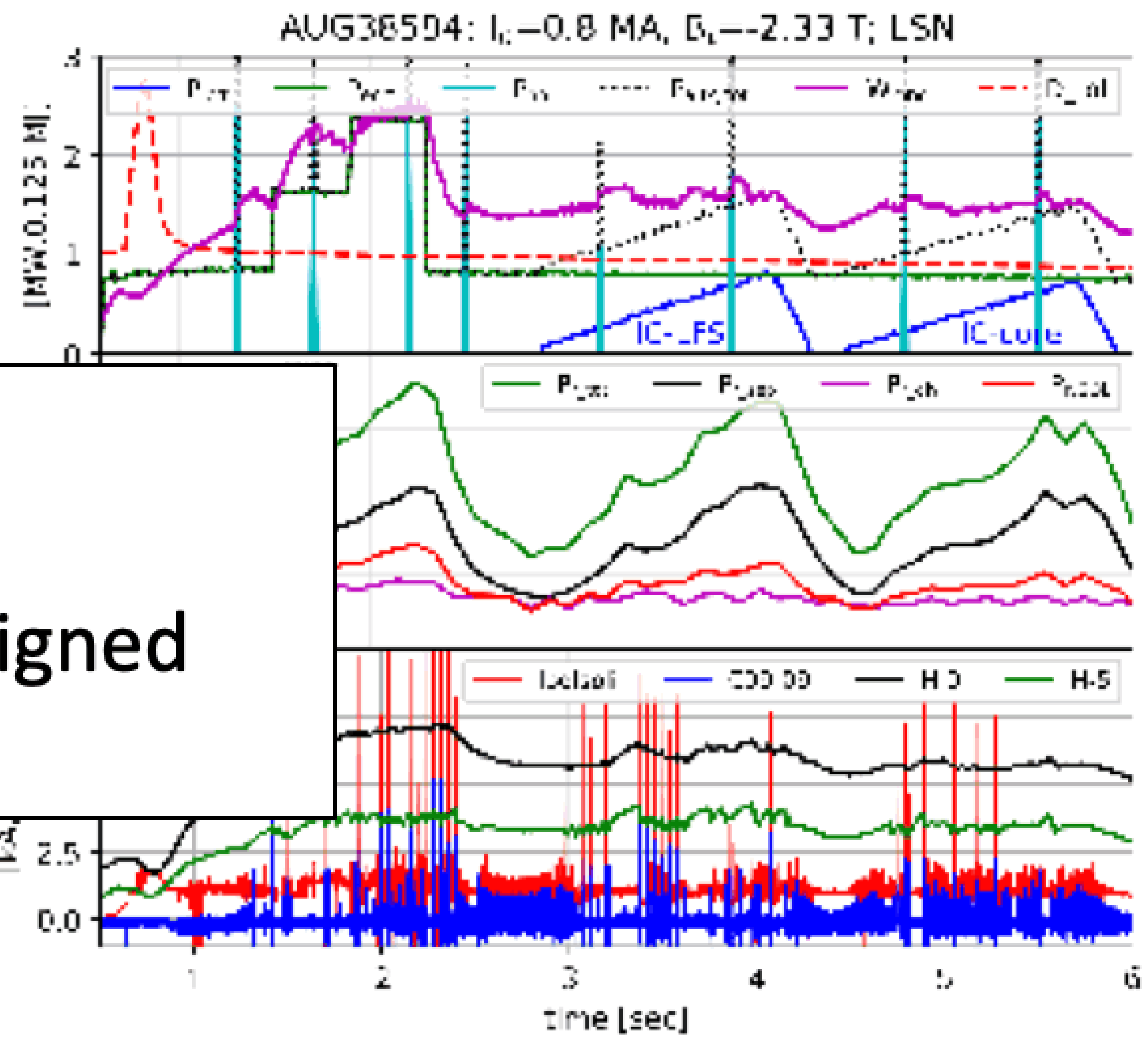
ICRF-generated fast-ion effects on the L-H transition

- **Proponets and Contact person:**
  R. Bilato, C. Angioni, V. Bobkov, E. Fable, J. Galdón, A. Kappatou, R. Ochoukov, U. Plank, P. Schneider, S. Sipilä, A. Snicker, M. Weiland
- **Scientific Background & Objectives**
  ICRF-generated fast ions (FIs) can help to shed light on the role

- TFL assessment: P3
- L-H transition not a priority for RT-09
- Data can be collected in a suitably designed experimental program.

and essential diagnostic

- USN (ref. discharge AUG38594): in USN the L-H power threshold is higher than in LSN and this gives a larger power window; additionally, the new upper divertor make these experiments "cleaner" than in the past;
- In each discharge an initial EC power ramp-up is performed to establish the L-H and H-L power thresholds with dominant electron heating and w/o fast ions;
- Two ICRF power ramp-ups at different IC frequency are performed (IC resonance on axis and on the LFS): either in the same discharge or in separate discharges;
- repeat the discharges at different magnetic field and ICRF frequencies;
- T_i and v_{tor} measurements with NBI blips or low NBI power if close to boronization; NPA, FIDA and FILD for the fast-ions.

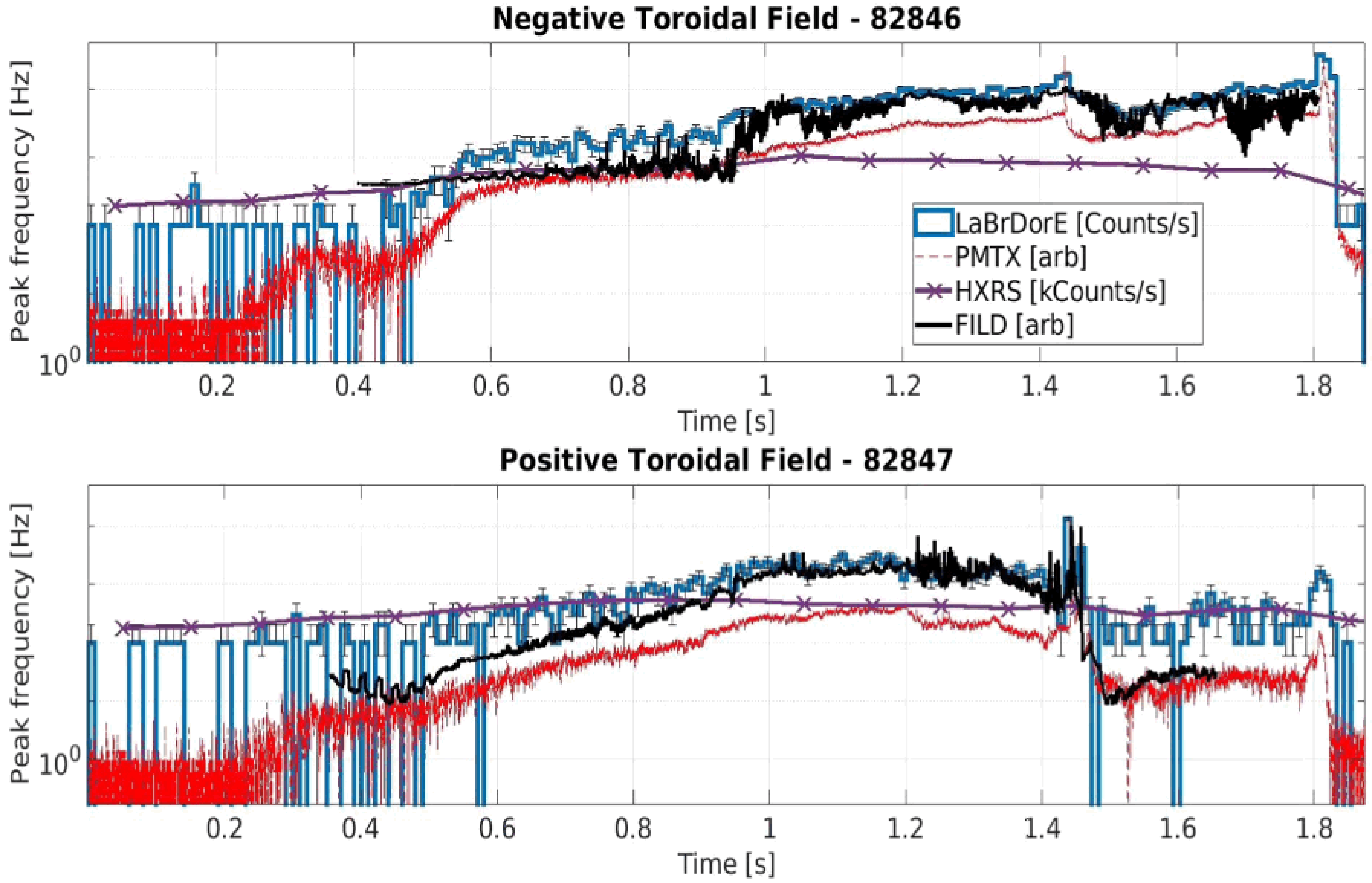


Proposed pulses

Device	# Pulses/Session	# Development
AUG	8 (6+2)	2
MAST-U		
TCV		
WEST		

201: Summary slide: measurement of RE losses

- Both TCV's FILD cameras observe a signal correlated with multiple Runaway electrons (RE) diagnostics.
- These new measurements can potentially allow us to retrieve the apparent velocity-space of the RE losses.
- Dedicated studies in multiple scenarios on TCV are foreseen to study these RE losses.



201: Summary slide: measurement of RE losses

- Both TCV's FILD cameras observe a signal co[...]ted with multiple Ru[...] electrons (RE) dia[...]
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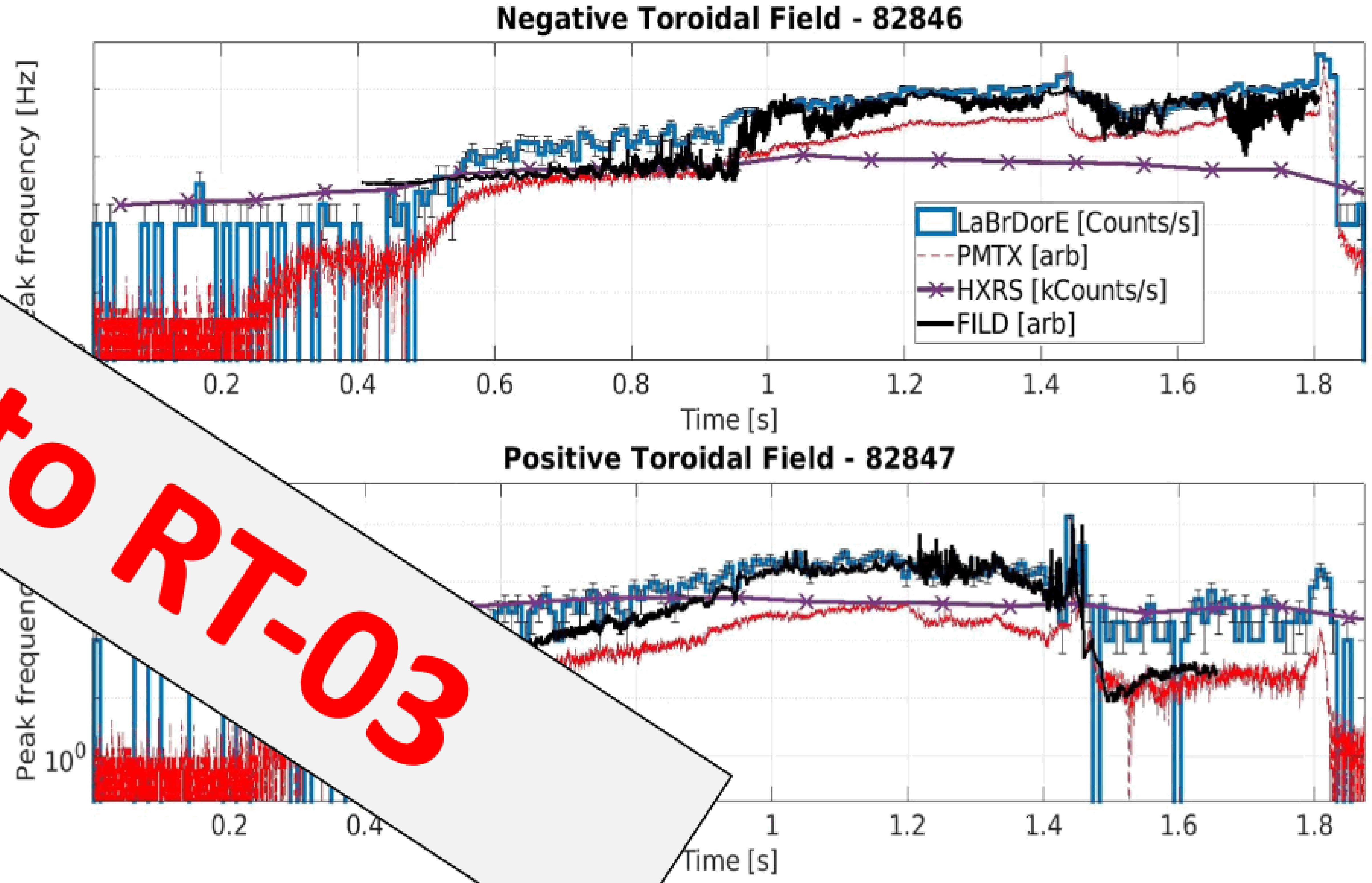
- Dedicated studies in multiple scenarios on TCV are foreseen to study these RE losses.



Moved to RT-03

202: Characterization of the interplay between fast ions inter-ELM MHD activity and ELMs

- **Proponents and contact person:**

J.Poley-Sanjuan (jesus.poley@epfl.ch) & M.Jimenez-Cómez (mjimenez37@us.es)

- **Scientific Background & Objectives**

Background:

- AUG: hybrid kinetic-MHD simulations suggest interplay between ELM and TAE close to the edge.
- TCV: experimentally, fast-ion losses correlated with inter-ELM MHD activity observed in low vs high collisionality plasmas

Goals:

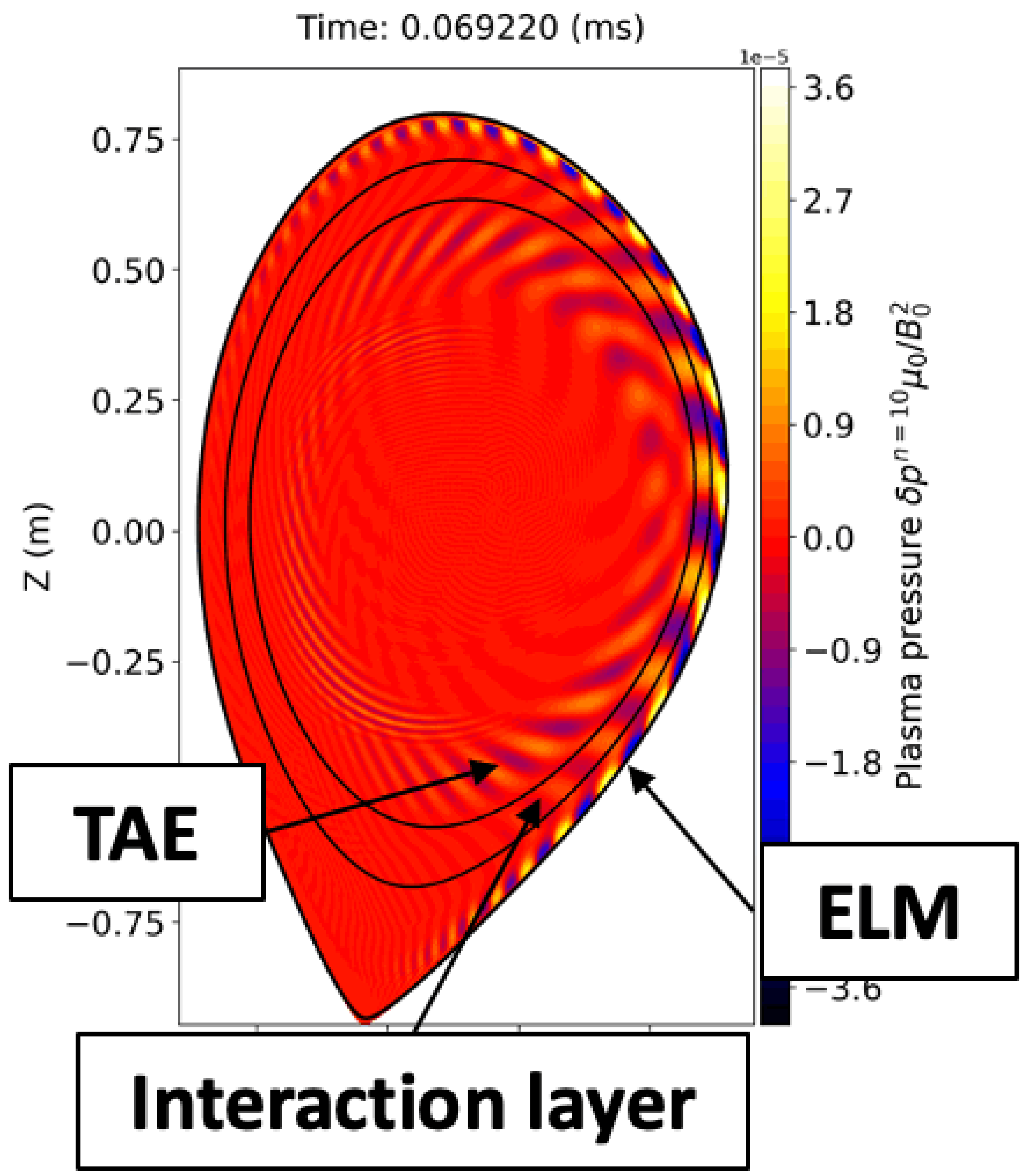
- Investigate interplay between ELMs, inter-ELM MHD activity and fast-ions.

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

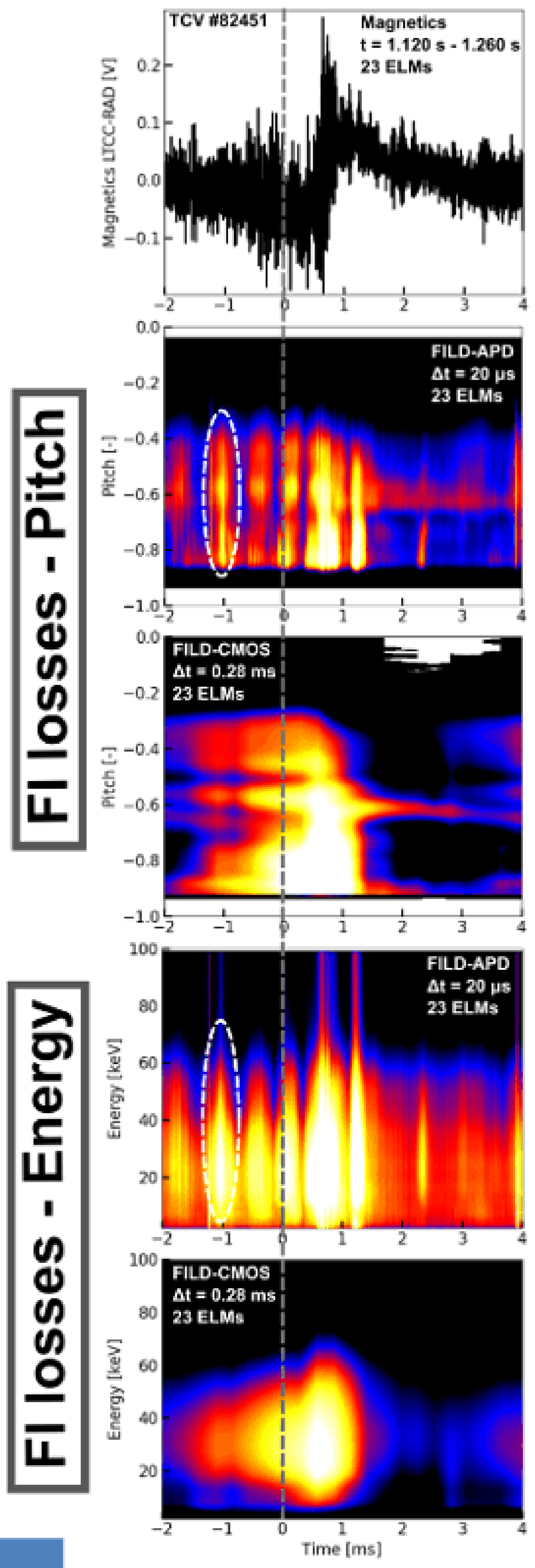
- **AUG**: develop scenario with NBI driven TAEs as much off-axis as possible to maximize ELM-AE interaction

- **TCV**: Follow-up experiments attempting to minimize inter-ELM MHD activity using ECRH (for comparison with previous experiments). Compare scenarios with on- vs off- axis fast-ion distributions.

AUG – MEGA simulation



TCV – Experiments



Proposed pulses

Device	# Pulses/Session	# Development
AUG	12	4
TCV	5	10

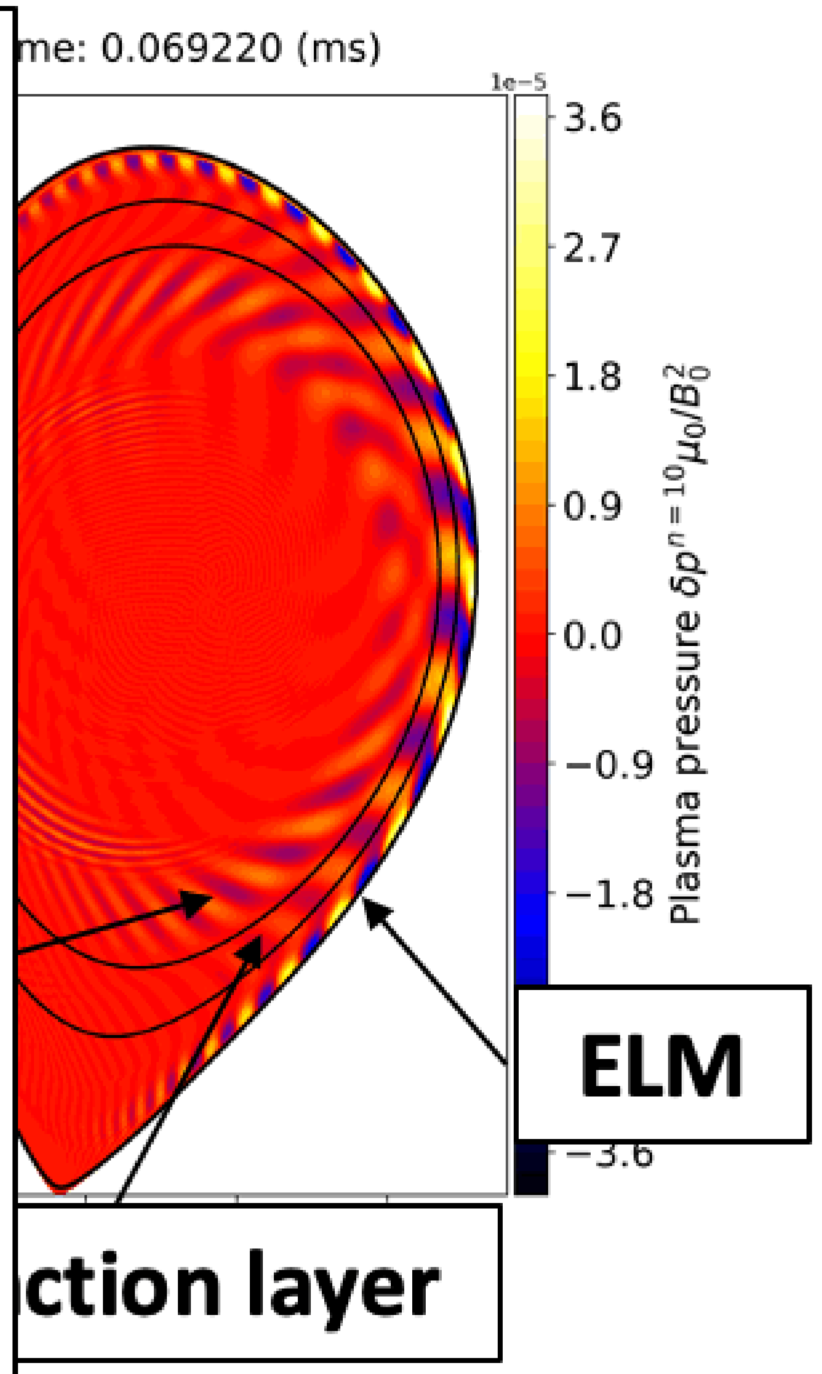
202: Characterization of the interplay between fast ions inter-ELM MHD activity and ELMs

- **Proponents and contact person:**
J.Poley-Sanjuan (jesus.poley@epfl.ch) & M.Jimenez-Cómez (mjimenez37@us.es)

- TFL assessment: P1
- Directed at D5, aims to compare effects of ELMs and edge located AEs by varying intensity of each
- Requires scanning heating methods power and geometry to achieve variance and power deposition location
- Supported by ITPA: JEX 6 and several ITER required research points.
- Parallels with P198

- AUG: hy b
- TCV: exp ELM MH
- Investi
- **Experimen**
- **AUG**: de axis
- **TCV**: Follow-up experiments attempting to minimize inter-ELM MHD activity using ECRH (for comparison with previous experiments). Compare scenarios with on- vs off- axis fast-ion distributions.

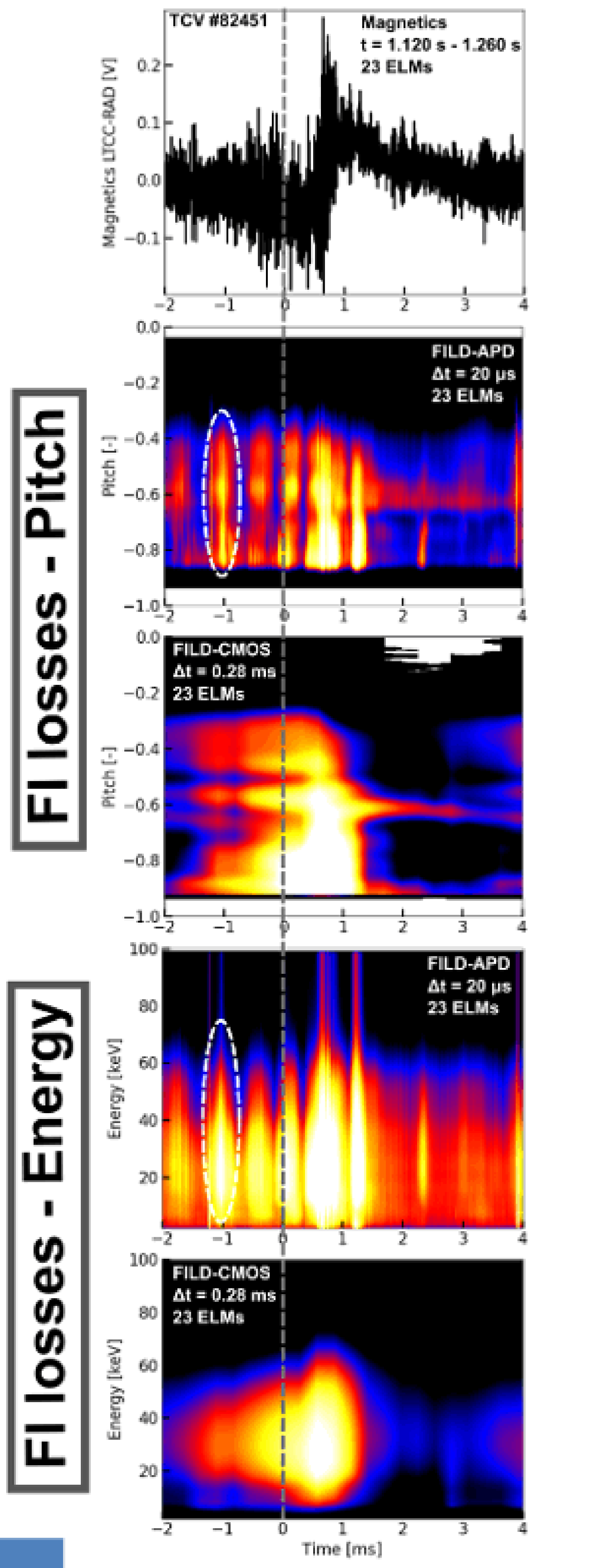
AUG – MEGA simulation



s

Device	# Pulses/Session	# Development
AUG	12	4
TCV	5	10

TCV – Experiments



203: Investigation of phase-space flows induced by TAEs on ICRH heated plasmas

Proponents and contact person:

A. Reyner-Viñolas: alereyvinn@alum.us.es

(full list in the wiki)

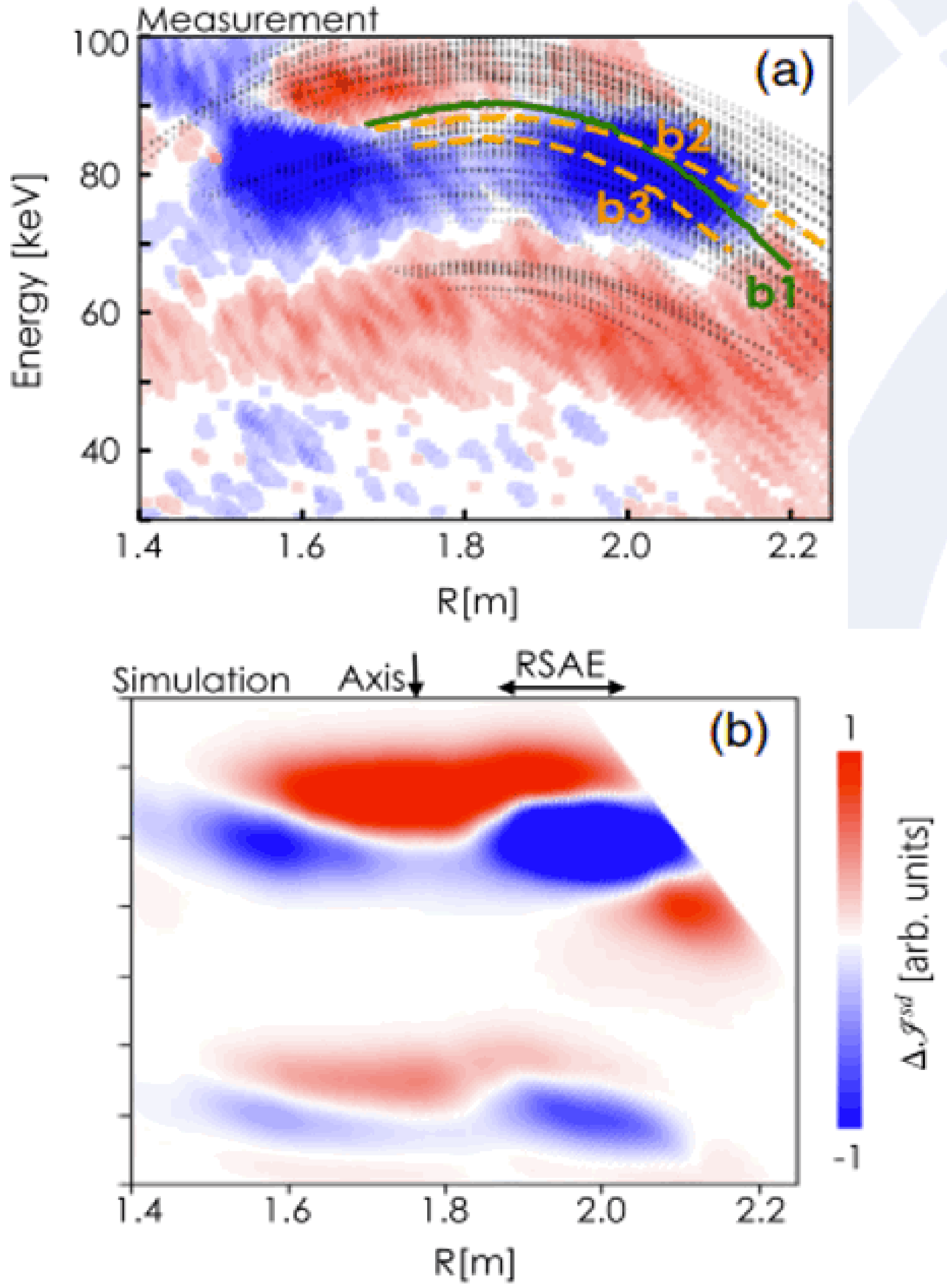
Scientific Background and Objectives

- **Background**: In DIII-D [X.Du PRL 2021] and AUG [J.Rueda NF 2024] phase space flows of NBI fast-ions induced by TAEs visualized using INPA diagnostic
- **Goal**: use **unique capabilities of AUG's INPA** diagnostic to measure this in **ICRF fast-ion populations** with **high temporal resolution**

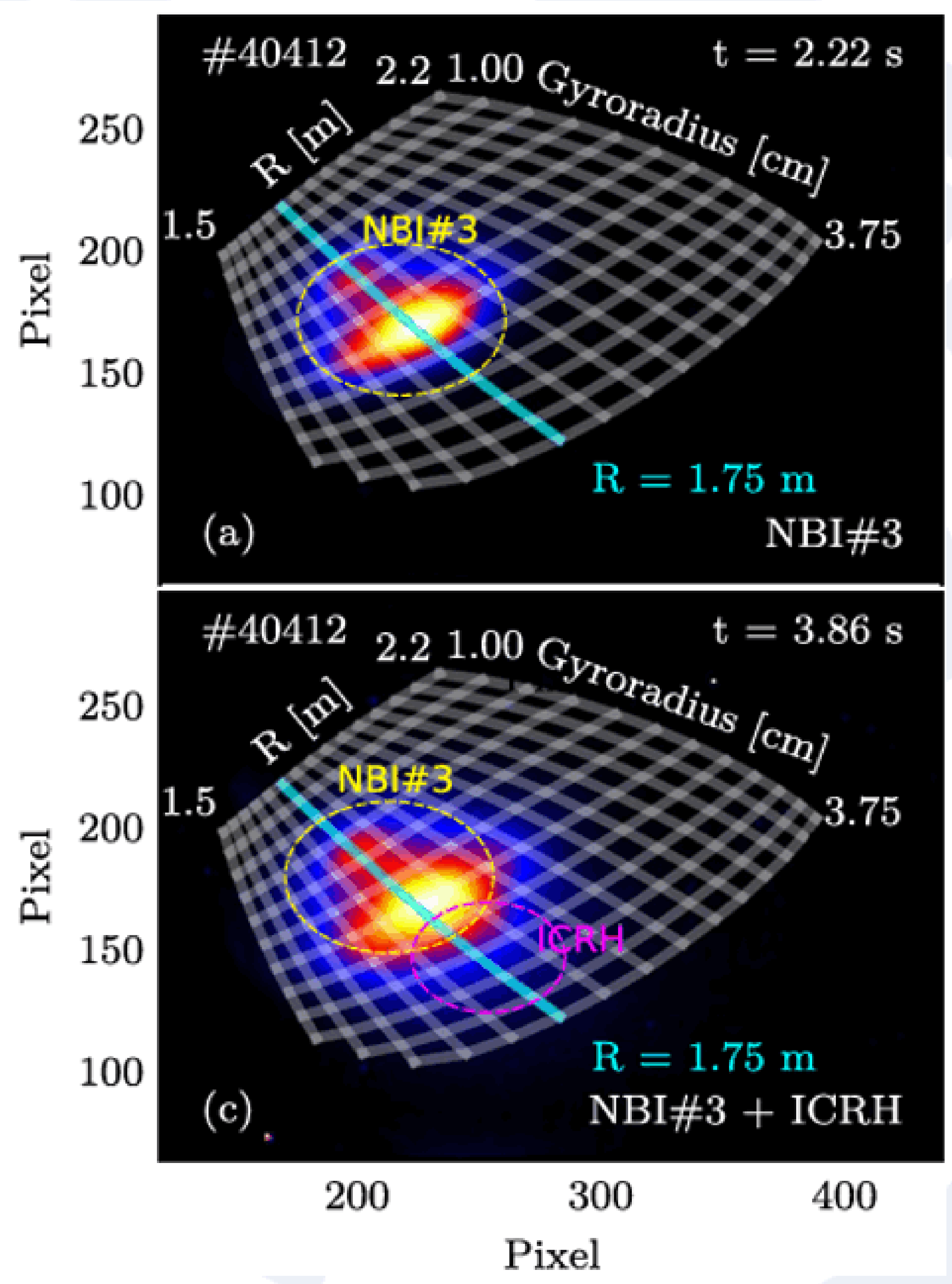
Experimental Strategy/Machine Constraints and essential diagnostics

- Reference scenario well established from WPTE 2021/22: ICRF driven TAEs w. counter-ECCD
- Scan NBI power and sources (for 2nd harmonic D heating)
- Monitor fast-ion distribution with whole suite of diagnostics: INPA, FIDA, FILDs, ICE, …

DIII-D INPA measurement vs simulation



AUG INPA signals including ICRF



Proposed pulses:

Device	# Pulses/Session	# Development
AUG	8	-

203: Investigation of phase-space flows induced by TAEs on ICRH heated plasmas

Proponents and contact person:

A. Reyner-Viñolas: alereyvinn@alum.us.es
(full list in the wiki)

Scientific Background and Objectives

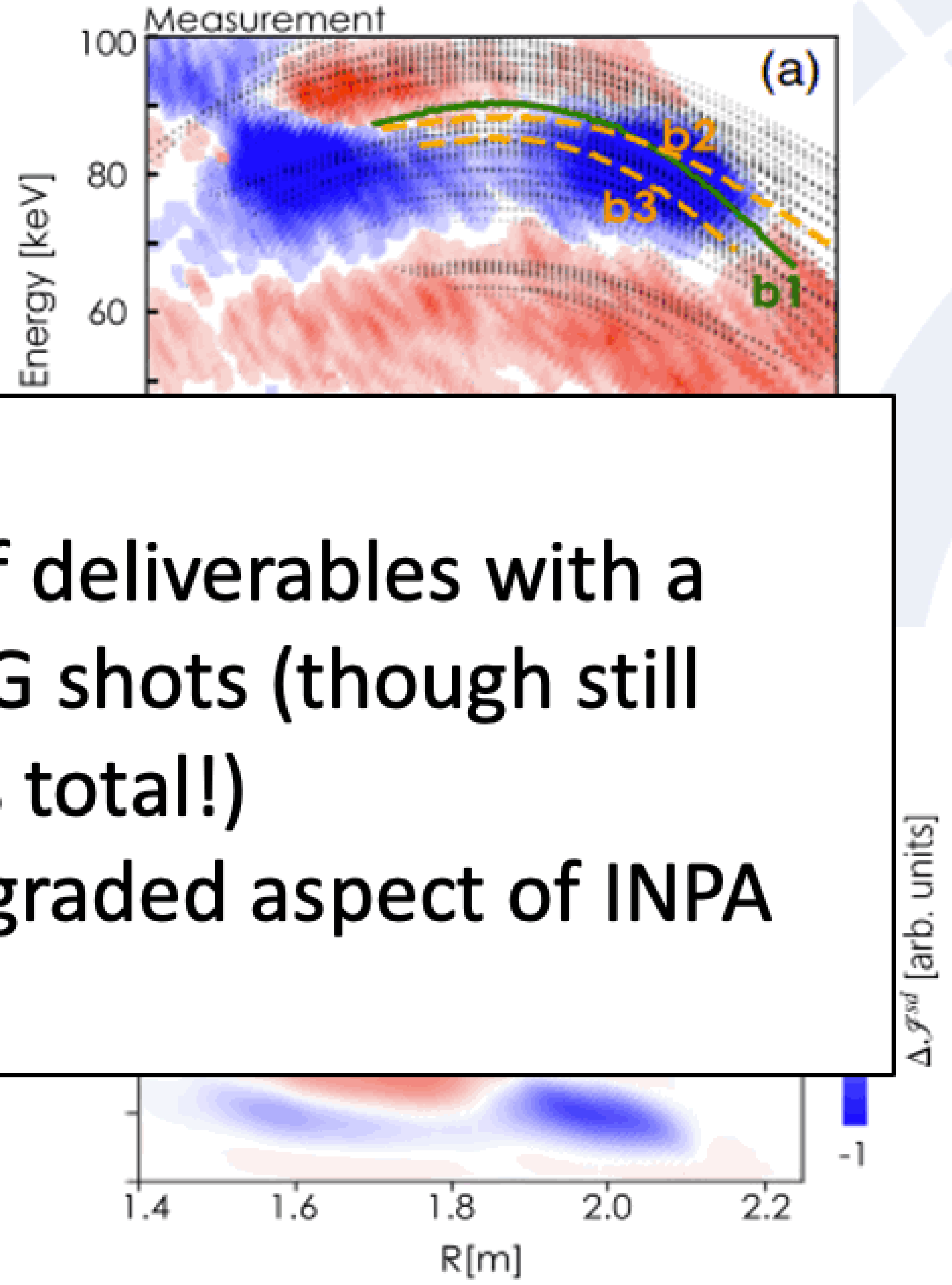
- **Background**: In DIII-D [X.Du PRL 2021] and AUG [J.Rueda NF 2024 … induced by TAEs …
- **Goal**: use **unique** … diagnostic to me… **populations** with…

Experimental Stra… essential diagnostics

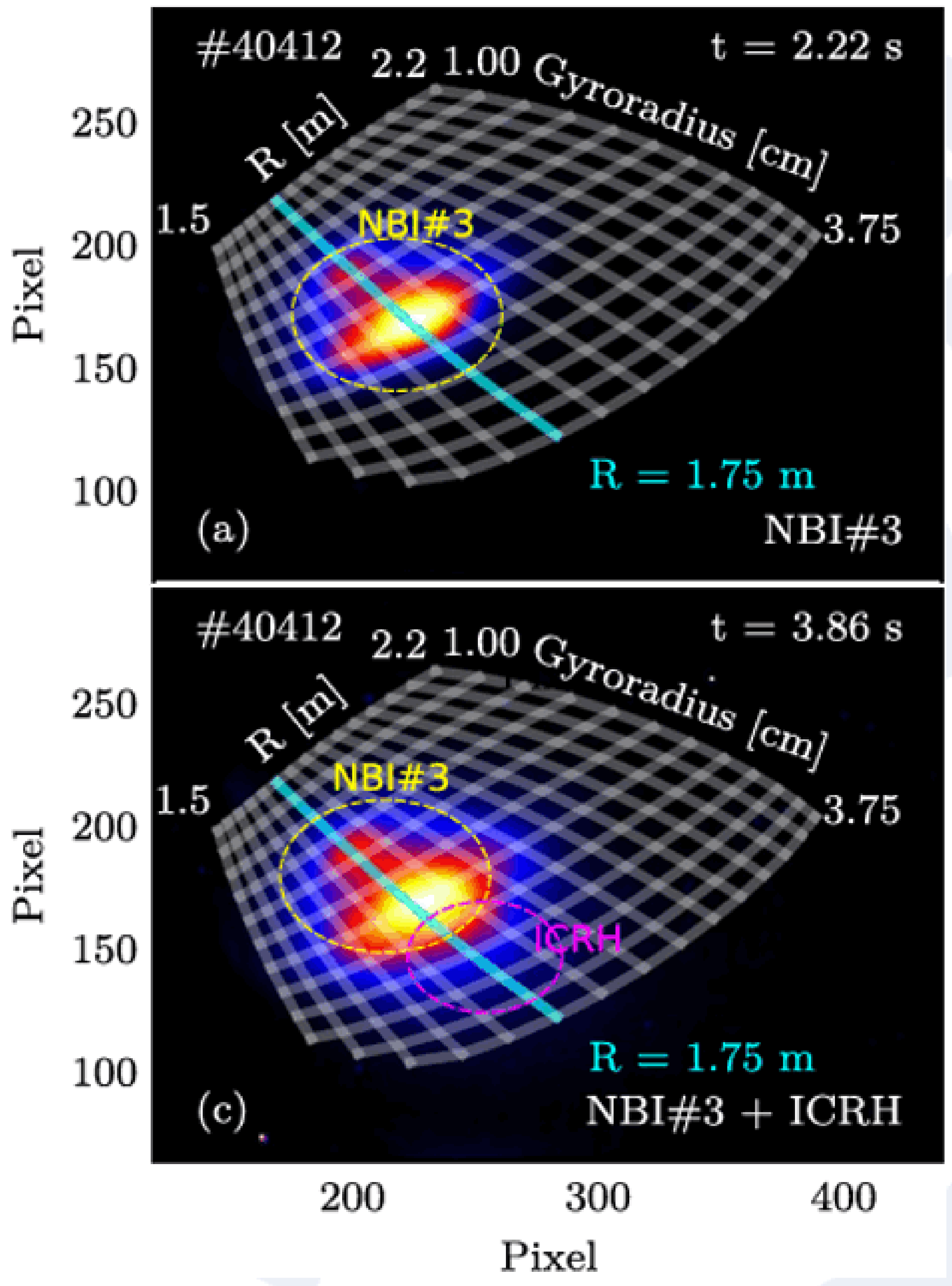
- Reference scenario well established from WPTE 2021/22: ICRF driven TAEs w. counter-ECCD
- Scan NBI power and sources (for 2nd harmonic D heating)
- Monitor fast-ion distribution with whole suite of diagnostics: INPA, FIDA, FILDs, ICE, …

- TFL assessment: P1
- Addresses a number of deliverables with a modest number of AUG shots (though still high proportion of RT's total!)
- also utilises unique upgraded aspect of INPA diag.

DIII-D INPA measurement vs simulation



AUG INPA signals including ICRF



Proposed pulses:

Device	# Pulses/Session	# Development
AUG	8	-

204: Optimization of active control of Alfvén Eigenmodes with externally applied 3D fields (P1-2025)

Proponents and contact person:

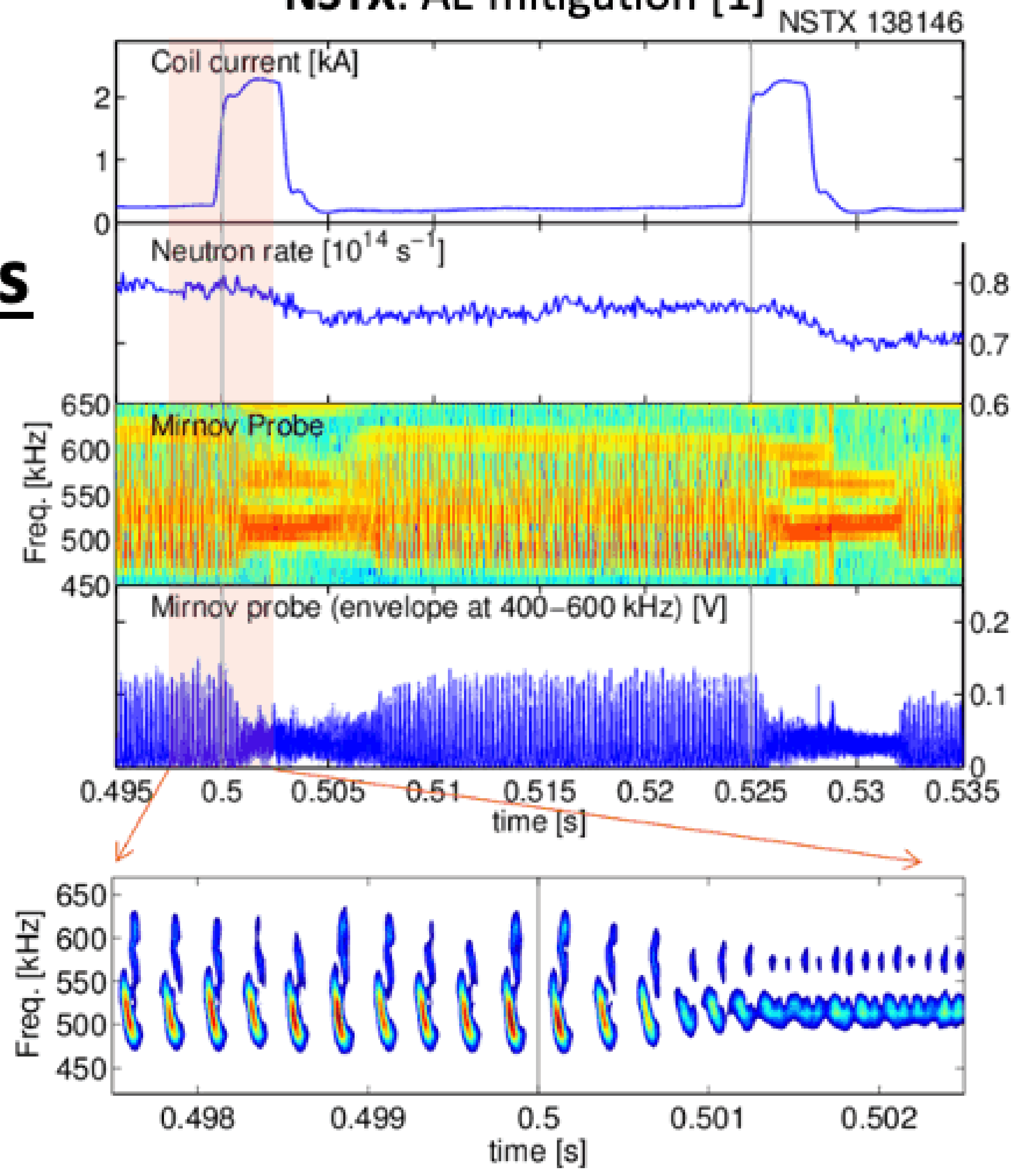
J. Gonzalez-Martin jgonzalez62@us.es
(full list in the wiki)

Scientific Background and Objectives

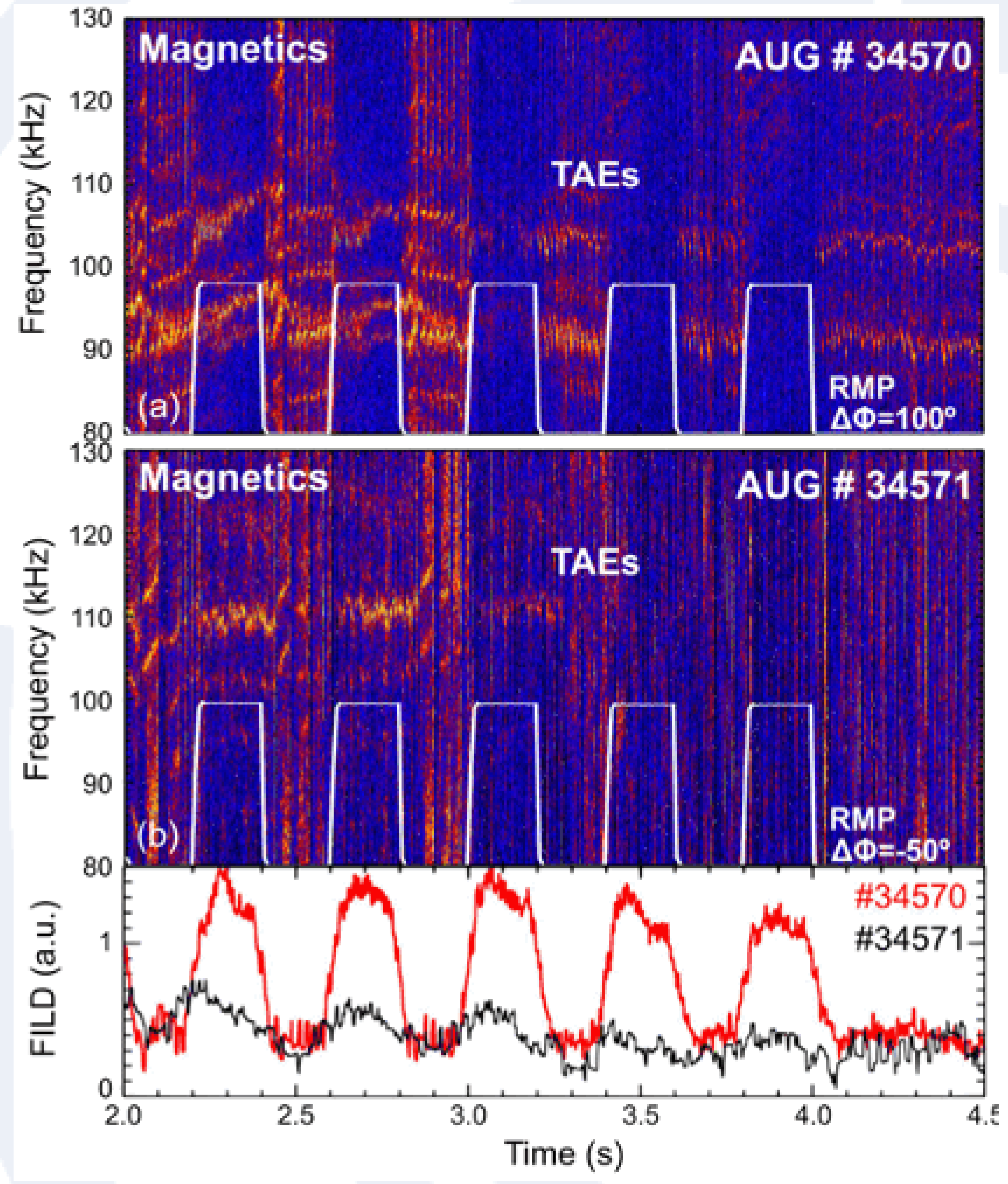
- ➢ Expand control towards ICRH-driven AEs and high frequency AEs
- ➢ Study impact on the global FI distribution

- In AUG:
- ➢ Control of high frequency AEs
- ➢ Control of ICRH-driven AEs
- In MAST-U:
- ➢ Control of high frequency AEs

NSTX: AE mitigation [1]



AUG: AE active control using n=2 [2]



Experimental Strategy/Machine Constraints and essential diagnostics

- ➢ FILD, FIDA, INPA, and other fast-ion diagnostics are essential
- ➢ In MU, special settings for IR thermography
- ➢ Scans in MP differential phase

Proposed pulses

Device	# Pulses/Session	# Development
MAST-U	18	5
AUG	20	5

[1] A. Bortolon et al., Phys. Rev. Lett (2013) [2] J. Gonzalez-Martin et al., Phys. Rev. Lett (2023)

204: Optimization of active control of Alfvén Eigenmodes with externally applied 3D fields

(P1-2025)

Proponents and contact person:

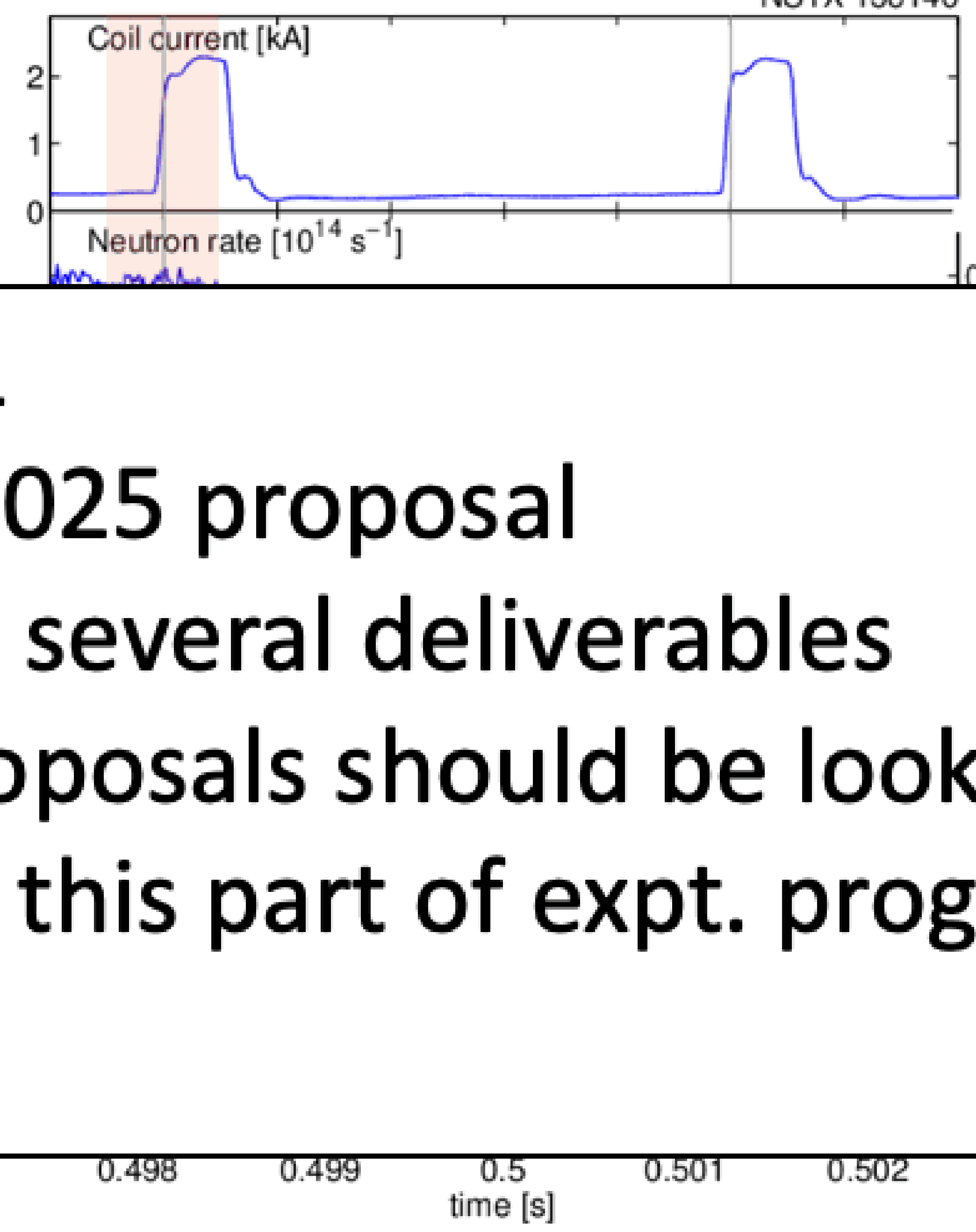
J. Gonzalez-Martin jgonzalez62@us.es
(full list in the wiki)

Scientific Background and Objectives

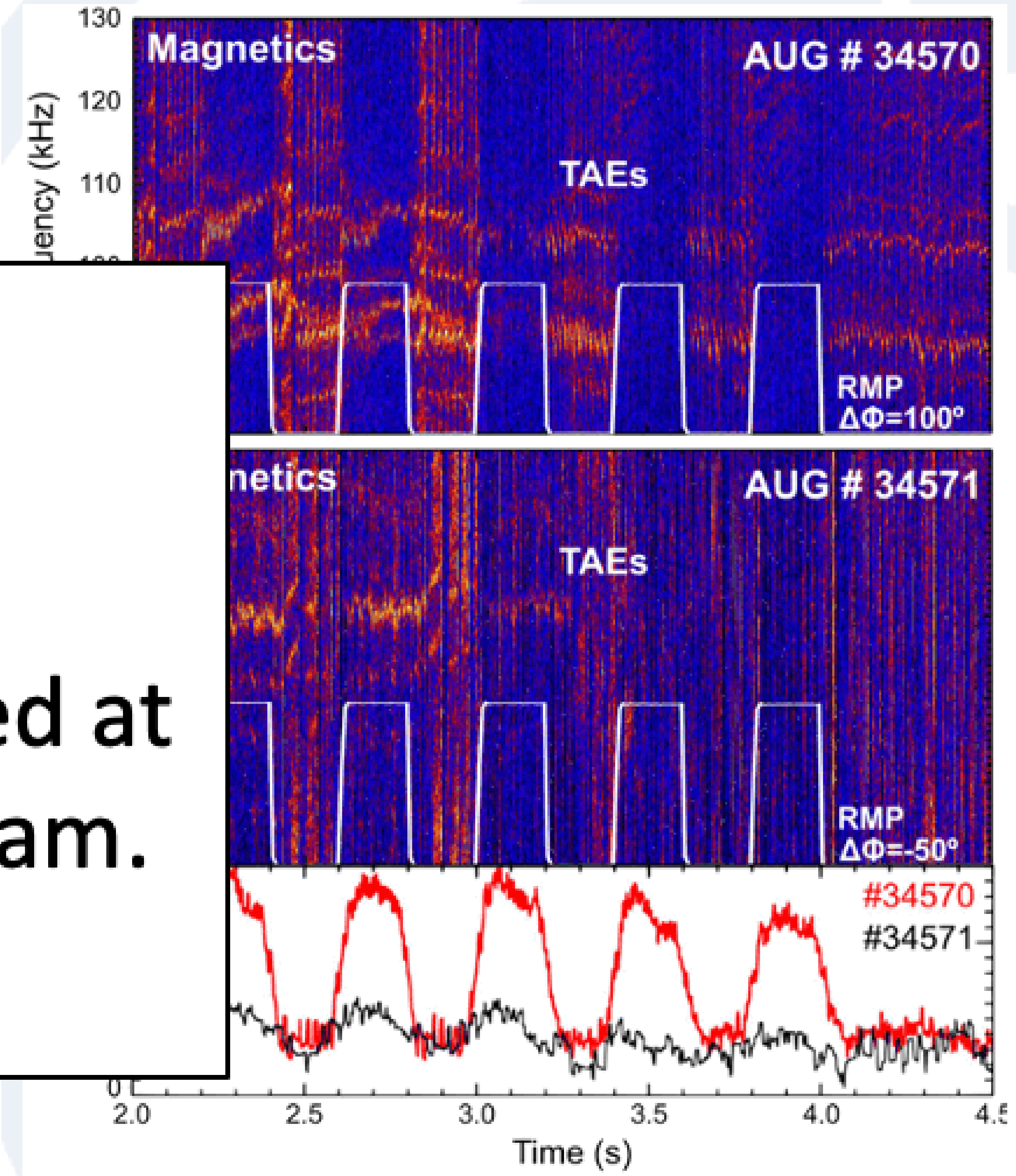
- ➢ Expand
  AEs and
- ➢ Study i
  distribu
- In AUG
- ➢ Control
- ➢ Control
- In MAST-U:
- ➢ Control of high frequency AEs

- TFL assessment: P1
- Re-submitted P1_2025 proposal
- Directly addressing several deliverables
- Partners P197 – proposals should be looked at jointly to construct this part of expt. program.

NSTX: AE mitigation [1]



AUG: AE active control using n=2 [2]



Experimental Strategy/Machine Constraints and essential diagnostics

- ➢ FILD, FIDA, INPA, and other fast-ion diagnostics are essential
- ➢ In MU, special settings for IR thermography
- ➢ Scans in MP differential phase

Proposed pulses

Device	# Pulses/Session	# Development
MAST-U	18	5
AUG	20	5

[1] A. Bortolon et al., Phys. Rev. Lett (2013) [2] J. Gonzalez-Martin et al., Phys. Rev. Lett (2023)

Priority ratings

Proposal #	Title	Priority rating
185	Fast-ion transport in real- and velocity-space in negative triangularity	1
186	Interplay between supra Alfvénic fast ions and Alfvén eigenmodes on TCV	2
187	Impact of Toroidal Alfvén Eigenmodes on Plasma Core Turbulence and Confinement	1
188	Investigation of fast-ion confinement in MHD active negative triangularity plasmas in TCV	1
189	Alfven Eigenmode mitigation and control by ECCD and ECRH in TCV	1
190	Characterization of neutral beam current drive in TCV	2
191	Investigation of high frequency Alfvén eigenmode properties in plasmas with ITER and DEMO relevant ion mixtures	1
192	Investigation of core ICE mode properties on TCV with ITER and JT-60SA relevant actuators	1
193	Investigation of stability and space structure of n=0 modes driven by energetic particles	2
194	RSAE activities in TCV	1
195	Transport and losses induced by high frequency Alfven Eigenmodes	1
196	Development of alpha-particle measurements on AUG in support of ITER rebaseline	1
197	Optimization of fast-ion confinement in tokamaks with externally applied 3D fields	1
198	Fast-ion losses induced by edge instabilities across different confinement regimes	PB
199	Effects of ICRF-generated fast-ions on core turbulence at different ion to electron fluxes	1
200	ICRF-generated fast-ion effects on the L-H transition	3
201	Study of runaway losses	-
202	Interplay of fast ions with MHD activity and ELMs	1
203	Investigation of fast-ion phase-space flows induced by TAEs in ICRH heated plasmas	1
204	Optimization of active control of Alfvén Eigenmodes with externally applied 3D fields	1

Initial grouping and pulse allocation

High level topics	Proposal #	Requested				1st suggested allocation			
		TCV	AUG	MAST-U	WEST	TCV	AUG	MAST-U	WEST
RMP studies	197, 204	0	44	49	0	0	6	30	0
NT studies	(185), 188	25	(6)	0	0	30	0	0	0
Interplay of AEs/FI (core/edge)	186, 189, (190/PB), 191 ,194, 195, 198, 202	165	59	27	0	40	0	10	0
ICRH/ECRH effects on plasma core turbulence/flow	187, 199, (200), 203	60	33	0	40	20	12	0	(10)
ICE	192	20	0	0	0	10	0	0	0
n=0 modes	193	45	0	0	0	0	0	0	0
Gamma measurements with Boron	196	0	32	0	0	0	12	0	0
Provisional 1st allocation						100	30	40	(10)
Total requested/factor		315	174	76	40	3.15	5.8	1.9	Inf

Analysis and Modelling needs

Together with participation proposals for executing experiments based on the presented proposals, analysis & modelling needs for the RT (list defined within the call documents) are as follow:

- Fast Ion Orbits, resonances and distribution function
  - E.g. ASCOT TRANSP/NUBEAM, Ebdyna
- Interpretive modelling
  - E.g. ASTRA, RAPTOR, ETS,…
- Improved/RT equilibrium
  - E.g. CLISTE, CHEASE, CREATE-NL
- Pedestal Stability
  - EPED,Europed,ELITE, MARS,..
- MHD stability and Nonlinear MHD, response to RMP
  - MHD(MISHKA, VMEC,…); Nonlinear(MEGA, JOREK,…); RMP(MARS-F, VMEC,…)
- Synthetic diagnostics and tomography
  - FIDASIM, FILDSIM, Velocity space tomography
- Core Gyrokinetic
  - E.g. GENE, GS2,…

Synergies with RT-15: High energy particle behaviour (JT-60SA)

- As will be presented later by Jeronimo, there are a number of synergies between RT-09 and RT-15
- JT-60SA OP2 expected ~mid 2026
  - JT-60SA experimental proposals not within scope of 2025 call
- TFLs recognise that some such work may include involvement with certain experiments on the WPTE devices
  - in such cases, participation bids to RT09 experimental work(supporting RT-15) will be considered
  - The links to RT-15 (or other RT where appropriate) should be made clear in the work-plan
- Any questions should be directed to relevant TFLs

Outstanding JET work

- From the recently reviewed publication plan a number of bids for completing JET analysis and publications are expected, at least from the indicated lead authors, in the following areas:
  - Synergistic FI effects in fusion plasmas
  - Optimizing ion heating in DT with 3-ion scheme
  - A&M of JET expts. with H-minority ICRH
  - FAR3D simulations of multiple FI populations
  - Summary of FI expts. with 3rd harmonic ICRH in DD and D 3He
  - High frequency RSAE effects in JET/projections to JT-60SA
- If you are lead/co – author on these your participation bid is expected
- If you wish to contribute to these but are not yet involved, please speak to the TFLs/RTCs and make a participation bid
- If you have intentions for other JET analysis work in support of RT09, please make the TFLs and RTCs aware of your intentions, the work to be done and the expected output (e.g. conference presentation/journal paper)