09 November 2026

RT-07 “Physics understanding of alternative divertor configurations as risk mitigation for DEMO”

Discussion on proposals and (re-)allocated priorities

A. Hakola

On behalf of WPTE TFLs
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Research Topic Coordinators
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Scientific Objectives and Machine Time

Scientific Objectives	
D1	Determine the characteristics for plasma exhaust and scenario control as well as core compatibility in H-mode for different alternative divertor configurations (ADCs)
D2	Characterize possible benefits of snowflake and other ADCs with multiple X-point configurations for their X-point radiation stability and dissipated power in H-mode
D3	Quantify the degree of heat load mitigation during ELMs and other transients, achieved by impurity seeding, and investigate their dependences on relevant machine parameters
D4	Evaluate existing reduced SOL models against ADCs and validate core-edge, SOL and divertor models of increasing complexity against experimental data, for divertor optimisation as well as plasma exhaust understanding and control

WPTE Grant Deliverables + Milestones and RT07 contribution

ID	Deliverables Table	Date
TE.D.16	Report on fully integrated simulation of high current partially detached plasma scenario including assessment of PFC erosion in D and DT plasma	Dec 2026
TE.D.17	Report on reduced model validation for plasma reattachment on multiple devices and wide operational space	Dec 2026
TE.D.18	Report on providing input on design and operation of conditioning systems for next step full W devices and focus on standard boronization systems	Dec 2026
TE.D.19	Report on qualification with experiment/modelling of the most promising no-ELM scenario in terms of confinement, exhaust capabilities and plasma wall interaction	Dec 2027
TE.D.20	Report on optimized scheme for “benign termination” of runaway beams documented in view of possible applicability for ITER	Dec 2027

ID	Milestones Table	Date
TE.M.09	Proper figure of merit for cross-scenario comparison among no-ELM / ADC defined	Dec 2026
TE.M.10	First wall particle and heat fluxes quantified in XPR in metallic devices	Dec 2026
TE.M.11	ADCs characterized in H-mode conditions in all relevant TE devices	Dec 2026
TE.M.12	Modelling of SPI experiment on JET and ASDEX-Upgrade completed	Dec 2027
TE.M.13	Impact of N-NBI on plasma behaviour documented in JT-60SA and extrapolation to ITER investigated	Dec 2027

Status of and forecast for the SSRLs of the objectives

		2025	Forecast after 2026
RT-07: Physics understanding of alternative divertor configurations as risk mitigation for DEMO	**D1:** Determine the characteristics for plasma exhaust and scenario control as well as core compatibility in H-mode for different alternative divertor configurations (ADCs)	Mature – needs underpinning	Mature – needs underpinning
	D2: Characterize possible benefits of snowflake and other ADCs with multiple X-point configurations for their X-point radiation stability and dissipated power in H-mode	Judgemental	Mature – needs underpinning
	D3: Quantify the degree of heat load mitigation during ELMs and other transients, achieved by impurity seeding, and investigate their dependences on relevant machine parameters	Exploratory	Judgemental
	D4: Evaluate existing reduced SOL models against ADCs and validate core-edge, SOL and divertor models of increasing complexity against experimental data, for divertor optimisation as well as plasma exhaust understanding and control	Judgemental	Judgemental

List of all proposals and their prioritization (GPM 2025)

Those labelled with P1-2027 (a year ago!) highlighted in light green

#	Title	Proponents	Priority
144	Impact of flux expansion on X-point radiator access and associated transport in ADCs in AUG	Ou Pan	P1-AUG-2026
161	Power sharing and transport in SF- configuration	Dominik Brida	P1-AUG-2026
162	AUG SF- configuration comparison between AUG and TCV	Dominik Brida	P1-AUG-2026, P1-TCV-2026
176	Super Compact Radiative Divertor at 1MA	Tilmann Lunt	P1-AUG-2026
177	Stability of the LFS SF- configuration during type-I ELMs	Tilmann Lunt	P1-AUG-2026/PB
150	Nitrogen seeding scan for far SOL detachment in SF- at AUG	Alessandro Mancini	P1-AUG-2026
151	Nitrogen seeding scan for XD power exhaust investigation at AUG	Alessandro Mancini	P1-AUG-2026
152	Detachment study with positive and negative Bt at AUG	Alessandro Mancini	P2-AUG
166	Study of detachment in L-Mode during systematic parameter sweep in ADCs	Felix Albrecht	P2-AUG
149	Slow ADC configuration scan at AUG	Alessandro Mancini	P2-AUG/PB
142	I-mode access in alternative divertor configurations in ASDEX Upgrade	Davide Silvagni	P2-AUG
143	High-radiative and detached I-mode in alternative divertor configuration in ASDEX Upgrade	Davide Silvagni	P1-AUG-2027
171	RMP effects on the access of detachment in super-x divertor and X-divertor configurations	Yunfeng Liang	P2-AUG, P2-MAST-U
145	Impact of the secondary X-point on the radial electric field in near SOL in SF- and super-CRD config.	Ou Pan	P2-AUG
147	Interplay between X-point separation and power fall-off length in ASDEX Upgrade	Michael Faitsch	P1-AUG-2026
146	Far SOL transport and its interaction with W wall in ADCs in AUG	Ou Pan	P1-AUG-2026
141	Burn throughs in ADC in Hydrogen in AUG	Matthias Willensdorfer	P2-AUG
167	ELM-resolved upper divertor profiles from spectroscopic measurements in ADCs at AUG	Hannah Lindt	P1-AUG-2027
170	Scrape-off layer fluctuation measurements in ADCs at AUG	William Fuller	P1-AUG-2026

List of all proposals and their prioritization (GPM 2025)

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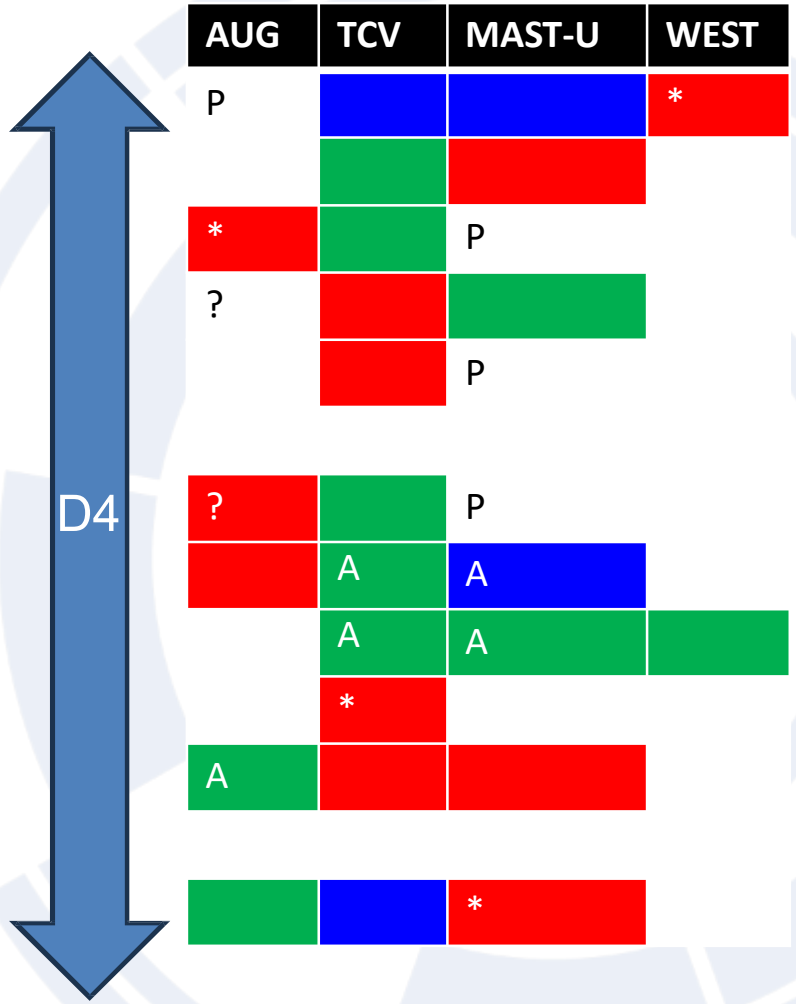
#	Title	Proponents	Priority
154	Optimization and Characterization of Power Exhaust at High Neutral Pressure in TCV's TBLLD	Benjamin Brown	P1-TCV-2026
155	Detachment Front Evolution in a Chimney-like Configuration	Benjamin Brown	P2-TCV
156	High power dissipation in TCV's Tightly-Baffled, Long-Legged Divertor (TBLLD)	Holger Reimerdes	P1-TCV-2026
164	Power and Fuelling transients in the TBLLD	Olivier Février	P1-TCV-2026
173	Characterisation of turbulence and transport in the TBLLD	Christian Theiler	P1-TCV-2026/PB
153	Characterization of turbulence in X-point radiator H-mode scenarios on TCV	Yinghan Wang	P1-TCV-2027/PB
157	Detachment in high-power NT scenarios leveraging ADCs on TCV	Garance Durr-Legoupil-Nicaud	P1-TCV-2027
168	Impact of secondary X-point radial distance from the separatrix on the X-point target performance	Massimo Carpita	P1-TCV-2027
159	High-power core-edge integrated scenarios for ADC exploration	Kevin Verhaegh	P1-MAST-U-2026
172	Impact of total flux expansion and divertor turbulence on PFR broadening	Peter Ryan	PB
158	Outer target optimisation through poloidal & total flux expansion	Kevin Verhaegh	P1-TCV-2026 P1-MAST-U-2026
160	Multi-machine study of power exhaust in the X-point target configuration	Kenneth Lee	P1-TCV-2026 P1-MAST-U-2026
165	Impurity transport in strongly baffled ADCs	Nicola Lonigro	P1-TCV-2027 P1-MAST-U-2026
174	Core-Divertor Integrated Power Exhaust Study with Impurities	Lingyan Xiang	P1-TCV-2026 P2-MAST-U
163	Effect of magnetic balance, divertor geometry, and fuelling/seeding location on radiation in DN plasmas	Nicola Lonigro	P1-WEST-2026 P2 others
148	ELM and transient buffering in ADCs of AUG, MAST-U, and TCV	Felix Albrecht	P1-AUG-2027 P1-TCV-2027 P2-MAST-U
175	Assess risk of reattachment during lost of DN magnetic balance in various ADCs for future reactors	Lingyan Xiang	P2
169	Dynamic response of ADCs to demonstrate reactor control & scenario integration benefits	Paulo Figueiredo	P1-AUG-2027 P1-TCV-2027 P1-MAST-U-2026

Grouping of proposals into different categories (review meeting 22.09.2026)

- Double-Null vs Single-Null — D2
- Optimisation of (longish) outer divertor (Rt, Fx, leg length) — D1
- Short-legged divertor scenarios (XD, CRD, sCRD, SF) — D1
- Assess X-Point Target (XPT) — D2
- ADC studies in negative triangularity (NT) — D1, D2

- Power sharing/dissipation with multiple X-point (short-leg SF) — D2
- SOL transport and widths in ADCs — D1
- Different roles of fueling, impurity seeding — D1, D2
- Assess the effect of tight baffling — D1, D3
- Transient buffering, dynamics & control and reattachment — D3

- Developments for high-power and H-mode ADC studies — D1-D3



P: Possible, but not envisaged
A: Analysis/(mostly) piggy back

Tentative priorities: (based on available data, capabilities, …)

High(est) *	High	Medium	Low	Not considered

Scientific Objectives and Machine Time

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Allocation of discharges (Prio 1* refers to prioritization in GPM 2025 in the highest category)

	AUG	TCV	MAST-U	WEST
Proposed / **Prio 1***	193 / **48 + 47**	404 / **203 + 147**	199 / **40**	32 / **32**
2026 Executed (up to Oct) /allocated	**11 / 35**	**179 / 231**	**39 / 48**	**17 / 15**
2027 allocated	**40** (up to summer break)	**110**	**0**	**0**

Main achievements in 2026 (up to now)

AUG

- **Super Compact Radiative divertor** (sCRD) successfully established with XPR upon applying N_2 seeding
- **I-mode detachment** achieved in the X-divertor configuration
- Detailed fluctuation characterizations in the far SOL and detachment onset scans completed in L-mode
- Heat loads measured in the **highly radiative snowflake (SF) configuration**

TCV

- **TBLLD experiments proceeding well**: high neutral pressures of >4 Pa measured
- **AUG/TCV comparison initiated** for SF^- comparison
- Detailed scans performed for X-Point Target (XPT) configuration and total/poloidal flux expansions in L-mode

MAST-U

- Deeply **detached Super-X configuration obtained in H-mode** with identical core and pedestal to an attached conventional divertor solution; benefits maintained at moderate shaping
- Demonstrated hybrid XPT + Super-X
- Lots of data on transients available or further analyses & modelling

WEST

- Detailed characterization of **XPR onset and dynamics in single null and double null**

Where to put the priorities in late 2026?

AUG

- Continue characterizing the **established ADCs at high plasma currents (up to 1 MA) and heating powers**
  - ✓ Restricted in early 2026 due to the missing flywheel generator EZ4
  - ✓ Focus on the short-legged scenarios
- Continue with the sessions that were **ready to fly already in July before the stop of the campaign**
  - ✓ #150 - Nitrogen seeding scan for far SOL detachment in SF- at AUG
  - ✓ #143 - High-radiative and detached I-mode in alternative divertor configuration in ASDEX Upgrade – complete the scans
  - ✓ #144 - Impact of flux expansion on X-point radiator access and associated transport in ADCs in AUG
- Proceed with **other topics labelled as P1-AUG-2026** – most likely will spill over into 2027
  - ✓ #151 - Nitrogen seeding scan for XD power exhaust investigation at AUG – **combine with #150**
  - ✓ #147 - Interplay between X-point separation and power fall-off length in ASDEX Upgrade
  - ✓ #161 - Power sharing and transport in SF- configuration
  - ✓ #177 - Stability of the LFS SF- configuration during type-I ELMs

TCV

- **TBLLD campaign with seeding incorporated, based on**
  - ✓ #165 - Impurity transport in strongly baffled ADCs
  - ✓ #174 - Core-Divertor Integrated Power Exhaust Study with Impurities

General guidelines for 2027

- **AUG:**
  - **Highest priority** – high-power H-mode studies at varying ELM frequencies including ELM buffering and ELM-free scenarios
    - ✓ Addresses D1 and D3
    - ✓ Expected to consume >50% of the available machine time → first goal to reach large type-I ELMs
    - ✓ In parallel proceed with SOLPS-ITER and EMC3-Eirene modelling (addresses D4)
  - **Second priority** – XPR in connection with ADCs and SF (addresses D2)
    - ✓ Subtopic AUG/TCV comparison in SF^- → work already initiated but scenarios turned out to be difficult
  - **Third priority** – low-power (L-mode) and far-SOL transport investigations → **also to be used as a backup**
    - ✓ Mainly leftover P1-AUG-2026 discharges, separate discussion for any P2-AUG program elements
- **TCV:**
  - **Highest priority** – high-power TBLLD program
    - ✓ Addresses mainly D1 but also D3
    - ✓ Proceed with SOLPS-ITER modelling in parallel (addresses D4)
    - ✓ Piggyback: shots with upgraded diagnostics (Fulcher measurements)
  - **Second priority** – TBLLD counterpart shots in the non-baffled phases, flux-expansion scans at the focus (D1 and D2)
    - ✓ Subtopic AUG/TCV comparison in SF^- (see above)
- **MAST-U and WEST**
  - Ongoing A&M, specific topic comparison between TCV TBLLD and MAST-U results
  - Finalize data analysis according to publication plan
- **Overarching points on modelling – questions to be addressed**
  - How to quantify the benefits of the proposed ADC solutions?
  - How to address core-edge coupling to keep the plasma performance in an acceptable level?

Main ingredients of the 2027 programme – detailed view
AUG specific proposals

#144: Impact of flux expansion on X-point radiator access and associated transport in ADCs in AUG

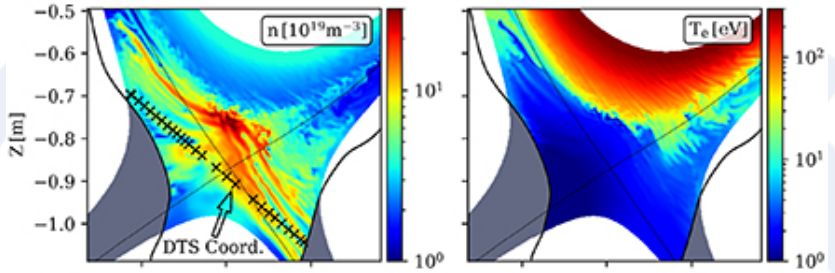
- **Proponents and contact person:**

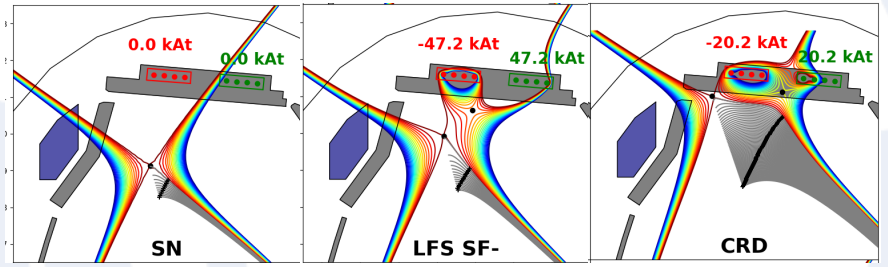
Ou Pan ou.pan@ipp.mpg.de, Y. C. Liang, M. Bernert, T. Lunt, B. Sieglin, D. Brida, M. Faitsch, S. Hörmann, G. Grenfell, F. Albrecht, M. Szücs, K. Eder, W. Fuller

- **Scientific Background & Objectives**
  - The XPR regime offers a promising solution to the power exhaust problem by combining divertor detachment with ELM mitigation. Analytical models [Stroth et al., NF 2022 / PPCF 2025] emphasize the role of magnetic flux expansion at the X-point in enabling XPR, and turbulence simulations [Eder et al., NF 2025] suggest enhanced radial transport structures in this region. It is therefore crucial to assess how X-point flux expansion affects XPR access, radiation efficiency, ELM mitigation thresholds, and transport, as well as its possible impact on confinement, using AUG's upper divertor with flexible configurations.
  - Compare XPR access conditions, ELM mitigation threshold and confinement performance in the XPR regime in ADCs with varying X-point flux expansion
  - Further refine and optimise the feedback control of the XPR position
  - Evaluate the maximum radiation fraction and the capability to withstand power transients with an XPR in ADCs
  - Diagnose edge modes and associated transport processes

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - A dedicated set of scenario development discharges is required to refine and optimize feedback control of the XPR position in the upper divertor.
  - In the upper SN divertor configuration, scan the XPR position until ELM suppression is achieved. Add a step of increasing heating power at the phase with maximum XPR height.
  - In LFS SF– divertor configurations, repeat the procedure with 2–3 different secondary X-point positions.
  - If the XPR position control is successfully developed in super-CRD, extend the procedure to this configuration.
  - Diagnostics: HEB, MEM, AXUV, TS, IR, LPs

[Eder et al., NF 2025]





Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	6

#144: Impact of flux expansion on X-point radiator access and associated transport in ADCs in AUG

- **Proponents and contact person:**

Ou Pan ou.pan@ipp.mpg.de, Y. C. Liang, M. Bernert, T. Lunt, B. Sieglin, D. Brida, M. Faitsch, S. Hörmann, Grenfell, F. Albrecht, M. Szücs, K. Eder, W. Fuller

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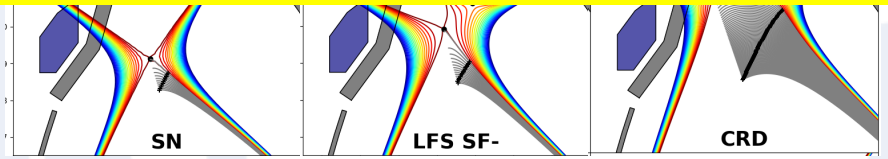
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  - Diagnostics: HEB, MEM, AXUV, TS, IR, LPs

P1-AUG-2026

At the heart of the set RT-07 priorities, will have synergy with RT-05

Update GPM 2026:

Extend the studies to high powers in type-I ELMy H-mode conditions



Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	6

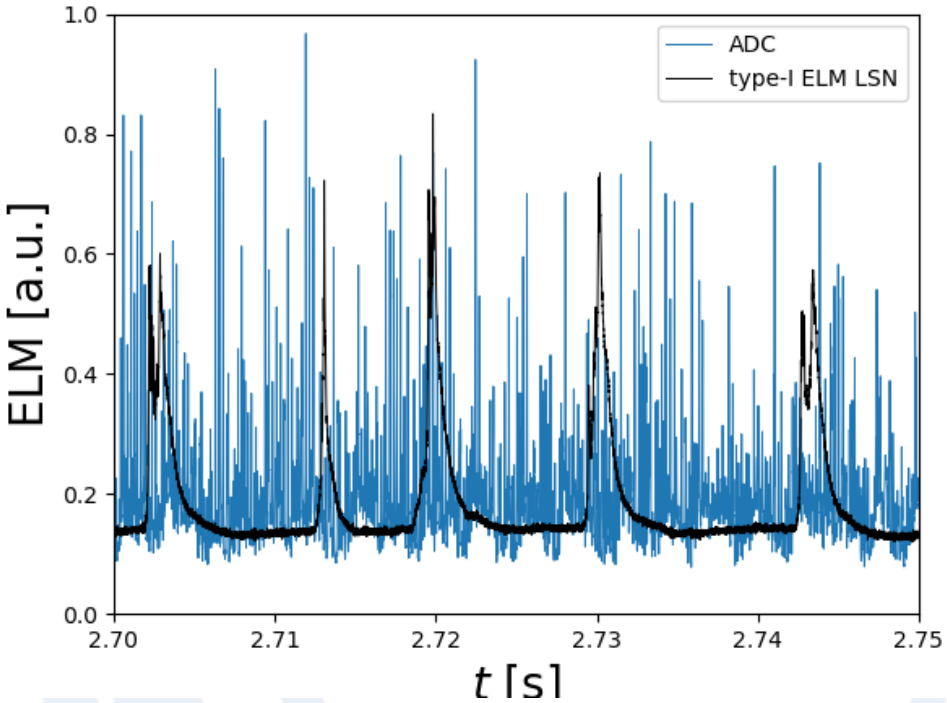
#177: Stability of the LFS SF- configuration during type-I ELMs

- **Proponents and contact person:**

tilmann.lunt@ipp.mpg.de

- **Scientific Background & Objectives**
  - Most (all?) of the ADC discharges in AUG in a small-ELM (QCE?) regime
  - This proposal aims at studying the LFS SF-configuration in a type-I ELM regime

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Develop type-I ELM regime in ADC trying the following options
  - Use the FoA gas valves in AUG to puff in the PFR (as opposed to the FoB used so far)
  - Operate just slightly above H-mode threshold, where ELMs are typically large
  - Moving the primary X-point (i.e. varying elongation and triangularity)
  - Acquire high quality edge profiles with the full-set of edge diagnostics (LP, IR, bolometry, spectroscopy, He-beam, TS and DTS, …)



Proposed pulses

Device	# Pulses/Session	# Development
AUG	8	2

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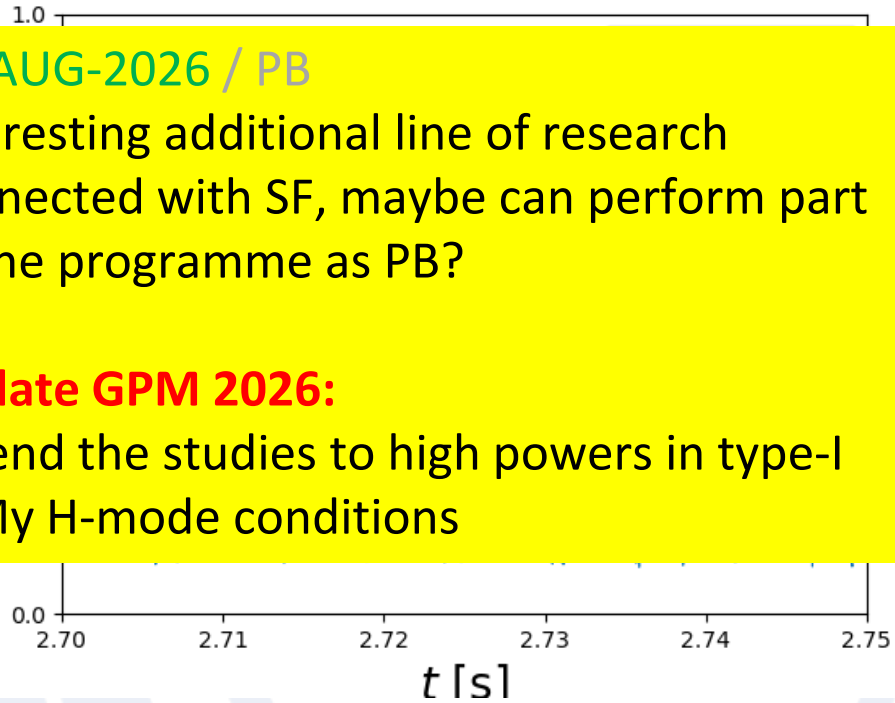
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P1-AUG-2026 / PB

Interesting additional line of research connected with SF, maybe can perform part of the programme as PB?

Update GPM 2026:

Extend the studies to high powers in type-I ELMy H-mode conditions



Proposed pulses

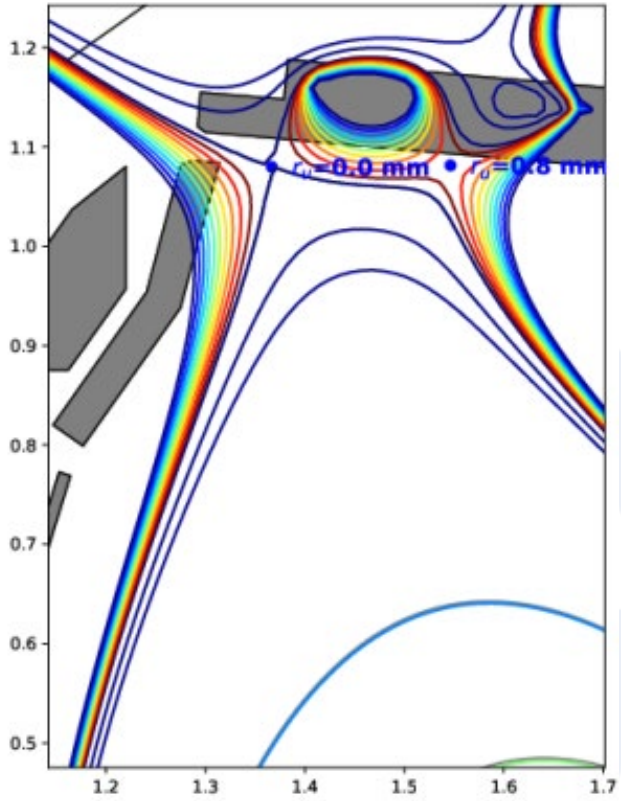
Device	# Pulses/Session	# Development
AUG	8	2

#176: Super CRD configuration at 1MA

- **Proponents and contact person:**

tilmann.lunt@ipp.mpg.de

- **Scientific Background & Objectives**
  - Establish the ‘super compact radiative divertor’ configuration at I_P=1MA
  - Compare the far-SOL heat fluxes to reference discharges at I_P=600 and 800 kA to test the dependence on the ratio of λ_q to the radial extension of the XPR volume Δr_{uXPR}
  - Measure heat and particle fluxes with IR and LP
  - Acquire high quality bolometry and spectroscopy data in the divertor volume
  - Identify the ELM regime (type I,II or II, QCE, …)
  - Test the robustness by varying the discharge conditions (density, puffing and seeding levels and positions,…)



Proposed pulses

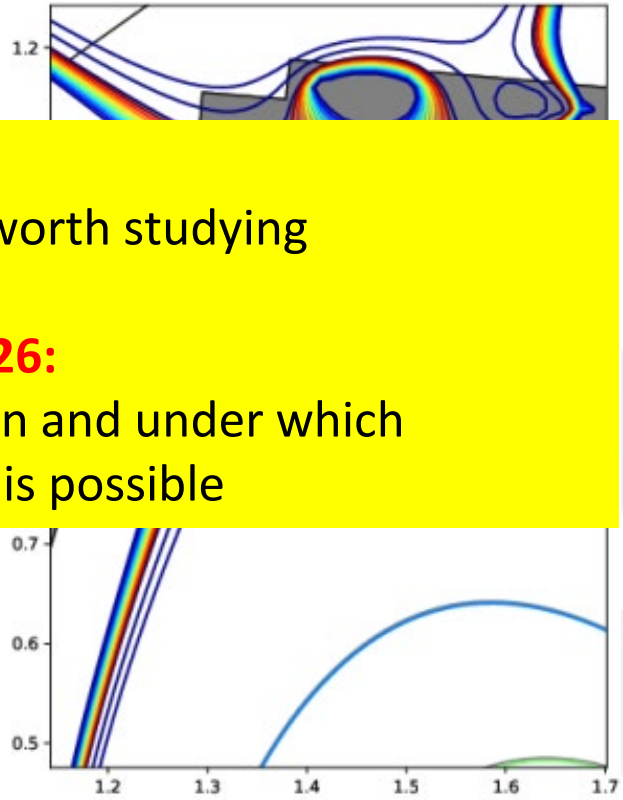
Device	# Pulses/Session	# Development
AUG	12	8

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  - Test the robustness by varying the discharge conditions (density, puffing and seeding levels and positions,…)



P1-AUG-2026

sCRD identified worth studying

Update GPM 2026:

Depends on when and under which conditions 1 MA is possible

Proposed pulses

Device	# Pulses/Session	# Development
AUG	12	8

#167: ELM-resolved upper divertor profiles from spectroscopic measurements in ADCs at AUG

- **Proponents and contact person:**
  - H. Lindl (Hannah.Lindl@ipp.mpg.de) et al.
- **Scientific Background & Objectives**

  With our upper divertor spectroscopic setup, we can measure radially resolved electron densities, electron and ion temperatures, drift velocities and impurity ion densities with a time resolution down to 2.4 ms. By measuring at low ELM repetition frequencies (vELM ~100 Hz), we want to obtain multiple measurement points in the inter-ELM phase and thereby gain information about inter-ELM transport, impurity behavior, and the detachment onset in ADCs at AUG.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - X-Divertor configuration at Ip=1MA, Bt = 2.5T, high triangularity
  - Sweep of Pheat (NBI/ECRH) to find minimum ELM repetition frequency at tolerable heat loads (1# + 2# backup)
  - Scan of N seeding/D fueling to observe attachment-detachment transition spectroscopically (1# + 1# backup)
  - Repetition in conventional USN configuration to study impact of flux expansion (1# + 1# backup)
  - Repeated measurements of higher ionization nitrogen lines to determine seeding impurity ion density (4# + 1#backup)
  - Essential diagnostics: Upper divertor spectroscopy, Langmuir probes, Thomson scattering, bolometry

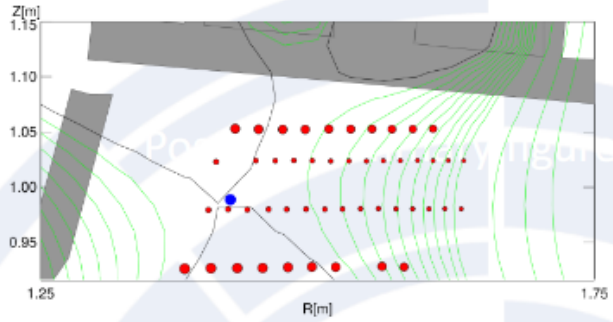


Fig. 1: Spectrometer measurement positions in the upper divertor volume.

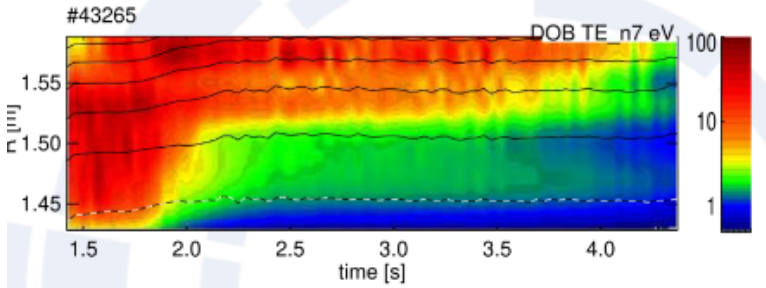


Fig. 2: Exemplary Te profile and time evolution of a N scan. The detachment onset can be seen around 2s. The separatrix position is indicated by the dashed line.

Proposed pulses

Device	# Pulses/Session	# Development
AUG	12	6

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- **Proponents and contact person:**
  - H. Lindl (Hannah.Lindl@ipp.mpg.de) et al.
- **Scientific Background & Objectives**

  With our upper divertor spectroscopic setup, we can measure radially resolved electron densities, electron and ion temperatures, drift velocities and impurity ion densities with a time resolution down to 2.4 ms. By measuring at low ELM repetition frequencies (vELM ~100 Hz), we want to obtain multiple measurement points in the inter-ELM phase and thereby gain information about inter-ELM transport, impurity behavior, and the detachment onset in ADCs at AUG.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - X-Divertor configuration at Ip=1MA, Bt = 2.5T, high triangularity
  - Sweep of Pheat (NBI/ECRH) to find minimum ELM repetition frequency at tolerable heat loads (1# + 2# backup)
  - Scan of N seeding/D fueling to observe attachment-detachment transition spectroscopically (1# + 1# backup)
  - Repetition in conventional USN configuration to study impact of flux expansion (1# + 1# backup)
  - Repeated measurements of higher ionization nitrogen lines to determine seeding impurity ion density (4# + 1#backup)
  - Essential diagnostics: Upper divertor spectroscopy, Langmuir probes, Thomson scattering, bolometry

P1-AUG-2027

The proposal utilizes a new diagnostics and would provide valuable data, to be scheduled after the P1-2026 proposals

Update GPM 2026:

Essential part of the program where the role of ELM frequency is to be characterized

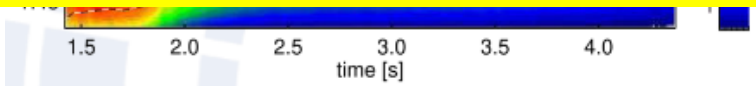


Fig. 2: Exemplary Te profile and time evolution of a N scan. The detachment onset can be seen around 2s. The separatrix position is indicated by the dashed line.

Proposed pulses

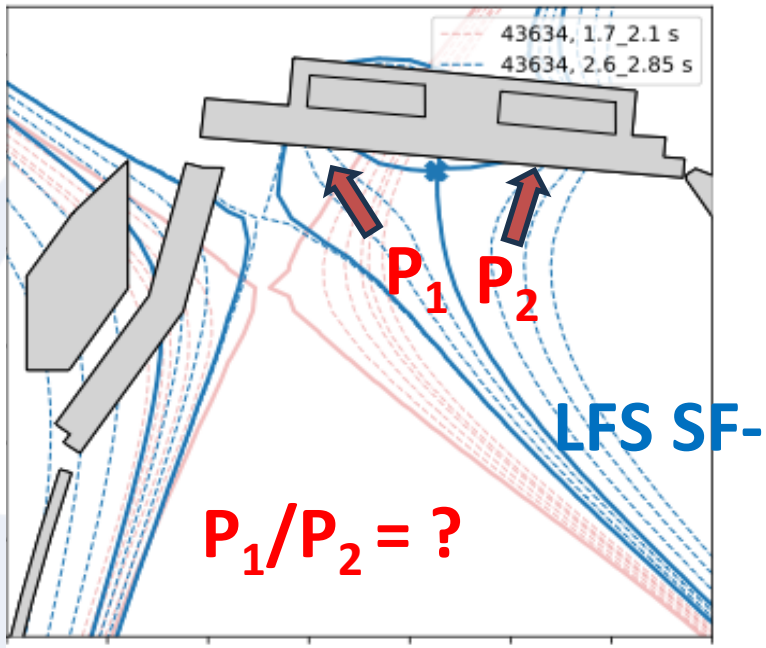
Device	# Pulses/Session	# Development
AUG	12	6

#161: Power sharing and transport in LFS SF-

- **Proponents and contact person:**

dominik.brida@ipp.mpg.de

- **Scientific Background & Objectives**
  - Access low density attached SF- configuration in H-mode, while keeping the peak heat flux within safe limits.
  - Scan secondary X-point configuration (primary X-point distance ru,x2)
  - Obtain good IR heat flux profiles (additionally good LP, DTS and upstream profiles highly desired)
  - Analyse the data to characterise power sharing between strike-points.



Proposed pulses

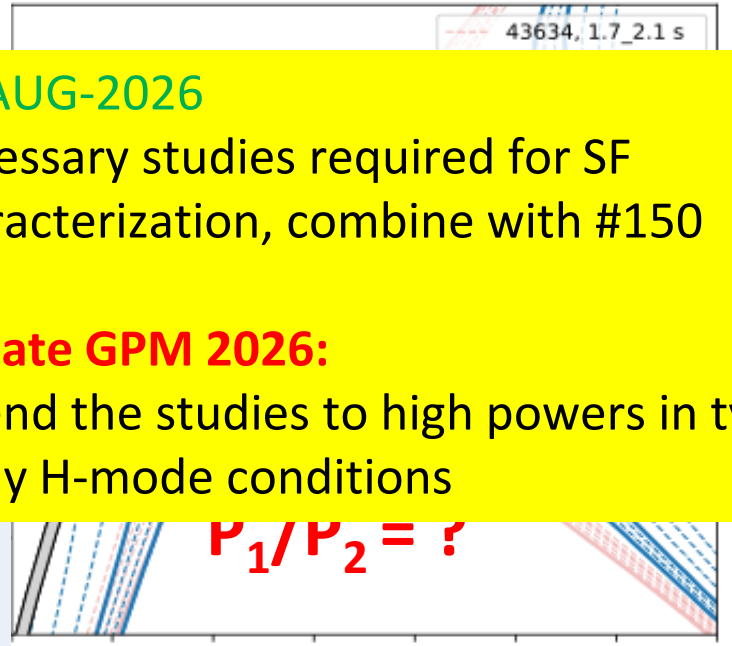
Device	# Pulses/Session	# Development
AUG	10	0

#161: Power sharing and transport in LFS SF-

- **Proponents and contact person:**

dominik.brida@ipp.mpg.de

- **Scientific Background & Objectives**
  - Access low density attached SF- configuration in H-mode, while keeping the peak heat flux within safe limits.
  - Scan secondary X-point configuration (primary X-point distance ru,x2)
  - Obtain good IR heat flux profiles (additionally good LP, DTS and upstream profiles highly desired)
  - Analyse the data to characterise power sharing between strike-points.



P1-AUG-2026

Necessary studies required for SF characterization, combine with #150

Update GPM 2026:

Extend the studies to high powers in type-I ELMy H-mode conditions

Proposed pulses

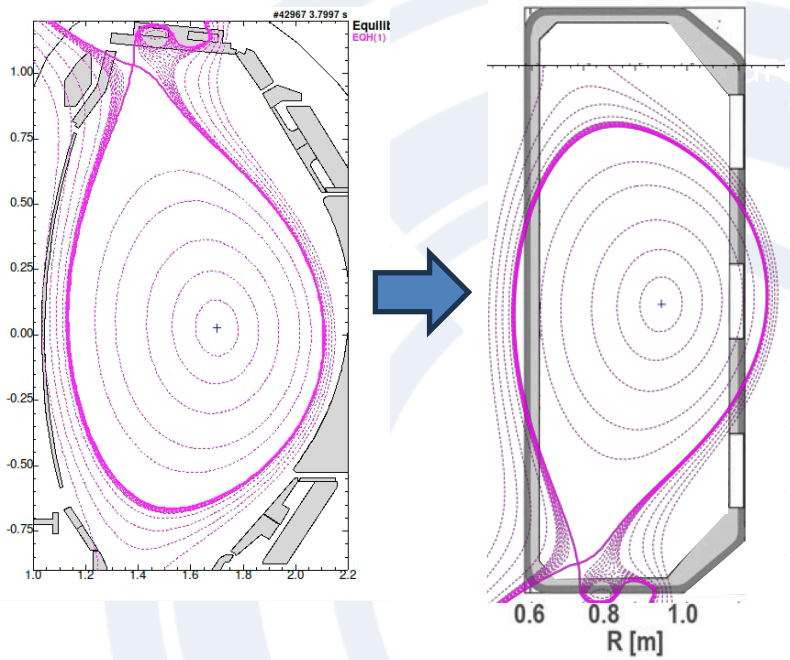
Device	# Pulses/Session	# Development
AUG	10	0

#162: AUG LSF SF- similarity experiments in AUG and TCV

- **Proponents and contact person:**

dominik.brida@ipp.mpg.de

- **Scientific Background & Objectives**
- Compare the detachment behavior in AUG and TCV in an AUG-SF⁻ similar divertor configuration.
- Determine whether the detachment behavior in the resulting configuration in TCV is more SF- or XPT-like.
- Investigate the effect of changes to the configuration such as strike-line orientation relative to the divertor target (which cannot be easily done AUG)



Proposed pulses

Device	# Pulses/Session	# Development
AUG	3	3
TCV	7	5

#162: AUG LSF SF- similarity experiments in AUG and TCV

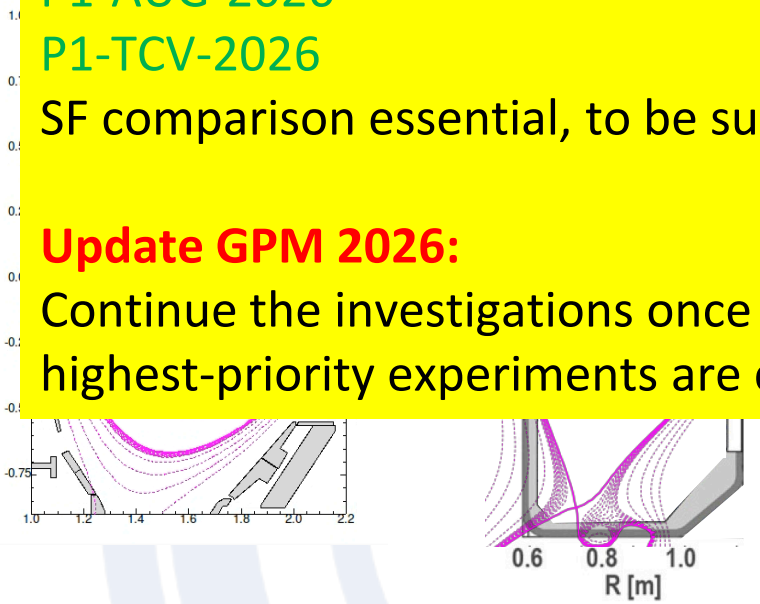
- **Proponents and contact person:**

dominik.brida@ipp.mpg.de

- **Scientific Background & Objectives**
- Compare the detachment behavior in AUG and TCV in an AUG-SF$^-$ similar divertor configuration.
- Determine whether the detachment behavior in the resulting configuration in TCV is more SF- or XPT-like.
- Investigate the effect of changes to the configuration such as strike-line orientation relative to the divertor target (which cannot be easily done AUG)

P1-AUG-2026
P1-TCV-2026
SF comparison essential, to be supported

Update GPM 2026:
Continue the investigations once the highest-priority experiments are completed



Proposed pulses

Device	# Pulses/Session	# Development
AUG	3	3
TCV	7	5

#150: Nitrogen seeding scan for far SOL detachment in LFS SF- at AUG

- **Proponents and contact person:**

A. Mancini (alessandro.mancini@ipp.mpg.de) et al.

- **Scientific Background & Objectives**

  During the last AUG experimental campaign it was found that the outer far SOL of LFS SF- configuration is difficult to detach, producing high heat loads on the divertor target. The aim of this proposal is to use N seeding ramps with LFS SF- at AUG to assess if and at what seeding rate the far SOL detaches.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Start from a SF- configuration with 0.8 MA/2.5 T and perform a nitrogen seeding scan. Repeat with increased heating power [2# + 1# backup]
  - repeat with increased plasma current [2# + 1# backup]

  Therefore 6 shots are requested for physical investigation.

  The analysis requires bolometric and Langmuir probes measurements to observe detachment.

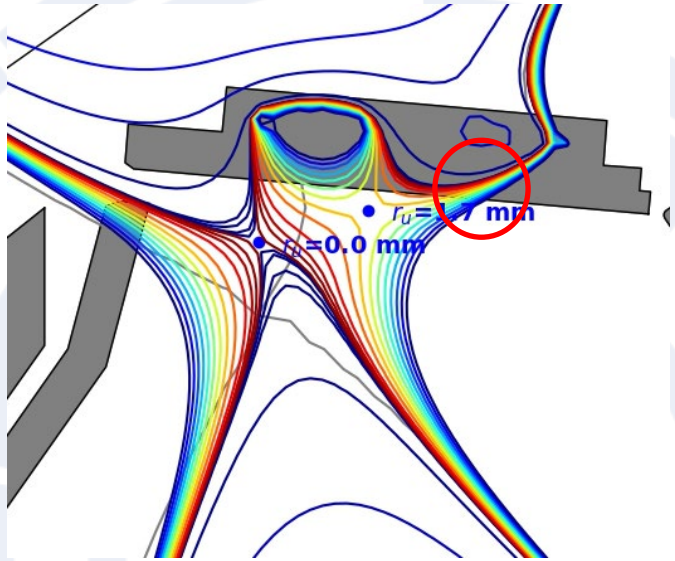


Fig. 1: LFS SF- with far SOL highlighted in red

Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	

#150: Nitrogen seeding scan for far SOL detachment in LFS SF- at AUG

- **Proponents and contact person:**

A. Mancini (alessandro.mancini@ipp.mpg.de) et al.

- **Scientific Background & Objectives**

  During the last AUG experimental campaign it was found that the outer far SOL of LFS SF- configuration is difficult to detach, producing high heat loads on the divertor target. The aim of this proposal is to use N seeding ramps with LFS SF- AUG to assess if and at what seeding rate the far SOL detaches.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Start from a SF- configuration with 0.8 MA/2.5 T and perform a nitrogen seeding scan. Repeat with increased heating power [2# + 1# backup]
  - repeat with increased plasma current [2# + 1# backup]

  Therefore 6 shots are requested for physical investigation.
  The analysis requires bolometric and Langmuir probes measurements to observe detachment.

P1-AUG-2026

Impact of N seeding need to be studied, combine with #161

Update GPM 2026:

Assume either being covered in 2026 or promote together with the previous two proposals



Fig. 1: LFS SF- with far SOL highlighted in red

Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	

#151: Nitrogen seeding scan for XD power exhaust investigations at AUG

- **Proponents and contact person:**

A. Mancini (alessandro.mancini@ipp.mpg.de) et al.

- **Scientific Background & Objectives**

  The strength of the XD configuration is the volume with increased flux expansion close to the divertor target (see Fig. 1). This volume is of particular importance since it provides longer magnetic connection length, spreading of the heating power and enhanced radiative cooling. The aim of this proposal is to study the radiative exhaust capability and detachment characteristics of the XD configuration. Particular attention is posed to where EM radiation is produced and to the detachment front tracking. The behaviour is investigated at different heating powers and λ_q.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Develop a close-to-ideal XD configuration, if not previously done by other proposals [2# scenario development]
  - Start from a XD configuration with 0.8 MA/2.5 T and perform a nitrogen seeding scan. Repeat with increased heating power [2# + 1# backup]
  - repeat with increased plasma current [2# + 1# backup]

  Therefore 8 shots are requested: 6 for physical investigation, 2 for scenario development.
  The analysis requires bolometric and Langmuir probes measurements.

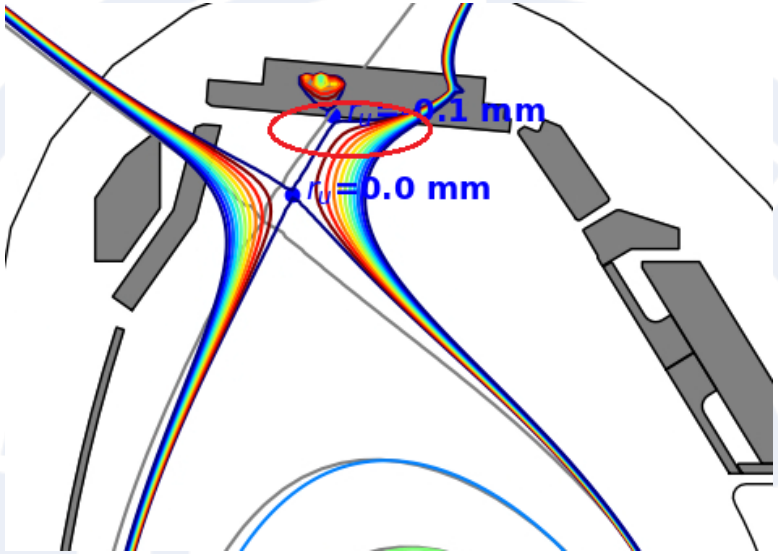


Fig. 1: XD with target volume highlighted in red

Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	2

#151: Nitrogen seeding scan for XD power exhaust investigations at AUG

- **Proponents and contact person:**

A. Mancini (alessandro.mancini@ipp.mpg.de) et al.

- **Scientific Background & Objectives**

The strength of the XD configuration is the volume with increased flux expansio close to the divertor target (see Fig. 1). This volume is of particular importance since it provides longer magnetic connection length, spreading of the heating power and enhanced radiative cooling. The aim of this proposal is to study the radiative exhaust capability and detachment characteristics of the XD configuration. Particular attention is posed to where EM radiation is produced and to the detachment front tracking. The behaviour is investigated at different heating powers and λ_q.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Develop a close-to-ideal XD configuration, if not previously done by other proposals [2# scenario development]
  - Start from a XD configuration with 0.8 MA/2.5 T and perform a nitrogen seeding scan. Repeat with increased heating power [2# + 1# backup]
  - repeat with increased plasma current [2# + 1# backup]

Therefore 8 shots are requested: 6 for physical investigation, 2 for scenario development. The analysis requires bolometric and Langmuir probes measurements.

P1-AUG-2026

Also in XD configuration seeding studies part of fundamental characterization

Update GPM 2026:

Address together with #150

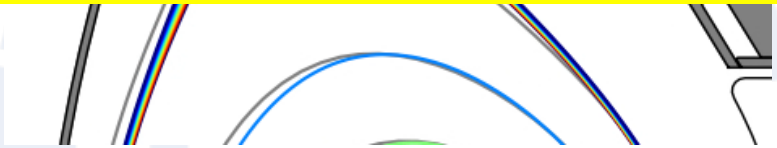


Fig. 1: XD with target volume highlighted in red

Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	2

#143: High-radiative and detached I-mode plasmas in alternative divertor configuration in ASDEX Upgrade

- **Proponents and contact person:**

D. Silvagni (davide.silvagni@ipp.mpg.de), O. Grover, A. Hubbard, … (full list in wiki)

- **Scientific Background & Objectives**

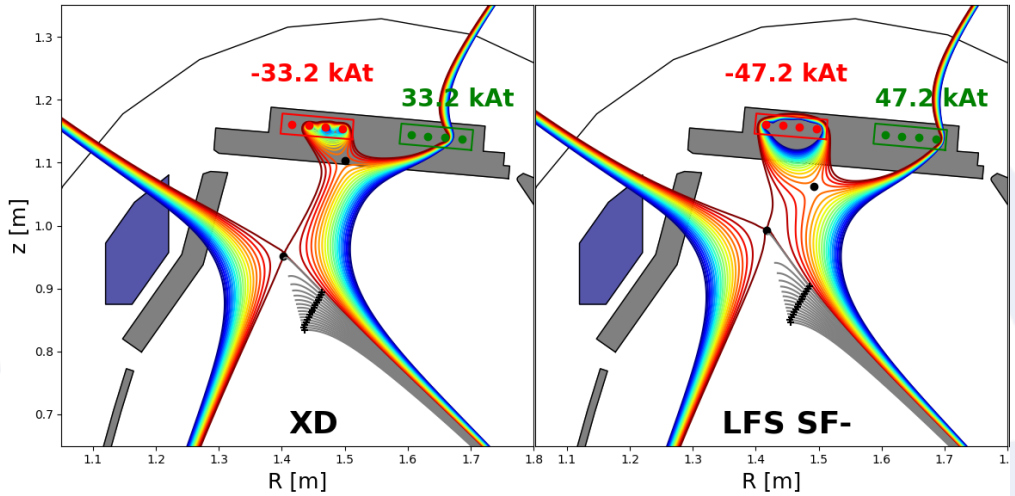
I-mode compatibility with divertor detachment and high-radiation fractions of uttermost importance for DEMO. ADC could facilitate detachment achievement, and allow high-radiation fraction in the SOL in I-mode plasmas. This proposal aims at obtaining a high-radiative and detached I-mode scenario in an ADC with nitrogen seeding.

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

For the most promising I-mode scenario in terms of divertor configuration and density level (determined in this proposal WPTE wikipages: Call for proposals 2026: RT07 proposals:I-mode ADC):

- Apply nitrogen seeding at different constant seeding rates (four levels), while keeping required beta_pol constant [4]
- If I-L back-transition occurs, apply nitrogen seeding at different seeding rates with linear ramp in beta_pol, i.e. with an increase in heating power (successful strategy in previous single null experiments) [4]
- Optimize nitrogen seeding and required beta_poloidal trajectories, in order to get a stable, detached, high-radiative I-mode plasmas [1]

Therefore 9 shots in total.



Proposed pulses

Device	# Pulses/Session	# Development
AUG	9	

#143: High-radiative and detached I-mode plasmas in alternative divertor configuration in ASDEX Upgrade

- **Proponents and contact person:**

D. Silvagni (davide.silvagni@ipp.mpg.de), O. Grover, A. Hubbard, … (full list in wiki)

- **Scientific Background & Objectives**

I-mode compatibility with divertor detachment and high-radiation fractions of uttermost importance for DEMO. ADC could facilitate detachment achievement, and allow high-radiation fraction in the SOL in I-mode plasmas. This proposal aims at obtaining a high-radiative and detached I-mode scenario in an ADC with nitrogen seeding.

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

For the most promising I-mode scenario in terms of divertor configuration and density level (determined in this proposal WPTE wikipages: Call for proposals 2026: RT07 proposals:I-mode ADC):

- Apply nitrogen seeding at different constant seeding rates (four levels), while keeping required beta_pol constant [4]
- If I-L back-transition occurs, apply nitrogen seeding at different seeding rates with linear ramp in beta_pol, i.e. with an increase in heating power (successful strategy in previous single null experiments) [4]
- Optimize nitrogen seeding and required beta_poloidal trajectories, in order to get a stable, detached, high-radiative I-mode plasmas [1]

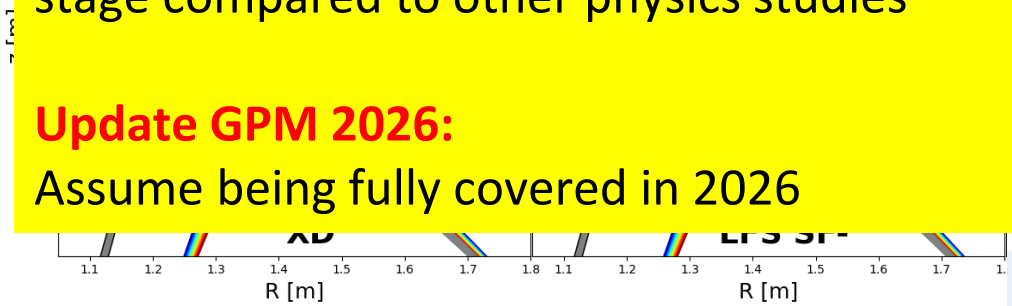
Therefore 9 shots in total.

P1-AUG-2027

Support the physics characterization of selected I-mode scenario but at a later stage compared to other physics studies

Update GPM 2026:

Assume being fully covered in 2026

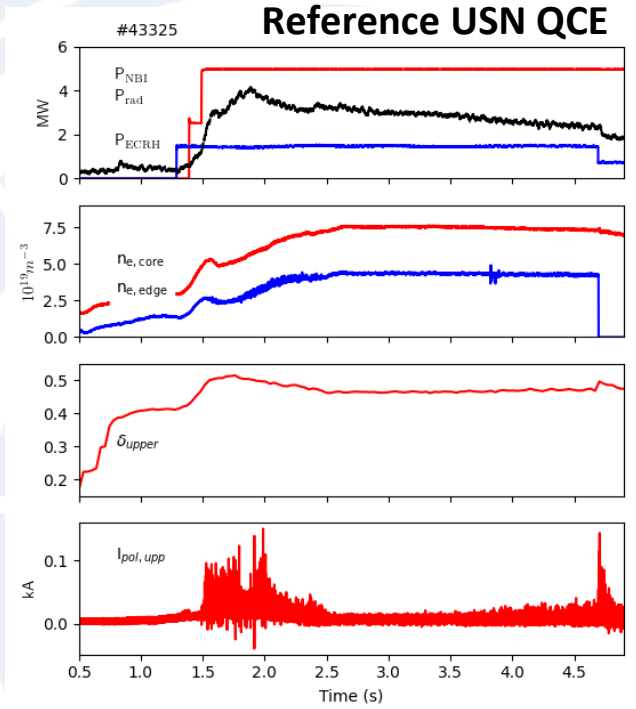


Proposed pulses

Device	# Pulses/Session	# Development
AUG	9	

#147: Interplay between X-point separation and power fall-off length

- **Proponents and contact person:**
  - Michael.Faitsch@ipp.mpg.de, Mike.Dunne@ipp.mpg.de
- **Scientific Background & Objectives**
  - Alternative divertor configurations use additional X-points to increase the wetted divertor area and increase the ability to radiate in the divertor volume. Especially the SF- divertor needs a well-balanced interplay between the location of the 2nd X-point and the power flowing in the SOL.
  - This optimisation challenge depends - among other quantities - on the distance of the 2nd X-point compared to the power fall-off length.
  - The QCE regime offers the unique capability to alter the power fall-off length by means of fueling.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - USN QCE discharge with
    - Varying separation of X-points
    - Fuelling scans at fixed X-point positions



Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	-

#147: Interplay between X-point separation and power fall-off length

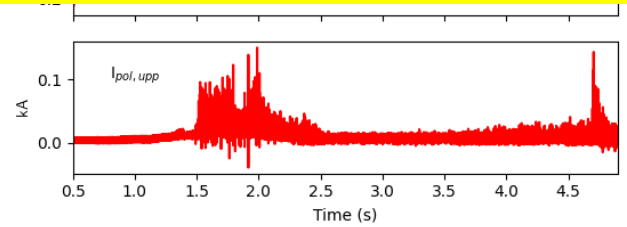
- **Proponents and contact person:**
  - Michael.Faitsch@ipp.mpg.de, Mike.Dunne@ipp.mpg.de
- **Scientific Background & Objectives**
  - Alternative divertor configurations use additional X-points to increase the wetted divertor area and increase the ability to radiate in the divertor volume. Especially the SF- divertor needs a well-balanced interplay between the location of the 2nd X-point and the power flowing in the SOL.
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  - The QCE regime offers the unique capability to alter the power fall-off length by means of fueling.
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - USN QCE discharge with
    - Varying separation of X-points
    - Fuelling scans at fixed X-point positions

P1-AUG-2026

For us this is a low-hanging fruit and utilizes synergy between RT-07 and RT-02

Update GPM 2026:

Assume being fully covered in 2026 or to be executed in early 2027



Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	-

#146: Far SOL transport and its interaction with W wall in ADCs

- **Proponents and contact person:**

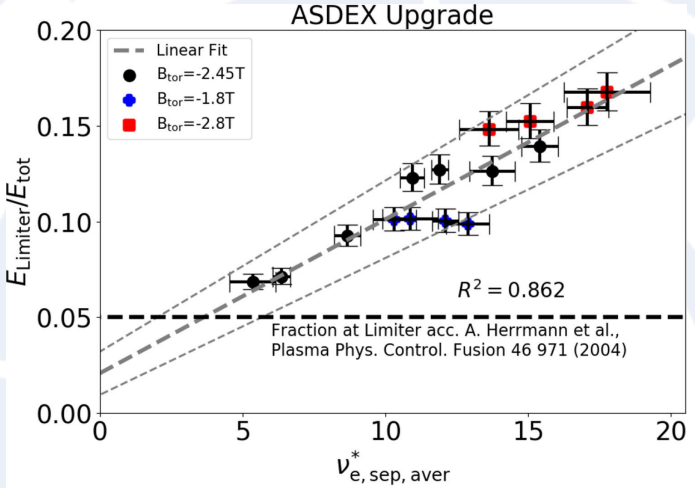
Ou Pan ou.pan@ipp.mpg.de, H. Wang, T. Lunt, B. Sieglin, D. Brida, M. Faitsch, S. Hörmann, G. Grenfell, F. Albrecht, A. Kappatou, H. Wu, M. Rabaldo, W. Fuller

- **Scientific Background & Objectives**

  The recent adoption of a tungsten first wall in ITER, together with the emergence of compact fusion concepts with reduced wall distance, underscores the urgency of reassessing critical issues such as far SOL transport, particle and heat loads on the wall, and tungsten sputtering and transport. Experiments and simulations show that detachment with ELM mitigation in a conventional divertor often requires higher separatrix densities and stronger radial transport, which in turn increase wall fluxes and complicate interactions. Thus, exploring ADCs for power exhaust must be closely linked with studies of far SOL transport and first wall interactions, highlighting the need for detailed diagnostics across different geometries and conditions.

  In XD, SF, and CRD divertor configurations under varying separatrix densities and detachment conditions:
  - Characterise far-SOL plasma parameters.
  - Quantify first-wall heat loads.
  - Assess core tungsten concentrations with different seeding impurities.
  - Collect comprehensive datasets to support integrated edge modeling.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - After fresh boronization, no impurity seeding: In the XD divertor configuration, apply two heating levels, each of which includes three fueling rate steps. Repeat the same sequence in the LFS SF- divertor configuration.
  - With Ar seeding: Conduct three discharges in each of the following configurations: XD, LFS SF-, and CRD.
  - With Ne seeding: Repeat the same experimental sequence as for Ar seeding; CRD optional.
  - Reference cases (as needed): Discharges with N seeding. Discharges in the SN divertor configuration.
  - Diagnostics: MEM, HEB, TS, IR, LPs, CXRS, BOLO, cooling water calorimetry



[Redl et al., NME 2023]

Proposed pulses

Device	# Pulses/Session	# Development
AUG	10	

#146: Far SOL transport and its interaction with W wall in ADCs

- **Proponents and contact person:**

Ou Pan ou.pan@ipp.mpg.de, H. Wang, T. Lunt, B. Sieglin, D. Brida, M. Faitsch, S. Hörmann, G
Grenfell, F. Albrecht, A. Kappatou, H. Wu, M. Rabaldo, W. Fuller

- **Scientific Background & Objectives**

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  complicate interactions. Thus, exploring ADCs for power exhaust must be closely linked
  with studies of far SOL transport and first wall interactions, highlighting the need for
  detailed diagnostics across different geometries and conditions.

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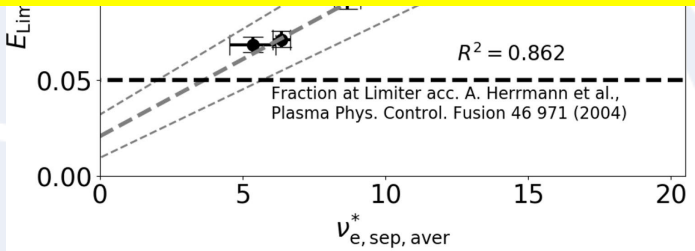
- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - After fresh boronization, no impurity seeding: In the XD divertor configuration, apply two heating levels, each of which includes three fueling rate steps. Repeat the same sequence in the LFS SF- divertor configuration.
  - With Ar seeding: Conduct three discharges in each of the following configurations: XD, LFS SF-, and CRD.
  - With Ne seeding: Repeat the same experimental sequence as for Ar seeding; CRD optional.
  - Reference cases (as needed): Discharges with N seeding. Discharges in the SN divertor configuration.
  - Diagnostics: MEM, HEB, TS, IR, LPs, CXRS, BOLO, cooling water calorimetry

P1-AUG-2026

High-priority topic for ITER and ITPA DiVSOL

Update GPM 2026:

Third priority program for 2027



[Redl et al., NME 2023]

Proposed pulses

Device	# Pulses/Session	# Development
AUG	10	

#170: Scrape-off layer fluctuation measurements in ADCs at AUG

Proponents and contact person:

William Fuller (william.fuller@ipp.mpg.de), F. Albrecht, D. Brida, G. Grenfell, M. Griener, S. Hörmann, X. Liu, T. Lunt

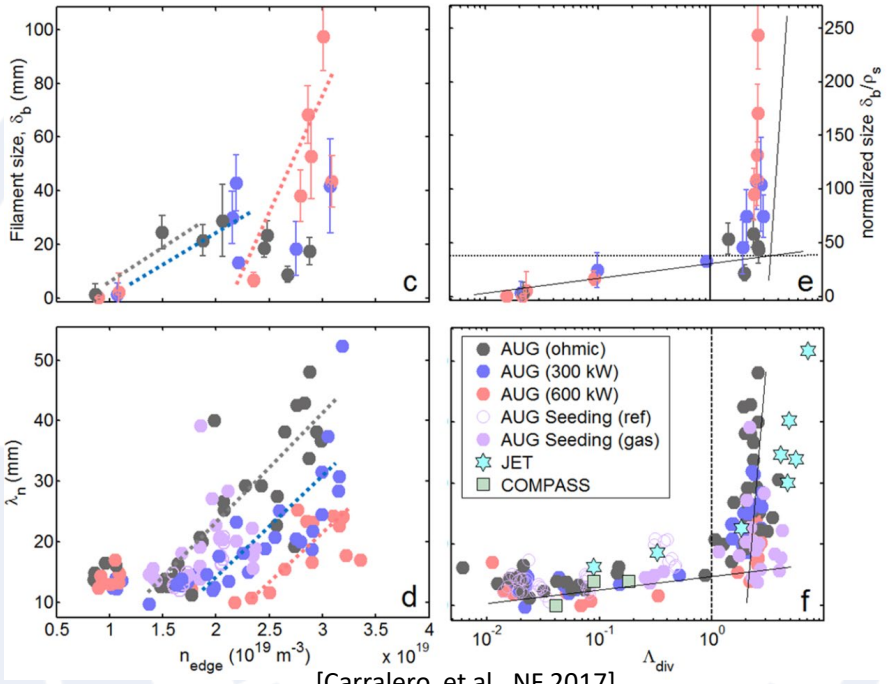
- ## Scientific Background
  1. Steep radial profiles and transport suppression necessary to sustain H-mode [Redl, et al., NF 2024]
  2. Collisionality and particle flux are instrumental in quantifying transport [Carralero, et al., NF 2017]
  3. Fluctuations in SOL can indicate turbulent mechanisms present [Bielajew, et al., NF 2023]

- ## Objectives

  Partly Addresses D1 (characterise plasma exhaust ADCs), D2 (characterise SF), strongly addresses D4 (validate core-edge models with ADC experiments). Determining relationship between ADCs and fluctuations in the SOL.

  - Measure fluctuating profiles across the SOL with multiple diagnostics.
  - Take measurements for ADC regimes in the AUG LSN.
  - Assess relation between fluctuations and transport processes for each ADC.
  - Add the ADC data to existing databases for turbulence models such as GRILLIX, SOLPS-ITER.

- ## Experimental Strategy/Machine Constraints and essential diagnostic
  - Sweep divertor shape across several ADCs at two densities.
  - **Diagnostics:** MEM, XPM, DBS, THB, lower divertor LPs



[Carralero, et al., NF 2017]

Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	0

#170: Scrape-off layer fluctuation measurements in ADCs at AUG

Proponents and contact person:
William Fuller (william.fuller@ipp.mpg.de), F. Albrecht, D. Brida, G. Grenfell, M. Griener, S. Hörmann, X. Liu, T. Lunt

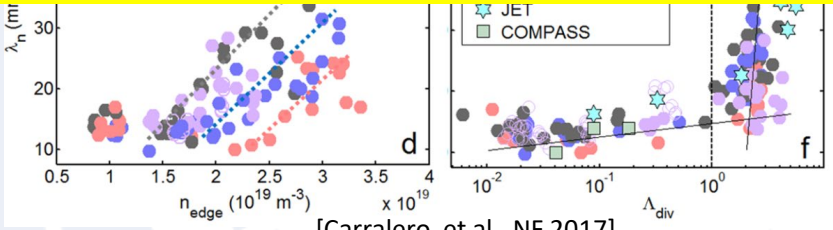
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  2. Collisionality and particle flux are instrumental in quantifying transport [Carralero, et al., NF 2017]
  3. Fluctuations in SOL can indicate turbulent mechanisms present [Bielajew, et al., NF 2023]

- **Objectives**
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  - Assess relation between fluctuations and transport processes for each ADC.
  - Add the ADC data to existing databases for turbulence models such as GRILLIX, SOLPS-ITER.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Sweep divertor shape across several ADCs at two densities.
  - **Diagnostics:** MEM, XPM, DBS, THB, lower divertor LPs

P1-AUG-2026
Fluctuation measurements required for model validation, not only SOLPS-ITER but also GRILLIX

Update GPM 2026:
Third priority program for 2027



[Carralero, et al., NF 2017]

Proposed pulses

Device	# Pulses/Session	# Development
AUG	6	0

Main ingredients of the 2027 programme – detailed view
TCV specific proposals, including TBLLD

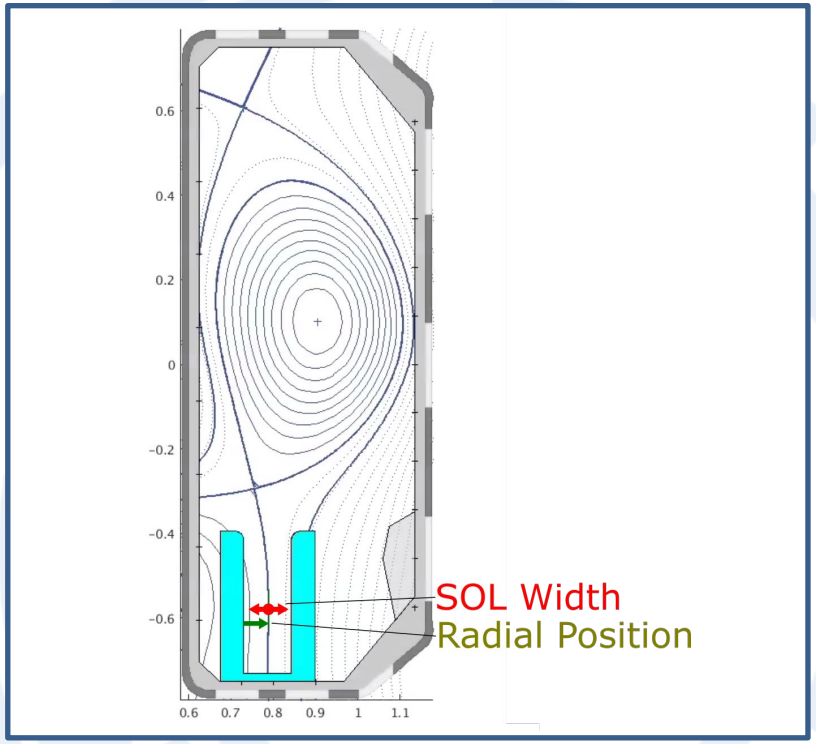
#154: Optimizing Plasma Plugging in a Tightly-Baffled Long-Legged Divertor

- **Proponents and contact person:**

Benjamin Brown (Benjamin.brown@epfl.ch), Olivier Février, Holger Reimerdes, Christian Theiler, Richard Ducker, Kenneth Lee, Pierre Sintre, Elena Tonello

- **Scientific Background & Objectives**
  - Elevated neutral pressure in the TBLLD is maintained through plasma plugging of the divertor entrance.
  - The influence of SOL plasma shaping on the effectiveness of plasma plugging will be investigated experimentally.
  - The performance of the optimized TBLLD scenario will be assessed.

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - TCV with TBLLD, D_2 Ohmic L-mode plasmas
  - Scanning flux expansion, radial position and density
  - Essential Diagnostics
    - APGs, DSS, IR, MANTIS, RDPA, LPs, STCs



Proposed pulses

Device	# Pulses/Session	# Development
TCV	40	10

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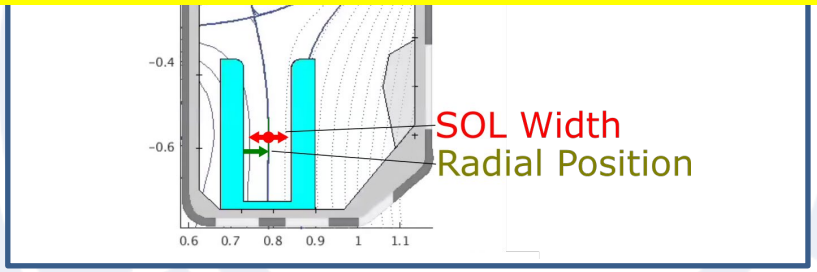
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P1-TCV-2026

TBLLD scenario work and different scans in L-mode. Support but reduced number of discharges.

Update GPM 2026:

Assume being covered in 2026



Proposed pulses

Device	# Pulses/Session	# Development
TCV	40	10

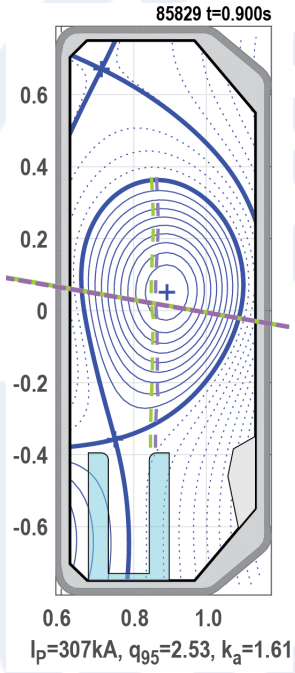
#156: High power dissipation in TCV's Tightly-Baffled, Long-Legged Divertor (TBLLD)

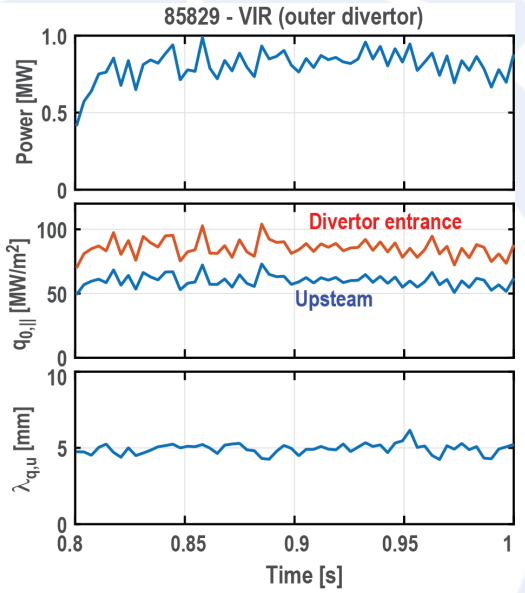
- **Proponents and contact person:**
  holger.reimerdes@epfl.ch, benjamin.brown@epfl.ch, olivier.fevrier@epfl.ch, kieran.murray@ukaea.uk, pierre.sintre@epfl.ch, christian.theiler@epfl.ch, k.h.a.verhaegh@tue.nl, martim.zurita@epfl.ch

- **Scientific Background & Objectives**
  - TBLLD designed for high heat flux mitigation → challenge concept with highest heat fluxes: $q_{||} > 100\ \mathrm{MW/m^2}$ (at lowest densities)
  - Measure target and divertor parameters to validate edge models; evaluate ELM buffering

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  1. Choose reference configuration (outer SP radius and flux expansion) from "TBLLD optimisation" experiment
  2. Add **NBI** with various power levels ranging from 0.5MW to 2.5MW with slow (quasi-static) ramps **10 shots**
  3. Add **ECH** with various power levels ranging from 0.5M to 2.6MW with slow (quasi-static) ramps **10 shots**
  4. If thermo-electric currents are not observed, increase **in-out asymmetry**, e.g. through higher flux expansion **5 shots**
  5. Select most severe exhaust scenario and **seed impurities** (N_2, Ne) **10 shots**
  6. Select stationary **ELM**y H-mode from step 2 and **seed impurities** **5 shots**

High $q_{||}$ scenarios





$P_{ECH\text{-}X2}$ = 1.5 MW

Proposed pulses

Device	# Pulses/Session	# Development
TCV	40	

#156: High power dissipation in TCV's Tightly-Baffled, Long-Legged Divertor (TBLLD)

- **Proponents and contact person:**
  holger.reimerdes@epfl.ch, benjamin.brown@epfl.ch, olivier.fevrier@epfl.ch, kieran.murray@ukaea.uk, pierre.sintre@epfl.ch, christian.theiler@epfl.ch, k.h.a.verhaegh@tue.nl, martim.zurita@epfl.ch

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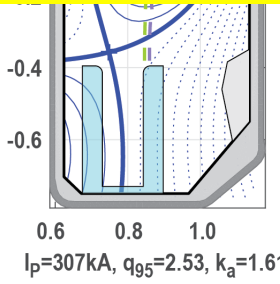
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P1-TCV-2026

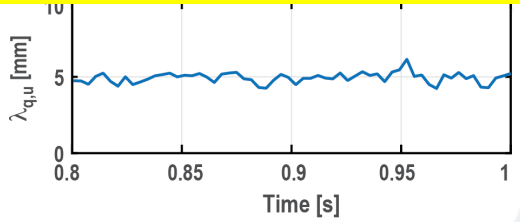
TBLLD scenario work and different scans in H-mode. WPTE highest priority among the TBLLD proposals.

Update GPM 2026:

To be pursued towards high powers in 2027



I_P=307kA, q_{95}=2.53, k_a=1.61



$P_{ECH\text{-}X2}$ = 1.5 MW

Proposed pulses

Device	# Pulses/Session	# Development
TCV	40	

#173: Characterisation of turbulence and transport in the TBLLD

- **Proponents and contact person:**

Christian Theiler et al. | christian.theiler@epfl.ch

- **Scientific Background**
  - SOLPS-ITER predicts an order-of-magnitude improvement in power exhaust for the Tightly Baffled, Long-Legged Divertor (TBLLD), yet relying on a simplified description of turbulence-induced transport
  - The role of turbulence in the TBLLD is difficult to predict. In particular, high levels of recycling at the outer sidewall of the TBLLD may play an important role in its performance, but remain poorly understood (see Umansky et al., NF 2017)

- **Scientific Objectives**

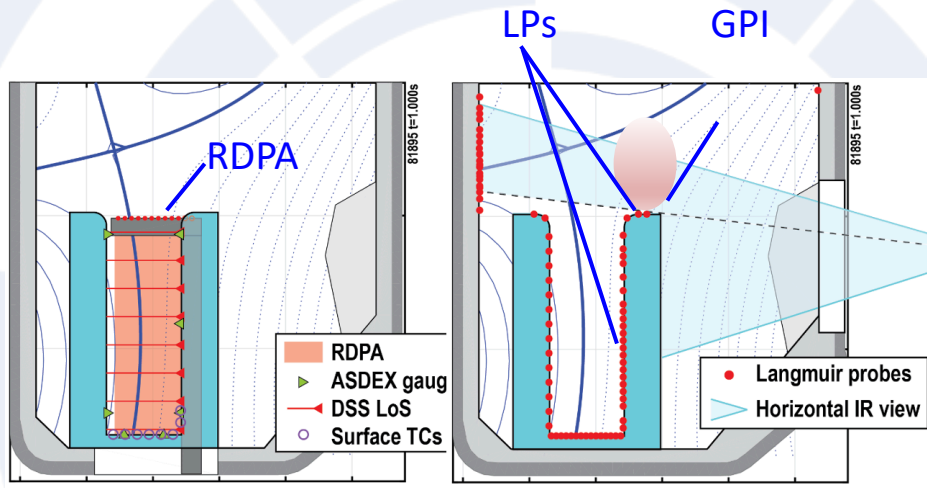
  Assess the effect of turbulence and related transport in the TBLLD on:
  - upstream density shoulder and first-wall interaction
  - plasma-wall interaction at the baffle entrance
  - transport towards the outer sidewall of the TBLLD and related recycling effects

  Simulate and interpret the results with the GBS turbulence code

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

  TCV
  - Cover attached and detachment conditions in L- and H-mode (QCE), scanning divertor gas puffing
  - Use full diagnostic suite, including fluctuation diagnostics at the midplane, the TBLLD entrance and inside the TBLLD (see figure at right)

Outboard midplane fluctuation diagnostics :
GPI, outer-wall LPs, future fast-reciprocating probe



[Reimerdes et al., IAEA-FEC 2025]

Proposed pulses

Device	# Pulses/Session	# Development
TCV	16	0

#173: Characterisation of turbulence and transport in the TBLLD

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- **Scientific Objectives**

  Assess the effect of turbulence and related transport in the TBLLD on:
  - upstream density shoulder and first-wall interaction
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- **Experimental Strategy/Machine Constraints and essential diagnostic**

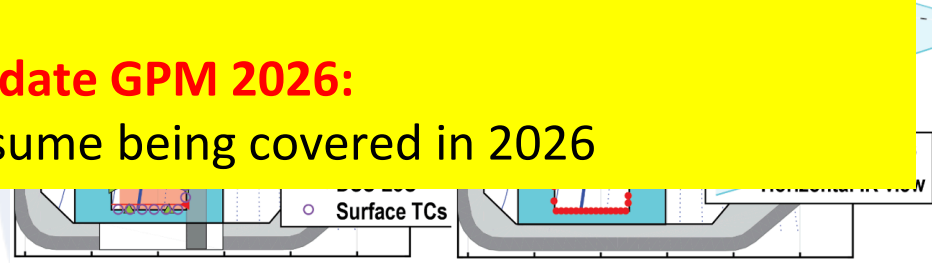
  TCV
  - Cover attached and detachment conditions in L- and H-mode (QCE), scanning divertor gas puffing
  - Use full diagnostic suite, including fluctuation diagnostics at the midplane, the TBLLD entrance and inside the TBLLD (see figure at right)

P1-TCV-2026 / PB

Turbulence measurements in TBLLD configuration can be included in the program, however, shot plan to be elaborated and part of the studies considered PB

Update GPM 2026:

Assume being covered in 2026



[Reimerdes et al., IAEA-FEC 2025]

Proposed pulses

Device	# Pulses/Session	# Development
TCV	16	0

#153: Characterization of turbulence in X-point radiator H-mode scenarios on TCV

- **Proponents and contact person:**

Yinghan Wang (yinghan.wang@epfl.ch), M. Agostini, M. Bernert, M. Czarski, O. Février, M. Griener, M. Herschel, A. Khan, M. La Matina, H. Reimerdes, K. Singh, C. Theiler, M. Ugoletti

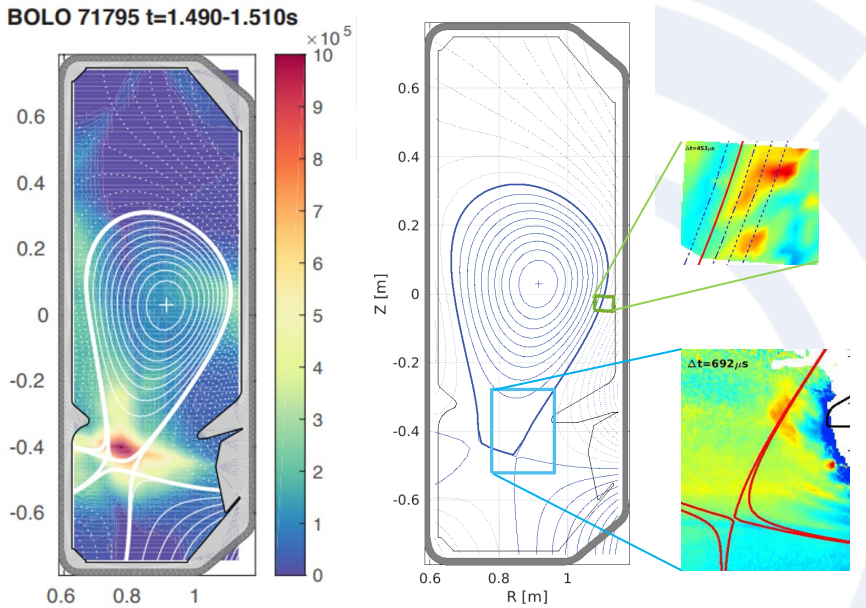
- **Scientific Background & Objectives**

  - **[Background]** The X-point radiator (XPR) regime in H-mode shows potential to combine high confinement with a detached divertor, which is critical for future tokamaks. Turbulence mechanism in this regime still requires exploration.

  - **[Main objective]**
    - Study the turbulence behavior
      - in single null and snowflake XPR in TCV
      - in different locations (midplane, X-point)
      - during the ELM suppression phase in the XPR regime, comparing with the ELMy phase.
    - Investigate the previous points as a function of fueling and seeding.
    - Study the particle transport in the XPR regime.

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

  - **H-mode XPR, NBI, possible ECRH** power for XPR stability
  - **Comparison with L-mode plasma** in SN and SF geometry
  - **midplane and X-point GPI systems** (SISO or SILO baffle, LFS and HFS)
  - **LPs, MANTIS, bolometry**: to monitor detachment and XPR
  - **High-speed camera**: wide field passive imaging
  - Combining with the **THB, Wall LP and RDPA** to study the particle flux during the ELM free phase.
  - Support with SOLPS-ITER XPR simulations + possibly turbulence codes



[H. Reimerdes et al. 2024 NME]

GPI fields of view

Proposed pulses

Device	# Pulses/Session	# Development
TCV	12	0

#153: Characterization of turbulence in X-point radiator H-mode scenarios on TCV

- **Proponents and contact person:**
  Yinghan Wang (yinghan.wang@epfl.ch), M. Agostini, M. Bernert, M. Czarski, O. Février, M. Griener, M. Herschel, A. Khan, M. La Matina, H. Reimerdes, K. Singh, C. Theiler, M. Ugoletti

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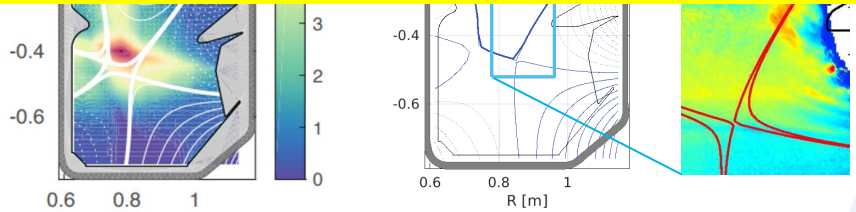
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P1-TCV-2027 / PB

To be executed after the TBLLD phase, also here consider doing work PB or under the internal campaign

Update GPM 2026:

Candidate for the non-baffled phase?



[H. Reimerdes et al. 2024 NME] GPI fields of view

Proposed pulses

Device	# Pulses/Session	# Development
TCV	12	0

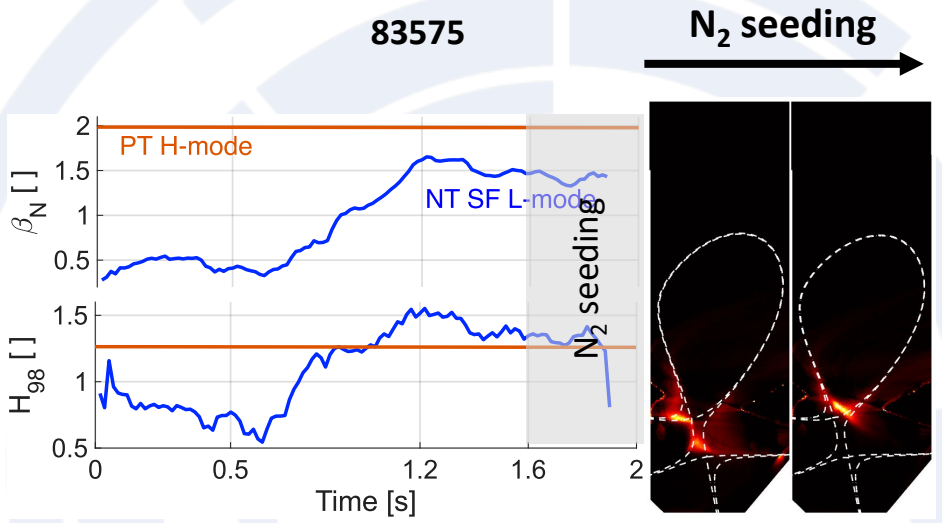
#157: Detachment in TCV high-power NT scenarios leveraging ADCs

- **Proponents and contact person:**
  - G. Durr-Legoupil-Nicoud garance.durr-legoupil-nicoud@epfl.ch
  - O. Février, 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.
Snowflake (SF) has demonstrated easier access to detachment more accessible in NT, and, surprisingly better core performances than standard LSN. [Durr-Legoupil-Nicoud'EPS25]
This proposal aims to assess how coupling ADCs in high-power NT scenarios on TCV affect detachment acess and window

→ Continue developing and characterizing a high-performance high-power NBI-heated NT L-mode scenario with a SF divertor and add ECRH to evolve to a reactor-relevant scenario
→ Extend the SF detachment using N_2 injection at various degrees of power and different ADCs (XD, XPT, TBLLD).
→ Investigate the nitrogen penetration in the core and thus core-edge compatibility at these different levels of power and with the different ADCs



[Durr-Legoupil-Nicoud'EPS25]

Can ADCs allow to obtain a detached NT L-mode with H-mode PT performances on TCV?

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - N_2 seeding ramps with NBI/ECRH in NT-ADC plasma: multiple input power levels, N_2 seeding at different rates
  - Detached NT L-mode with NBH and or/ECRH with ADCs: preferably no baffles (except for TBLLD)
  - Essential diagnostics: edge diagnostics (IR,LP,RDPA,GPI) and CXRS

Proposed pulses

Device	# Pulses/Session	# Development
TCV	30	20

#157: Detachment in TCV high-power NT scenarios leveraging ADCs

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  - G. Durr-Legoupil-Nicoud garance.durr-legoupil-nicoud@epfl.ch
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  - Detached NT L-mode with NBH and or/ECRH with ADCs: preferably no baffles (except for TBLLD)
  - Essential diagnostics: edge diagnostics (IR,LP,RDPA,GPI) and CXRS

P1-TCV-2027

Continuation of the promising work initiated in 2025. Requirements for the baffle configuration to be further discussed which would affect the 2026/2027 scheduling and number of shots allocated.

Update GPM 2026:
Focus on the high-power TBLLD program

[Durr-Legoupil-Nicoud'EPS25]

Proposed pulses

Device	# Pulses/Session	# Development
TCV	30	20

#168: Investigation of the impact of secondary X-point radial distance from the separatrix on the X-point target performance

- **Proponents and contact person:**

Massimo Carpita | massimo.carpita@epfl.ch

- **Scientific Background**
  - XPT has been shown to greatly reduce target temperature and heat fluxes compared to LSN, in different plasma scenarios
  - Recent SOLPS-ITER modelling shows a large sensitivity of the results to the secondary X-point separation in radial space (dru_XP2, mapped upstream), due to ExB-driven redistribution of particles around the secondary X-point

- **Scientific Objectives**

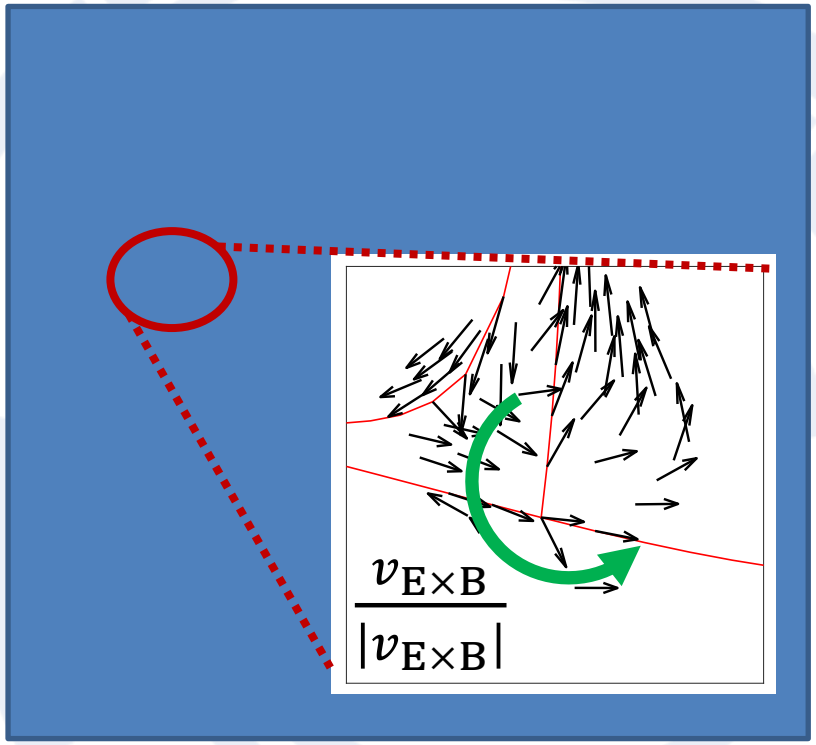
1. validate SOLPS-ITER simulations
2. identify the optimal XPT shape and its sensitivity to dru_XP2
3. highlight the different mechanisms driving the XPT performance

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

  TCV
  - Ohmic L-mode, fix dru_XP2 and scan density (5)
  - High-power EC-heated L-mode, fix dru_XP2 and scan density (5)
  - Diagnostic repeats (5)

  Backup: fix density, scan geometry

  Diagnostic: standard TCV edge diagnostics



Proposed pulses

Device	# Pulses/Session	# Development
TCV	15	5

#168: Investigation of the impact of secondary X-point radial distance from the separatrix on the X-point target performance

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Massimo Carpita | massimo.carpita@epfl.ch

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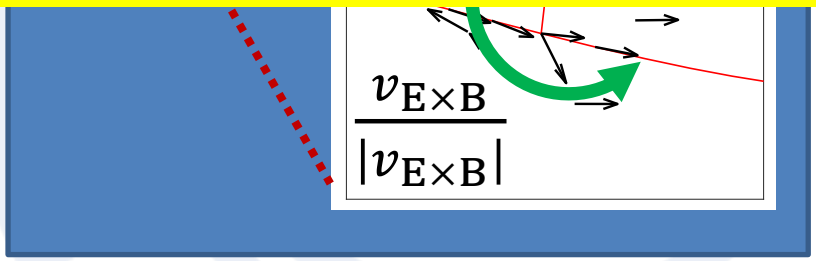
  Diagnostic: standard TCV edge diagnostics

P1-TCV-2027

Specific proposal for SOLPS-ITER modelling validation in the XPT configuration. High priority but at a later stage than other proposals.

Update GPM 2026:

Covered in 2026



Proposed pulses

Device	# Pulses/Session	# Development
TCV	15	5

Main ingredients of the 2027 programme – detailed view
Multimachine proposals

#148: ELM and transient buffering in ADCs of AUG, MAST-U and TCV

Proponents and contact persons:

AUG: Felix Albrecht (felix.albrecht@ipp.mpg.de), D. Brida, H. Lindl, A. Mancini, M. Herschel, T. Lunt, B. Sieglin, O. Pan, M. Faitsch, M. Komm. MAST-U: Jack Flanagan (jack.flanagan@ukaea.uk), R. Scannell, K. Verhaegh, P. Figueiredo, S. Reddy, D. Moulton, S. Kobussen. TCV: Martim Zurita (martim.zurita@epfl.ch), H. Reimerdes, K. Lee, C. Theiler, O. Février, M. Carpita, Y. Wang.

Scientific Background

1. Up to 60% ELM buffering in AUG with single-null (SN) [M. Komm, NF (2023)]
2. ELM buffering in MAST-U w/ Super-X [J. Flanagan, NF (2025)]
3. Strong ELM buffering in TCV with the x-point target (XPT) [M. Zurita, APS (2025)]

Objectives

Directly linked to RT07 D3: ELM heat load mitigation in ADC

Objectives at AUG

1. Observe and quantify the buffering of ELMs in the upper divertor
2. Assess the influence of fuelling and seeding, in terms of neutral pressure
3. Compare performance between USN, XD and SF-, and the impact of dr_{x2}

Objectives at MAST-U

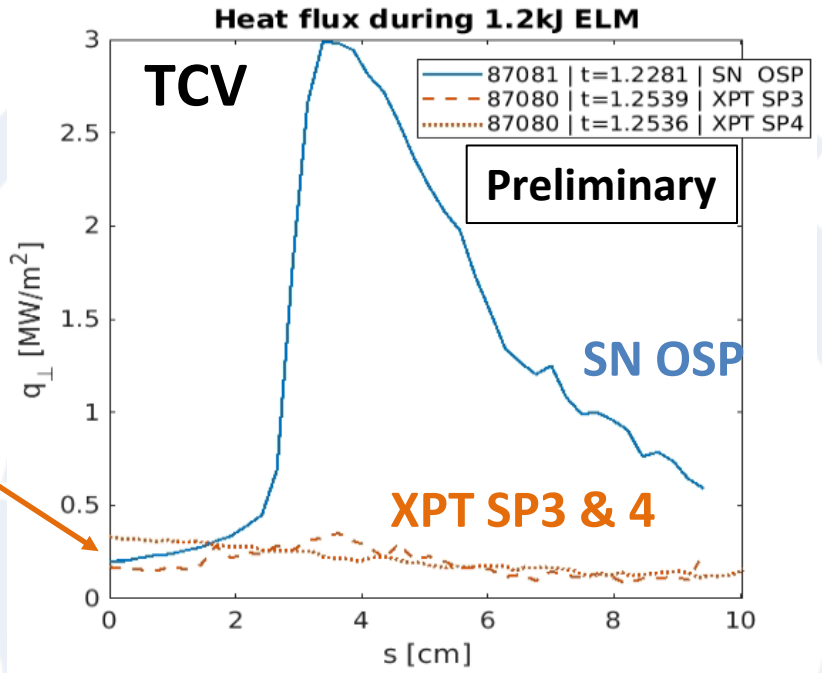
1. Measure the transient buffering benefits of the baffled Super-X vs Conventional divertor
2. Assess maximum ELM energy that the Super-X can buffer with seeding
3. Study the physics of detached buffering mechanisms with novel spectroscopic techniques
4. Validate buffering modelling in RemKiT1D and SOLPS, and reduced models for control

Objectives at TCV

1. Understand the mechanisms behind the XPT ELM buffering (XD vs SXD vs XPT, dr_{x2})
2. Assess maximum ELM energy that the XPT can buffer (and add seeding if needed)
3. Compare ELM buffering in XPT and snowflake divertors
4. Compare seeded buffering in SN and XPT

Experimental Strategy/Machine Constraints and essential diagnostic

- Compare type-I ELM buffering fraction in SN and ADCs
- **Diagnostics.** AUG: IR, LPs, Gas Puff Imaging, Div. Spectroscopy. MAST-U: Fast IR, Fast MWI, ultrafast divertor spectroscopy. TCV: IR, FastCam
- **Heating.** ECRH, NBI
- **Seeding.** AUG: N_2, Ar. MAST-U: unseeded, N_2. TCV: unseeded, N_2, Ne, Ar



Proposed pulses

Device	# Pulses/Session	# Development
AUG	10	2
MAST-U	12	4
TCV	17	18

#148: ELM and transient buffering in ADCs of AUG, MAST-U and TCV

Proponents and contact persons:

AUG: Felix Albrecht (felix.albrecht@ipp.mpg.de), D. Brida, H. Lindl, A. Mancini, M. Herschel, Lunt, B. Sieglin, O. Pan, M. Faitsch, M. Komm. MAST-U: Jack Flanagan (jack.flanagan@ukaea. R. Scannell, K. Verhaegh, P. Figueiredo, S. Reddy, D. Moulton, S. Kobussen. TCV: Martim Zuri (martim.zurita@epfl.ch), H. Reimerdes, K. Lee, C. Theiler, O. Février, M. Carpita, Y. Wang.

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2. Assess the influence of fuelling and seeding, in terms of neutral pressure
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Objectives at TCV

1. Understand the mechanisms behind the XPT ELM buffering (XD vs SXD vs XPT, dr_{x2})
2. Assess maximum ELM energy that the XPT can buffer (and add seeding if needed)
3. Compare ELM buffering in XPT and snowflake divertors
4. Compare seeded buffering in SN and XPT

Experimental Strategy/Machine Constraints and essential diagnostic

- Compare type-I ELM buffering fraction in SN and ADCs
- **Diagnostics.** AUG: IR, LPs, Gas Puff Imaging, Div. Spectroscopy. MAST-U: Fast IR, Fast MWI, ultrafast divertor spectroscopy. TCV: IR, FastCam
- **Heating.** ECRH, NBI
- **Seeding.** AUG: N_2, Ar. MAST-U: unseeded, N_2. TCV: unseeded, N_2, Ne, Ar

Heat flux during 1.2kJ ELM

P1-AUG-2027
P1-TCV-2027
P2-MAST-U

Very important topic on all the devices (objective D3) but due to other priorities should be executed after TBLLD (TCV) and fundamental scenario development (AUG). On MAST-U subject to success in scenario development.

Update GPM 2026:
High priority in 2027

Device	# Pulses/Session	# Development
AUG	10	2
MAST-U	12	4
TCV	17	18

#165: Impurity transport in strongly baffled ADCs

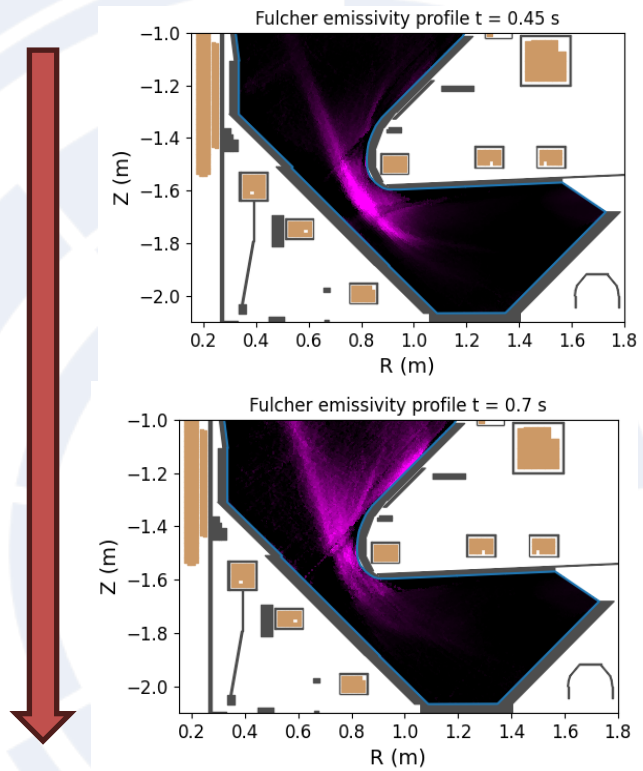
- **Proponents and contact person:**

- MAST-U Team: N. Lonigro (nicola.lonigro@ukaea.uk), C. Beckley, N. Bundschuh, S. Menmuir, D. Moulton, R. Osawa, K. Verhaegh, L. Xiang, S. Kobussen
- TCV Team: R.Morgan(riccardo.morgan@epfl.ch), M. Cornelissen, R. Ducker, D. Mykytchuk, A. Perek, B. Brown, O. Février, H. Reimerdes, C. Theiler

- **Scientific Background & Objectives**
  - Transport of impurities from the divertor to the main chamber and core will influence the integrated core-edge scenario.
  - **Strong baffling can improve neutral retention** in the divertor region, even in detached conditions. Increased leakage of D neutrals to main chamber observed when the ionization front exist the divertor throat in MAST-U. **Explore how this behavior extends to impurities** and ADCs.
  - Quantify improvements in impurity transport from the divertor to the main chamber in strongly baffled ADCs as a function of magnetic geometry, impurity species, ionization front position, and in the presence of ELMs (D1). Create dataset for validation high-fidelity simulations of impurity transport (D4).

- **Experimental Strategy/Machine Constraints and essential diagnostic**
  - Use fueling steps to change ionization front position and for each step perform small (ideally non-perturbative) puffs of impurities in the divertor. Use difference in main chamber spectroscopy and CXRS impurity line signals to quantify leakage.
  - Type I ELMs can strongly affect compression but are not reactor relevant → Focus on L-mode discharges for cleaner diagnostic data and modelling comparisons. Then compare to H-mode discharges to quantity the effect of ELMs on impurity compression.

Increased leakage as ionization region exits baffle. What about impurities ?



Proposed pulses

Device	# Pulses/Session	# Development
MAST-U	29	3
TCV	25	3

#165: Impurity transport in strongly baffled ADCs

- **Proponents and contact person:**

- MAST-U Team: N. Lonigro (nicola.lonigro@ukaea.uk), C. Beckley, N. Bundschuh, S. Menmuir, D. Moulton, R. Osawa, K. Verhaegh, L. Xiang, S. Kobussen
- TCV Team: R.Morgan(riccardo.morgan@epfl.ch), M. Cornelissen, R. Ducker, D. Mykytchuk, A. Perek, B. Brown, O. Février, H. Reimerdes, C. Theiler

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  - Type I ELMs can strongly affect compression but are not reactor relevant → Focus on L-mode discharges for cleaner diagnostic data and modelling comparisons. Then compare to H-mode discharges to quantity the effect of ELMs on impurity compression.

P1-TCV-2027

P1-MAST-U-2026

The outcomes of the proposal will be essential in benchmarking modelling results. On TCV, however, to be scheduled at a later stage and concentrate first on MAST-U – subject to scenario development being successful.

Update GPM 2026:

Candidate proposal for A&M purposes

Experimental part covered in 2026

Proposed pulses

Device	# Pulses/Session	# Development
MAST-U	29	3
TCV	25	3

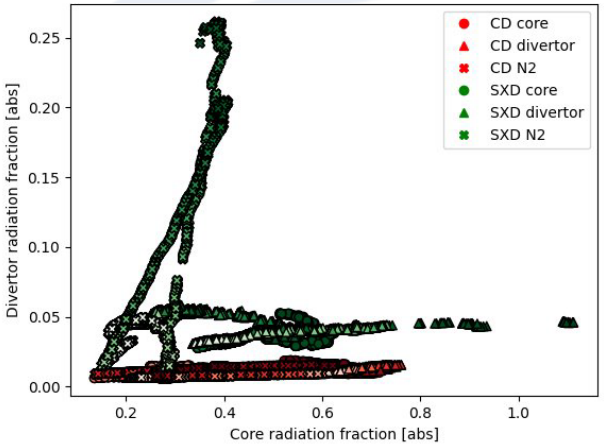
#174: Core-divertor integrated power exhaust study with impurity seeding

- **Proponents and contact person:**

Lingyan Xiang(lingyan.Xiang@ukaea.uk), Riccardo Ian Morgan(riccardo.morgan@epfl.ch)

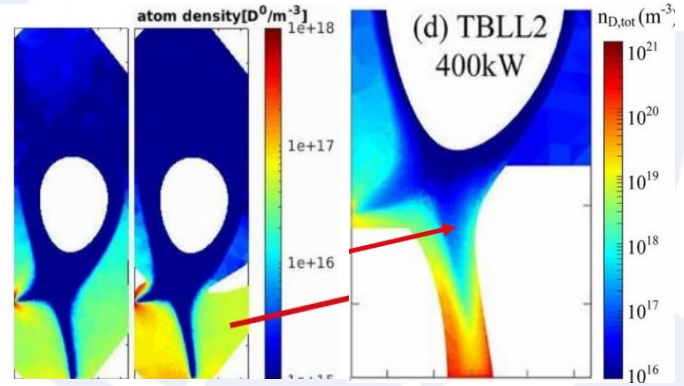
- **Scientific Background & Objectives**
  - Background –
  - MAST-U MU03/04 experiments showed that in ADCs the divertor decouples more from the core. Now we want to
  - Assess level of cross-talk between divertors (does seeding in the upper divertor influence the lower divertor?)
  - What is the radiation pattern in a Double-Null ? Can double-XPR exist, and, if so, under what conditions ?
  - How does different seeded impruties impact the radiation pattern and core contamination?
  - Objectives –
    1. Investigate core-divertor decoupling regarding impurity screening from the core with different seeding locations in the divertor at different divertor conditions and with different impurities (N_2, Ar. Low to very high seeding rates to match the seeding scenarios on reactors).
    2. Continue the study and gather stronger evidence for the different impacts of impurity seeding in various divertor geometries, regarding (a) radiation distribution, (b) divertor pressure, (c) power decay length, (d) parallel temperature gradient, (e) the detachment front sensitivity, (f) the impurity compression and (g) core contamination.
- **Experimental Strategy/Machine Constraints**
  - **TCV :**

    Experiments to assess the required N_2 seeding for achieving detachment at different levels of P_{sol}, with the TBLLD configuration.
  - **MAST-U:**
    1. Experiments to test how deep the detachment can get by impurity seeding alone. Ramp impurity seeding at different rates at core density of 1.0-2.0 in CD and SXD. Do this in DN/LSN-Hmode with 2 beams. Impurity species include N_2 and Ar.
    2. Experiments to complete the database (matrix of (a) core fuelling & divertor fuelling & seeding, (b) in L-mode & H-mode, (c) in DN & LSN, (d) with & without cryopump). The missing experiments are: Lmode-DN-cryoon-seeding-CD/SXD, Lmode-LSN-cryoon-seeding-CD/SXD, Hmode-DN-cryoon-seeding-SXD, Hmode-DN-cryoon-divertorfuelling-CD/SXD, Hmode-DN-cryoon-seeding-CD/SXD, Hmode-LSN-cryoon-divertorfuelling-CD/SXD, Hmode-LSN-cryoon-seeding-CD/SXD.



MAST-U SXD has much higher divertor radiation than CD

TCV TBLLD achieves higher neutral pressure in the divertor



Device	# Pulses/Session	# Development
MAST-U	14	0
TCV	13	0

#174: Core-divertor integrated power exhaust study with impurity seeding

- **Proponents and contact person:**
  Lingyan Xiang(lingyan.Xiang@ukaea.uk), Riccardo Ian Morgan(riccardo.morgan@epfl.ch)
- **Scientific Background & Objectives**
  - Background –
  - MAST-U MU03/04 experiments showed that in ADCs the divertor decouples more from the core. Nc
    want to
  - Assess level of cross-talk between divertors (does seeding in the upper divertor influence the lower
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  - How does different seeded impruties impact the radiation pattern and core contamination?
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    1. Investigate core-divertor decoupling regarding impurity screening from the core with different
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       high seeding rates to match the seeding scenarios on reactors).
    2. Continue the study and gather stronger evidence for the different impacts of impurity seeding
       divertor geometries, regarding (a) radiation distribution, (b) divertor pressure, (c) power decay
       (d) parallel temperature gradient, (e) the detachment front sensitivity, (f) the impurity compre
       (g) core contamination.
- **Experimental Strategy/Machine Constraints**
  - **TCV :**
    Experiments to assess the required N_2 seeding for achieving detachment at different levels of P_{sol}, with the TBLLD configuration.
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    1. Experiments to test how deep the detachment can get by impurity seeding alone. Ramp impurity seeding at different rates at core density of 1.0-2.0 in CD and SXD. Do this in DN/LSN-Hmode with 2 beams. Impurity species include N_2 and Ar.
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P1-TCV-2026

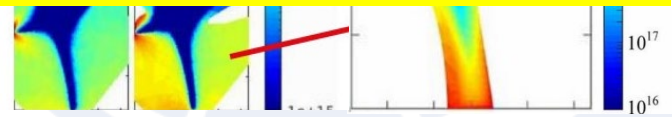
P2-MAST-U

The TCV part would benefit TBLLD investigations in the presence of impurities. The MAST-U part could be considered once the more straightforward investigations under #165 are completed.

Update GPM 2026:

Candidate proposal for A&M purposes

Experimental part covered in 2026



Device	# Pulses/Session	# Development
MAST-U	14	0
TCV	13	0

#169: Dynamic response of ADCs to demonstrate reactor control & scenario integration benefits

- **Proponents and contact person:**

Paulo Figueiredo (p.a.marinhofigueiredo@differ.nl), Jorn Veenendaal, Max Winkel, Gijs Derks, Stijn Kobussen, Nicola Lonigro, Kevin Verhaegh, Matthijs Van Berkel

- **Scientific Background & Objectives**

Alternative divertor configurations (ADCs) have demonstrated reduced sensitivity of the detachment front to transients, both in quasi-steady-state and dynamic experiments. This provides us with a larger operational range and increased tolerance for transients. Characterizing these dynamics across configurations and operating points is essential to assess their impact on integrated control and to provide critical benchmarks for time-dependent models supporting reactor-scale exhaust design.

In this proposal, we aim to:

- Expand the characterization of plasma dynamics in ADCs for different tokamaks and scenarios
- Analyze the effect of impurities and valve location on detachment dynamics
- Explore the interaction between inner and outer divertors detachment state

- **Experimental strategy and essential diagnostics**

- MAST-U:
  - System-identification with mixed N_2 and D_2 perturbations.
  - System-identification in H-mode to explore the possibility of ELM-buffering (requires UFDS)
  - System-identification for close to attached high elongation SN scenario in ADCs.
  - System-identification with PFR valve vs LFSD valve to probe interaction between inner and outer leg.
- AUG
  - Measure plasma dynamics for upper divertor snowflake configuration.
- TCV
  - Continue to measure plasma dynamics for LLD (long legged divertor) combined with SN and XPT configurations.

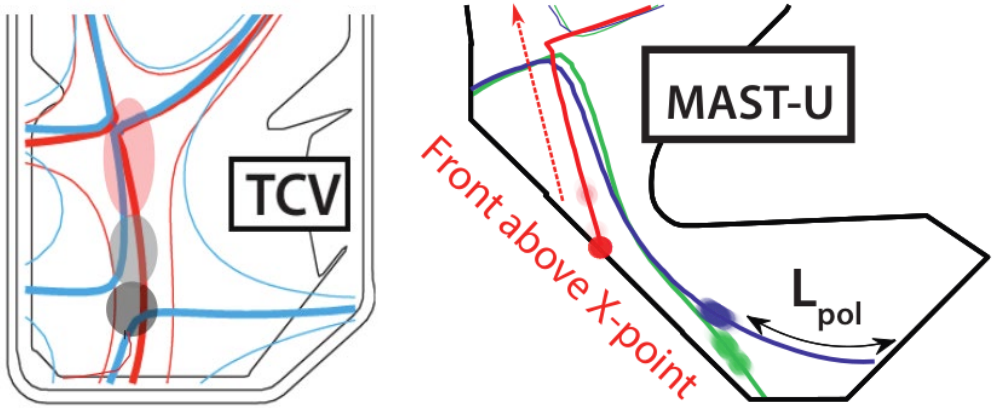


Fig: Illustration of varying sensitivities across ADCs in MAST-U and TCV

Proposed pulses

Device	# Pulses/Session	# Development
AUG	8	-
MAST-U	16	-
TCV	8	-

#169: Dynamic response of ADCs to demonstrate reactor control & scenario integration benefits

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P1-AUG-2027
P1-TCV-2027
P1-MAST-U-2026
System identification work should be pursued on varying ADC configurations but only at a later stage on AUG and TCV: try to include some discharges into the MAST-U programme in 2026.

Update GPM 2026:
Experimental part completed on TCV and MAST-U; AUG part can be done piggy back

Device	# Pulses/Session	# Development
AUG	8	-
MAST-U	16	-
TCV	8	-

Concluding remarks

- The **experimental priorities for the 2027 RT07 program are well settled**
  - ✓ Focus on the high-power H-mode experiments on both the running devices (AUG, TCV) to maximally contribute to D1-D3
  - ✓ Complete the TBLLD investigations on TCV
  - ✓ Promote AUG/TCV comparison wherever applicable (e.g., SF^{-})
  - ✓ Keep lower-power experiments as programmatic backup in case of restrictions in the operational basis
- Most of the originally **P1-2027 labelled experiments are still considered relevant** – with some exceptions
  - ✓ On AUG, I-mode studies already done in 2026
  - ✓ On TCV, large fraction of the low-power NINO program executed in 2026 (e.g., work for PhD students) and all low-power TBLLD program (including seeding) more appropriate for 2026
  - ✓ System-identification and control experiments already completed or can be done piggy back
- **Much more emphasis to be put on analyses and modelling (objective D4)**
  - ✓ Target is to advance also the SSRL for D4 by the end of 2027 and aim at establishing a metrics to compare the pros and cons of different ADCs