

Preparation of ITER Operation, WPPrIO

X. Litaudon (PL), Gloria Falchetto (PSO) on behalf of WPrIO team

DE LA RECHERCHE À L'INDUSTRIE

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This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.



- **Contribute to lay the foundation of a **coordinated significant EUROfusion participation in the ITER team** benefiting from the strength of the EUROfusion programme in **operation, technology and simulation****
- **Integrate Physics and Engineering Optimization in line with the Roadmap priorities**
- **Implement some of the recommendations* on “EUROfusion role in ITER operation and scientific exploitation”**

*) EUROFUSION GA (20) 32 - 4.7 - ITER White Paper Report WG1 Issue 1 10-Dec-2020 (Decision).docx and EUROFUSION GA

(20) 32 - 4.7 - ITER White Paper Report WG2 Issue 3 7-Dec-2020 (Decision).docx

Recommendations* on “EUROfusion role in ITER op. & scientific exploitation” and PrIO contributions



*) EUROFUSION GA (20) 32 - 4.7

	Sub-systems	Required involvement for EU implication in ITER operation	Impact level on the EU DEMO design
2022 ?	TF & PF Magnets and Cryo-plant	*** in commissioning phase (* during full operation)	++ (for DEMO design)
→	Divertor & PFCs	***	++
→	Tritium Plant	***	+++
→	Breeding Blanket System	***	+++
→	H&CD: Neutral Beam	*** (NBTF)	+++
→	Diagnostics	***	+++
→	Control and Analysis/operational/simulation tools	***	++ (+++ for some control aspects)
→	Neutronics, Waste and Radiological Protection	**	+++
	H&CD: Electron Cyclotron	**	++
	H&CD: Ion Cyclotron	** (present operation in present facilities)	+
	Vacuum Vessel	*	+
	Remote Handling Equipment	*	+
	Vacuum Pumping & fueling	*	+
	Building and Electrical Power Supply & Distribution System	*	+++ (for DEMO design)

(+++): Unique, (++) High, (+) Significant

(***) Strong: Organized team with defined commitments, (**) Organized team, (*) Expertise for follow-up



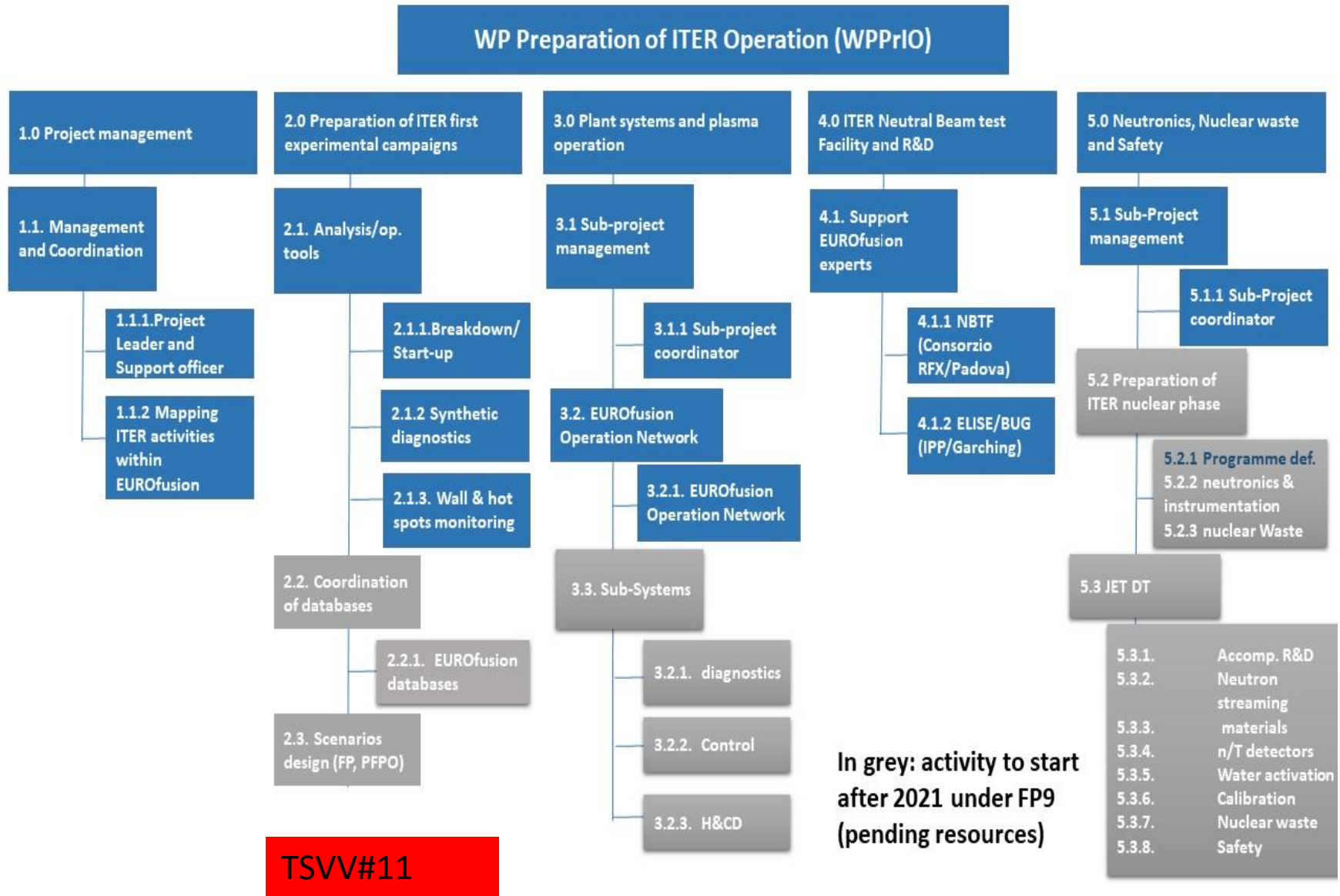
- 1. Contribute to the preparation at the EUROfusion level of the initial ITER experimental campaigns**
- 2. Support knowledge transfer on operational topics and Develop training opportunities**
- 3. Contribute to the NBTF activities and exploitation of smaller ITER-like ion sources**
- 4. Improve EUROfusion knowledge on neutronics, instrumentation, nuclear codes, and techniques**

Project structure as in IMS



- **SP-1: Project management and coordination**
 - **SP-2: Preparation of ITER first experimental campaigns**
 - **SP-3: Plant System and Plasma Operations**
 - **SP-4: Neutral Beam test Facility and R&D for ITER Neutral Beam**
 - **SP-5: Neutronics, Nuclear waste and safety**
- ✓ **WP is implementing some elements of the EUROfusion preparation to ITER operation and scientific exploitation**
- ✓ **reference documents:**
- ITER Research Plan within the Staged Approach: <https://www.iter.org/technical-reports?id=9>
 - Required R&D in Existing Fusion Facilities to Support the ITER Research Plan A. Loarte (for the Science Division) <https://www.iter.org/technical-reports?id=14>
 - Cooperation agreement on NBTF

Work Breakdown Structure - 5 Sub-Projects



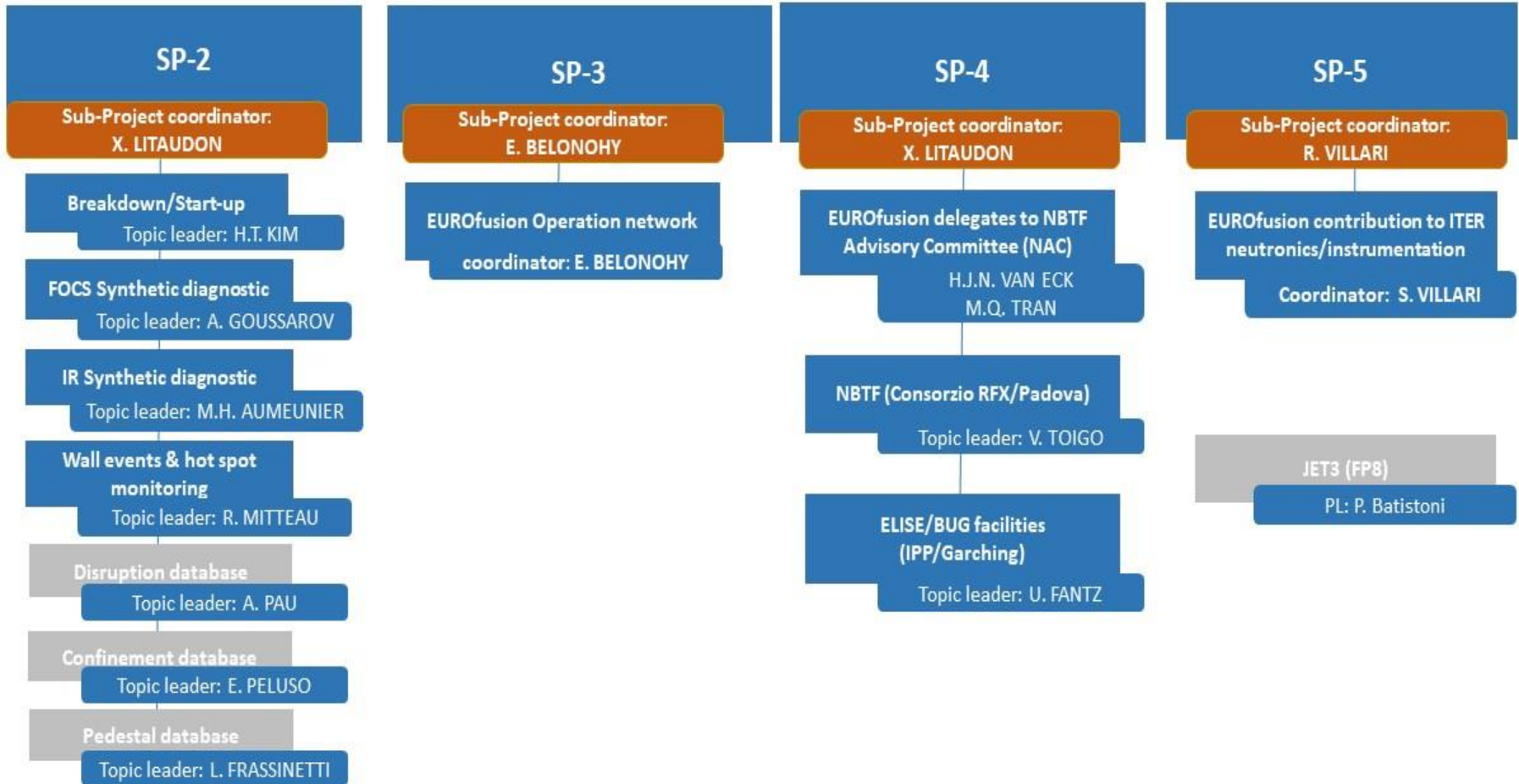
TSVV#11

Roles and Responsibilities



WP10 Project Leader X. LITAUDON
Project Support Officer: G. FALCHETTO

[June 2021]



TSVV#11

[In grey : database and JET3 under FP8 resources]



Progress summary and status for 2021:

WP activities, TSVV links, status of allocated resources, risks, synergies, international collaborations, status of the 2021 GA milestones/deliverables,...



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- **Set-up the new project structure**
- **Initiate a mapping of the EUROfusion scientific and collaborative activities for ITER with the support of the contact persons for ITER specific activities in the various EU labs**
- **Initiate a mapping of the specific ITER cross-WPs activities performed within the EUROfusion**
- **Link with ITPA TG activities (web page)**
- **PL Member of E-TASC Scientific Board and Thrust facilitator on whole device modelling**
 - Physics Properties of Strongly Shaped Configurations (TSVV#02)
 - Validated Frameworks for the Reliable Prediction of Plasma Performance and Operational Limits in Tokamaks (TSVV#11)
 - Multi-Fidelity Systems Code for DEMO (TSVV#14)

SP-2: Preparation of ITER first experimental campaigns



- **Plasma breakdown/burn-through simulation tools and application for ITER operation plasma**
 - Synergy and link with TE, SA, TSVV11 has been set-up (joint meetings)
- **IR synthetic diagnostic and first wall/divertor monitoring system for real time PFC's protection**
- **Synthetic diagnostic for the Fiber Optics Current Sensor based on JET experience**
- **EUROfusion databases on disruption, core confinement and pedestal (FP8 resource)**

SP-2: Preparation of ITER first experimental campaigns: Plasma initiation

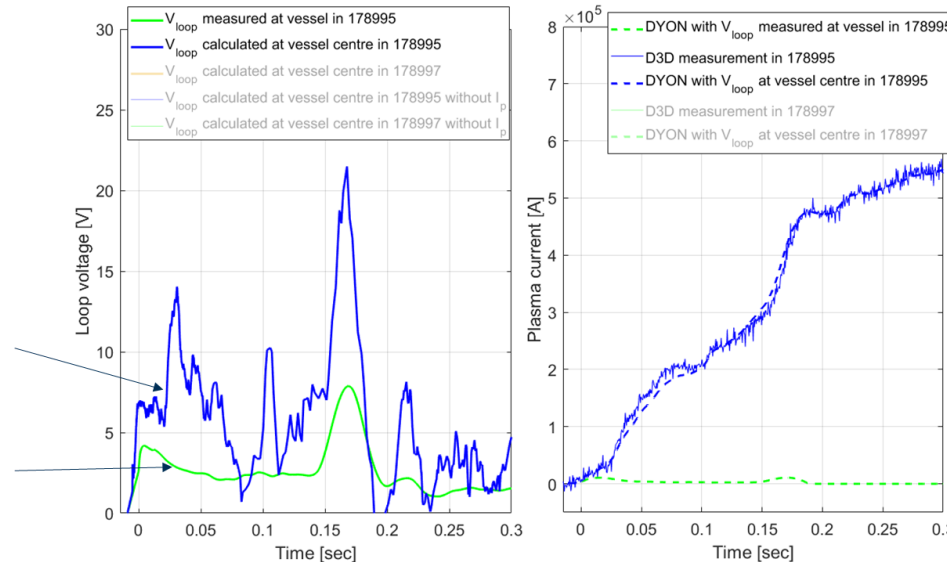


- Full circuit equations have been integrated in DYON, and synthetic flux loop data agrees well with measurement.

D-IIID modelling with DYON

V_{loop} calculated in the plasma position

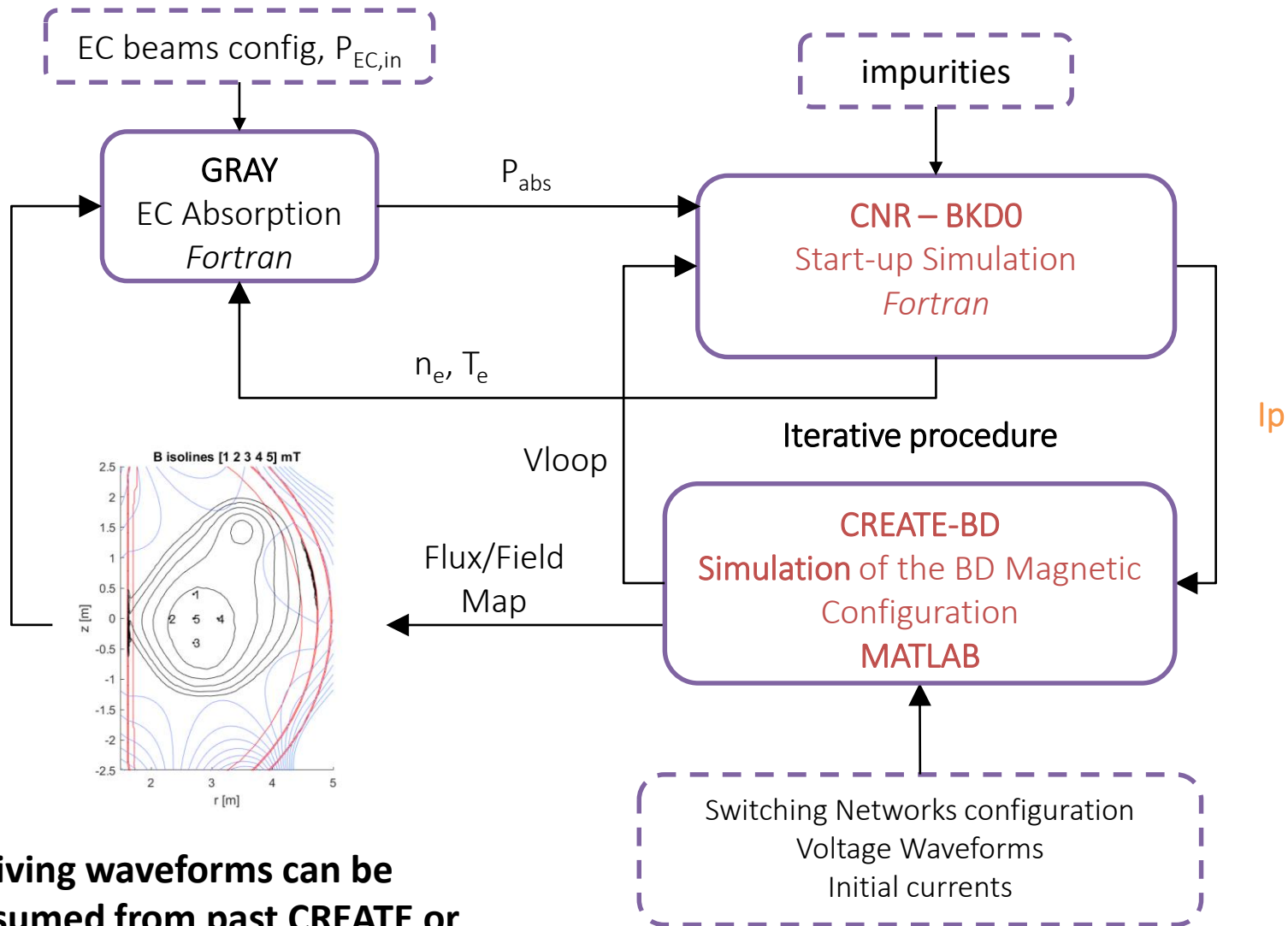
V_{loop} measured in the inboard mid-plane in D-IIID



[H.T KIM]

- Initiate the coupling to IMAS of CREATE-BD/BKD0/GRAY workflow
 - GRAY for EC beam reflection models
- Validation of CREATE-BD/BKD0/GRAY workflow
- Assess ECRH absorption in the initial phase of ITER

SP-2 : GRAY – BKDO – CREATEBD : The direct simulation scheme to be used for ITER-BD



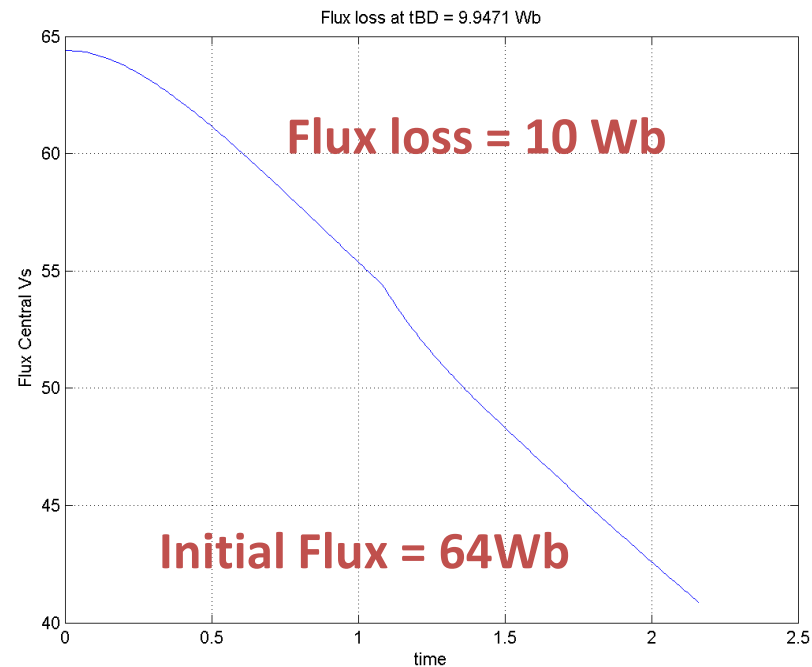
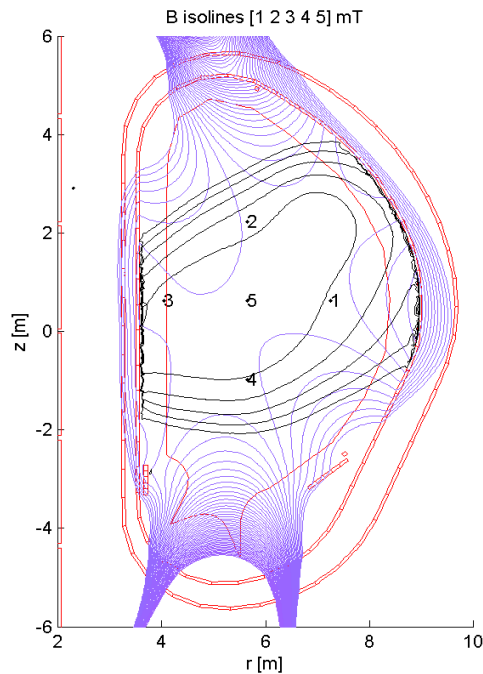
Driving waveforms can be assumed from past CREATE or DINA scenarios

D. Ricci, M. Mattei, L. Figini

SP2 : ITER magnetic model – Scenario Definition



- ITER magnetic Model for the BD phase has been developed by CREATE and compared with DINA models output
- Latest studies concentrated on FPO breakdown scenarios with half field and reduced current in the Central Solenoid



**Half toroidal field – Reduced current in the CS – FPO
(DINA/TRANSMAK-like Scenario ITER_D_WDRNWZ Doc. 23/4/18)**

SP-2 Development of IR temperature synthetic diagnostic for ITER real-time application and offline analysis.



A synthetic diagnostic: an end-to-end simulation aiming to model all physical phenomenon involved in the IR measurement chain: from source to optical response of instrument

1 IR Source Modeling

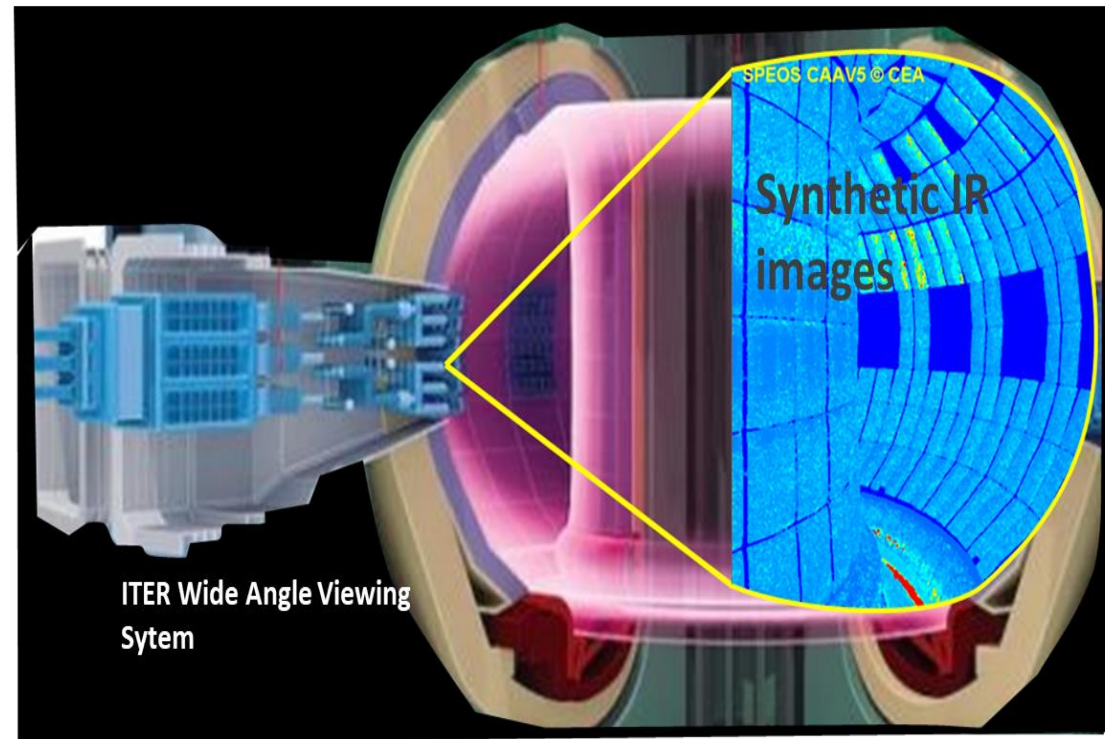
- Modeling of plasma heat loads deposited on PFCs (main IR source)
- Modeling of resulting 3D temperature field

2 Materials Thermal-radiative Modeling

- Emissivity model
- Reflectivity Model

3 Optics Modeling

- Camera model
- Optical Transfer Function



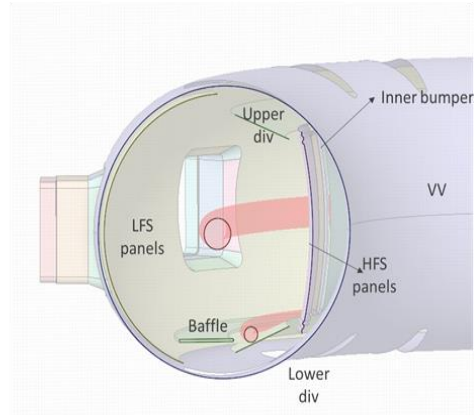
Light propagation in 3D model based on **Monte Carlo Ray Tracing (MCRT)** code (ANSYS-SPEOS CAAV5 here) getting all radiations of thermal scene

First results of RaySect vs ANSYS-SPEOS benchmarking

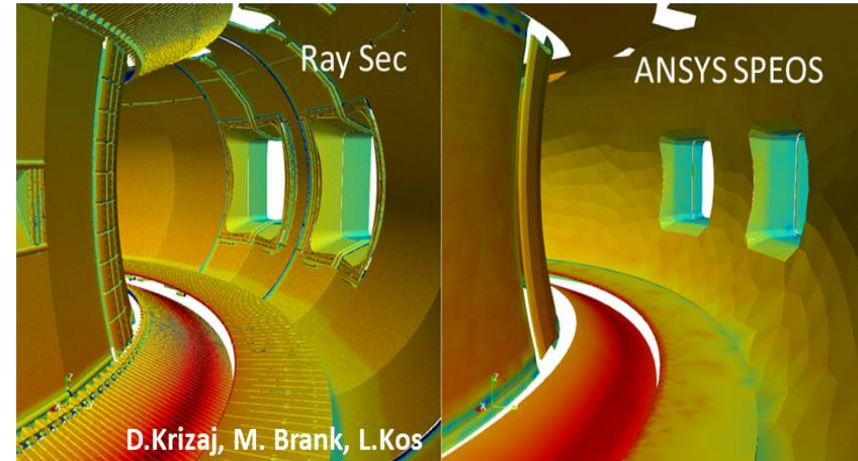


First comparison achieved on WEST tokamak:

- ❑ Good results obtained in **non-reflective case** (considering absorbing surface for all materials)

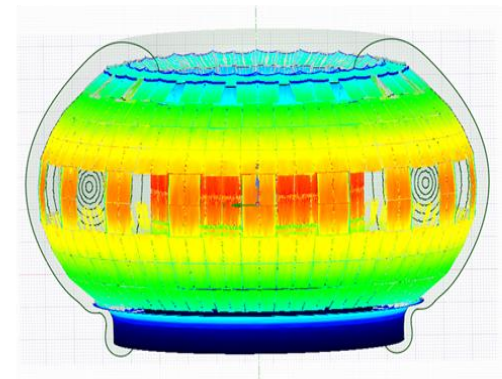


Non reflective case simulation



❑ Points to work :

- Computation of absorbed flux in **reflective case** in RaySec code
- Modeling of complex optical properties in Ray Sect
- Quantify the impact of sampling of plasma source (ITER antenna)



Incorporation of Ray-Sect inside the generalized platform SMITER

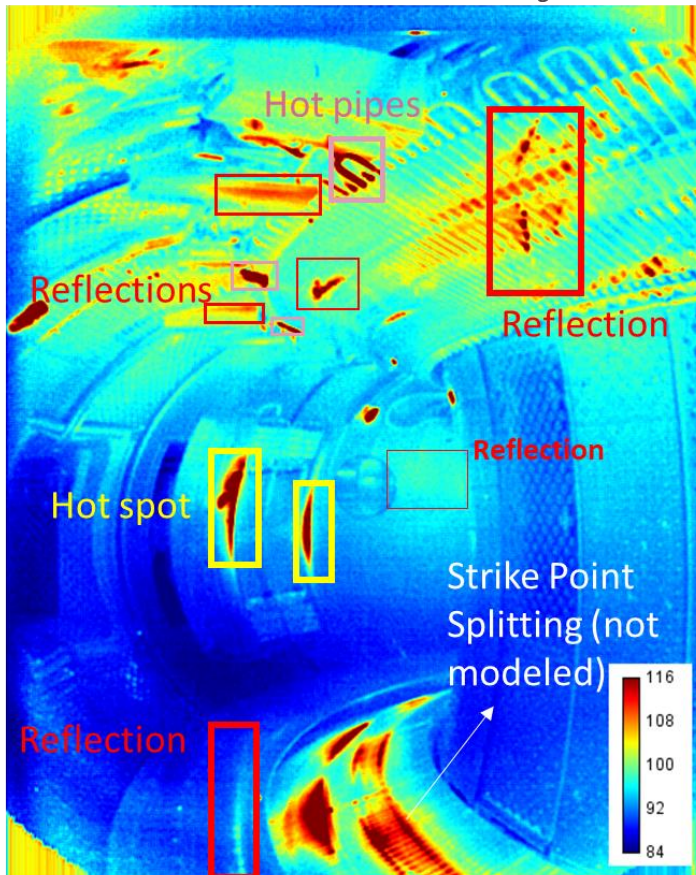
SP-2 Development of a wall thermal events & hot spot monitoring system



Off-line automatic detection of Hot-Spot

Experimental IR Image

#Pulse 55210 @ 7s($I_p=500$ kA, 4.4MW LH + 0.7MW FCI)
Brightness T° Map

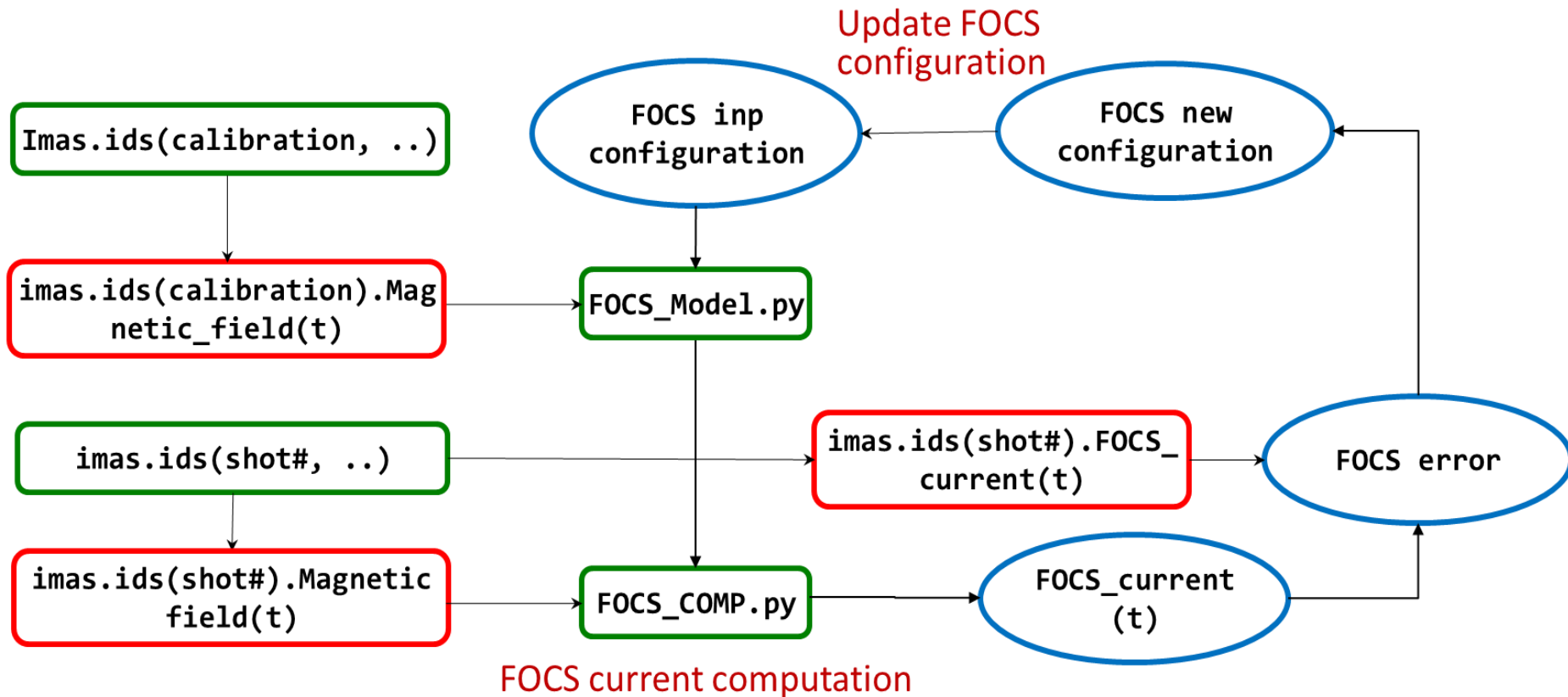


- develop a wall monitoring system for real time protection of ITER PFC
 - provide safe and high performance steady-state long duration operation
- To be tested on existing long pulse facilities (W7X and WEST) before ITER application
- human operators could not process a large numbers of thermal events
 - automatic detection with AI

SP-2 : Develop synthetic diagnostic for the Fiber Optics Current Sensor



- 2021 consists of defining the algorithm for a FOCS synthetic diagnostics fully compatible with ITER requirement and IMAS



- In 2022-23 the FOCS synthetic diagnostic in IMAS



- **Pedestal**

- More 4000 entries (JET, TCV, AUG, MAST-U)
- Validation by TE/JET participants
- 3 publications

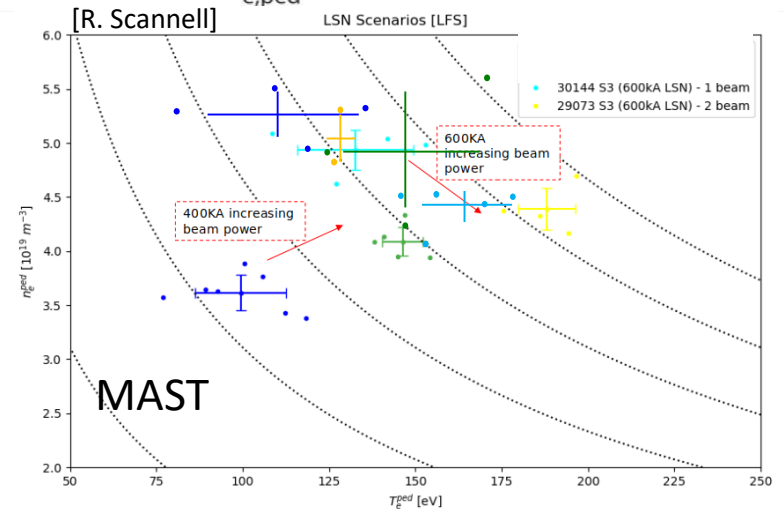
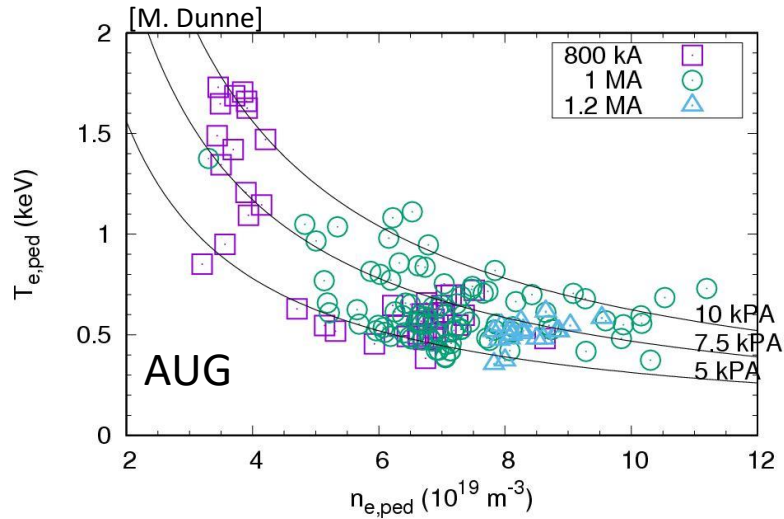
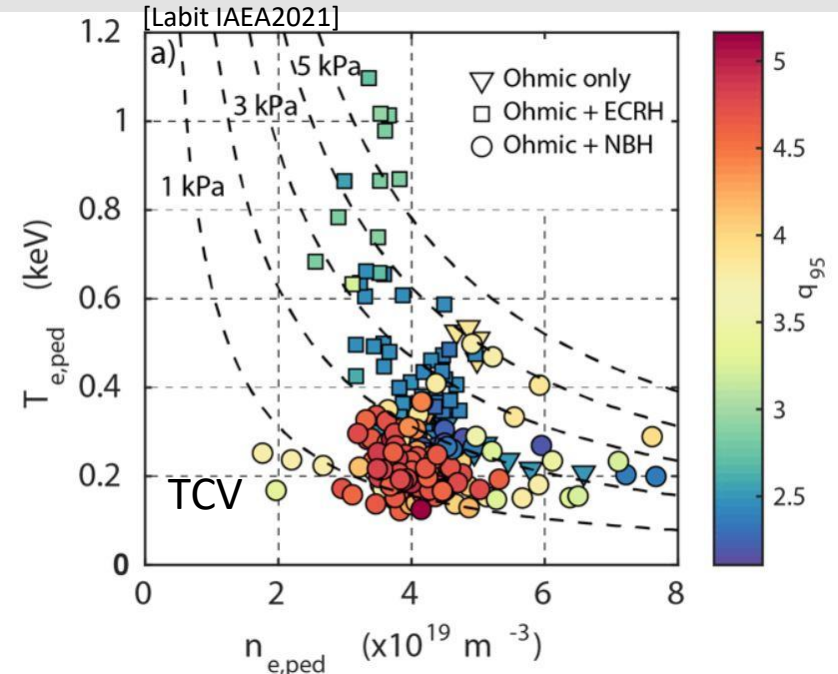
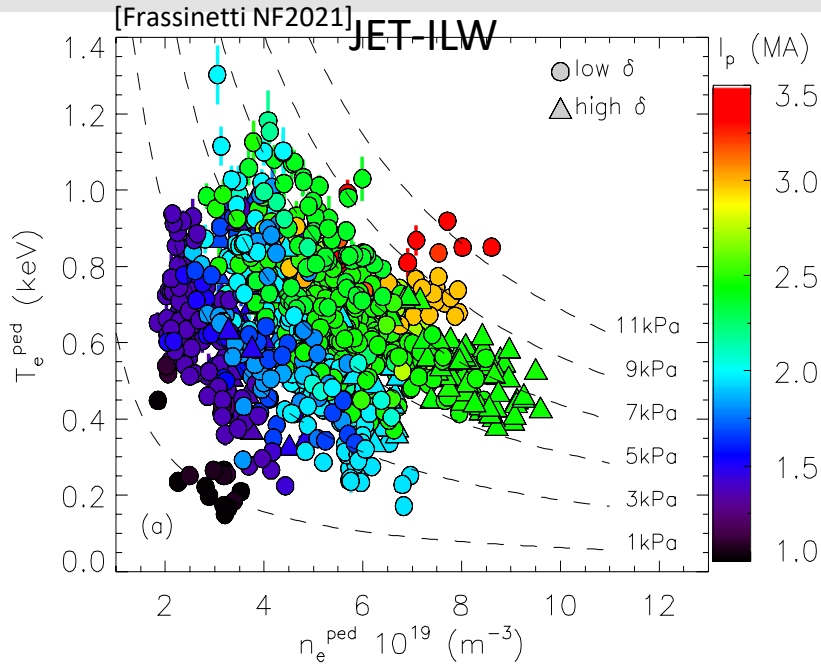
- **Confinement database**

- 0D: focus on Metallic wall machine
- Around 2000 entries : JET, AUG are included (data to be updated) – WEST has been contacted
- Start definition 1D data – JET pilot case

- **Disruption database**

- well-structured and standardized architecture: consistent data validation, provenance tracking and capability of reproducing analysis
- Automatic RE detection has been defined
- Support of disruption avoidance & modeling , Baseline scenario development at JET

Multi machines analysis of pedestal height



SP-3: Plant System and Plasma Operations



EUROfusion Operation Network (EON) established in 2021

[https://wiki.euro-fusion.org/index.php?title=WPPrIO-OP: EUROfusion Operations Network \(EON\)](https://wiki.euro-fusion.org/index.php?title=WPPrIO-OP: EUROfusion Operations Network (EON))

- 18 members from 9 associations including all European tokamak and stellarator facilities
- facilitate connection between the operational groups of EUROfusion facilities, to share operational experience, improve reliability and performance and support training of operators
- Set up competency-based subnetworks : NBI in 2021
- Support the EUROfusion preparations for ITER (integrated) commissioning and operation

2021 activities – “Foundation year”	Status
Establish EON network	Completed. First meeting held on 10th June 2021
Map out operational areas and identify the competencies of EUROfusion associations	Structure agreed. Expected at 2 nd EON meeting on 24/9/2021.
Map out operational roles and operator training in EUROfusion facilities	Structure agreed. Expected at 2 nd EON meeting on 24/9/2021.
Set up pilot EON subnetwork on the NBI competency	NBI seminar series with all NBI teams in Europe + JT-60SA, ITER and NBTF. First seminar expected in 2021.



WPPrIO area – NBTF – Negative Beam Test Facilities (Padova, Garching)

Proposal developed through discussions with and support from:

- EUROfusion PMU: Programme Manager, FSD Department Head, International Relations, Education
- Fusion for Energy: JT-60SA (deputy) project leader
- EUROfusion work packages: project leaders of WPPrIO, WPHCD, WPSA
- Consorzio-RFX, Padova - NBTF
- Large NBI teams; IPP Garching and Greifswald, UKAEA, QST
- Smaller NBI teams: IPP-Prague, CIEMAT, EPFL
- ITER Organisation – NBI group

Monthly NBI seminar series starting in 2021:

- Join the positive and negative ion beam communities in Europe and Japan focusing mainly on operations, although open to other topics as well.
- 2-hour monthly remote seminar. Focused-Discussion. Invite whole NBI operational team.
- Open to EUROfusion experts, ITER, F4E and QST staff.
- Bottom-up approach in participation, presenting and proposal of topics.

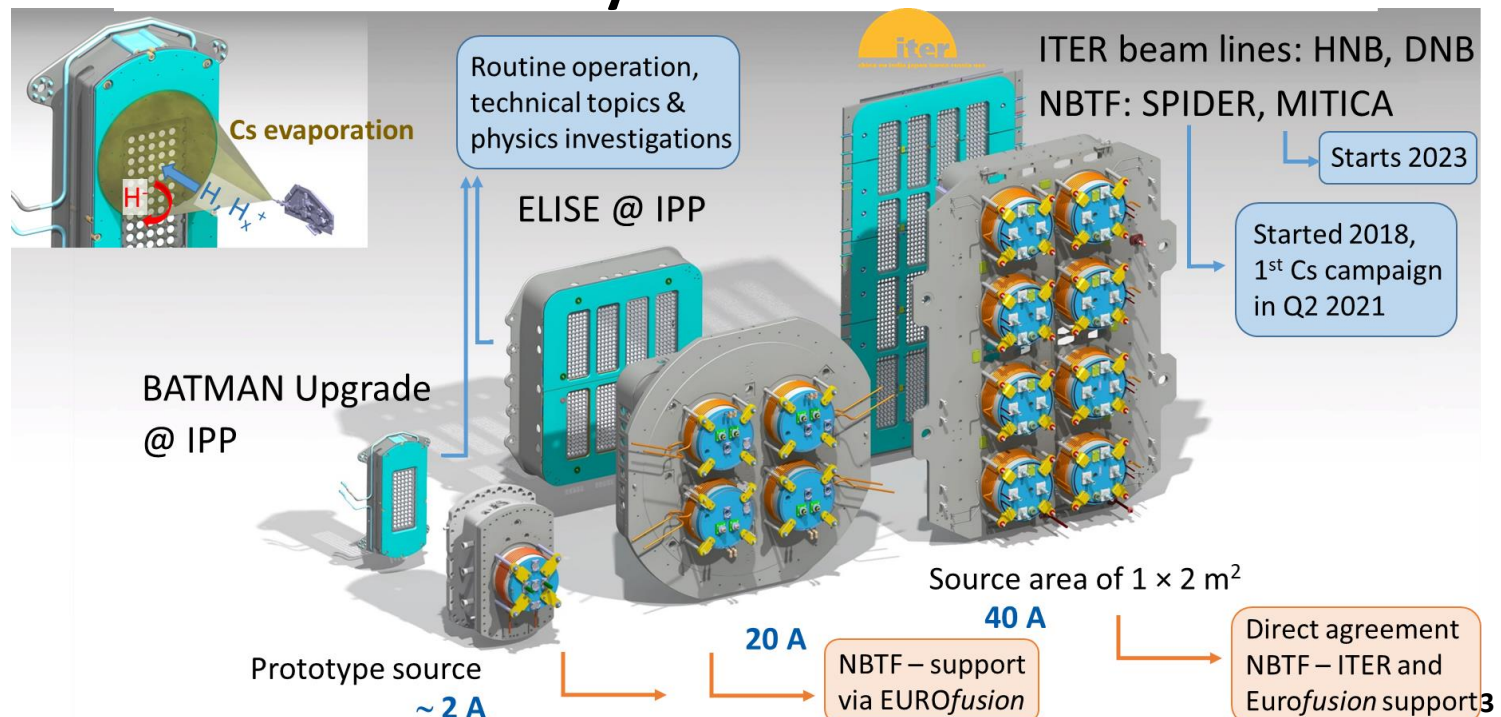


- **Knowledge capture, management and transfer of commissioning, operational experience and training**
 - Initial discussions with G. Lange (PMU Education)
 - Need for access-controlled knowledge database with advanced search tools and clearly identified short and long-term functionality.
 - Identify the type of operational information to begin knowledge database.
- **Contribute to ITER FILD diagnostic design – on hold**
 - Review: reciprocating scintillator detector or dedicated IR based solution?

SP-4: Neutral Beam Test Facility and R&D for ITER Neutral Beam



- **Support EUROfusion experts at NBTF (Consorzio RFX/Padova)**
 - Participate in the operation of the ITER Neutral Beam Test Facility SPIDER and MITICA **Up to 14 ppy/y**
- **Support EUROfusion experts at ELISE (IPP/Garching)**
 - ELISE and BATMAN Upgrade for the demonstration of CW operation in D or H **Up to 6 ppy/y**
- **Participation in the NBTF Advisory Committee**



SP-4: IPP support to NBTF and ITER NBI



- **Symmetrisation and reduction of co-extracted electrons (D₂ op.)**
 - Biasing surfaces in combination with magnetic filter field configuration
- **Long pulse operation**
 - Test HV power supply has started (July) on ELISE following a successful completion of the tests on dummy load , 35kV reached (60kV Max) for short pulse
- **Temporally stable co-extracted electron current for long pulses**
 - Cs management, evaporation rate, oven position and nozzle, modelling with CsFlow3D
- **Detailed studies of beam optics: divergence and beamlet deflection**
 - Experiments complete with the “MITICA like grid” on BUG following request from IO

	Q1	Q2	Q3	Q4
Symmetrisation of coex. electrons (ELISE)	█			
Commissioning of cw-PS on ELISE		█		
stepwise increase of pulse length on ELISE			█	
installation/commissioning of cw calo. on ELISE				█
studies on beam optic on BATMAN	█			
installation/commissioning of ITER-like grids on BATMAN		█		
compensation of beamlet zig-zag deflection on BATMAN			█	
beam optics studies on BATMAN				█

summer break

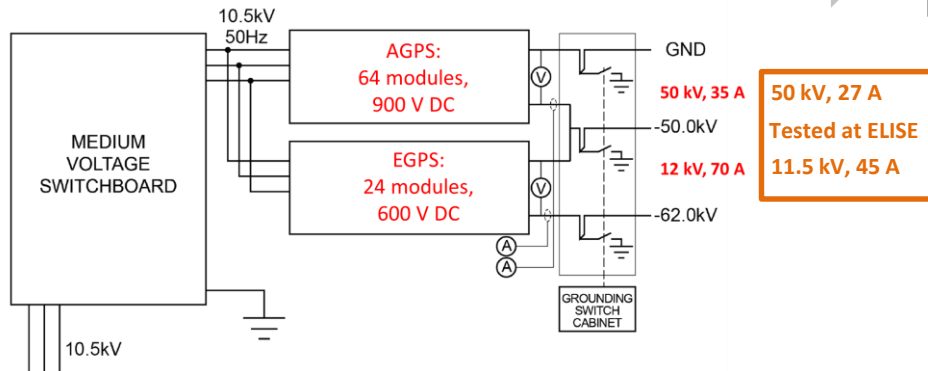
ELISE: Upgrade for cw beam extraction



► Installation of a cw calorimeter → end 2021

► **CW power supply for beam extraction**

Supported by EUROfusion

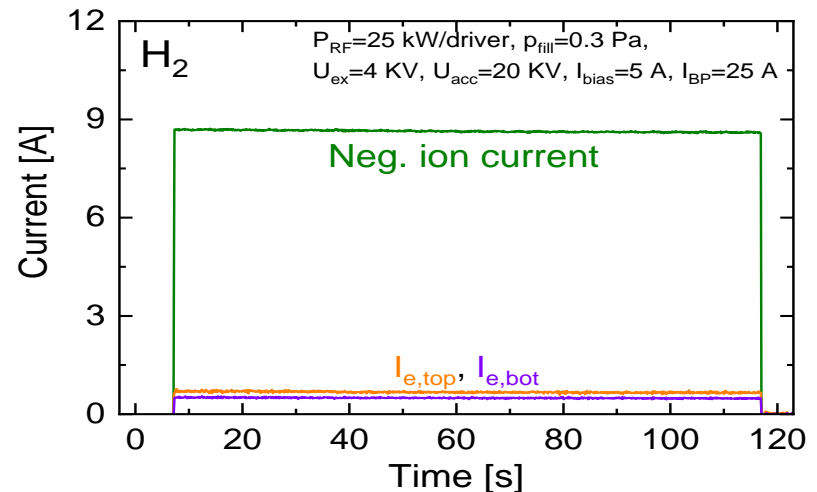


Full relevance
of ELISE for
NBTF & ITER



Commissioning started in 2021

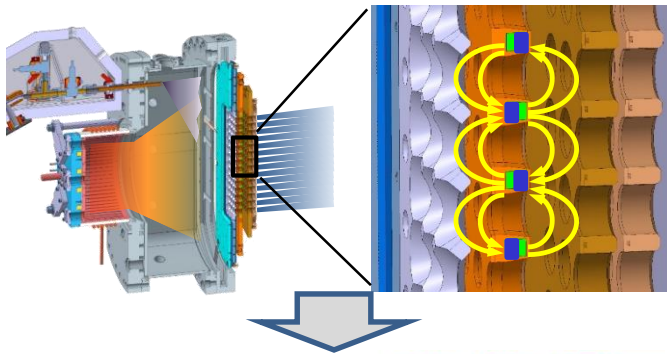
- ✓ Completed on dummy load in April 2021
- ✓ Connected to ELISE in July 2021
- ✓ **First 100 s cw extraction achieved**



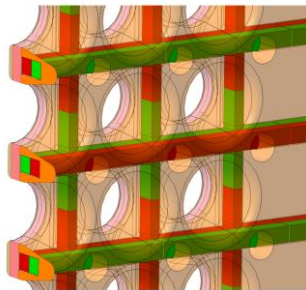
Beam optic studies: BUG-MLE- Test of MITICA-like grid extraction system



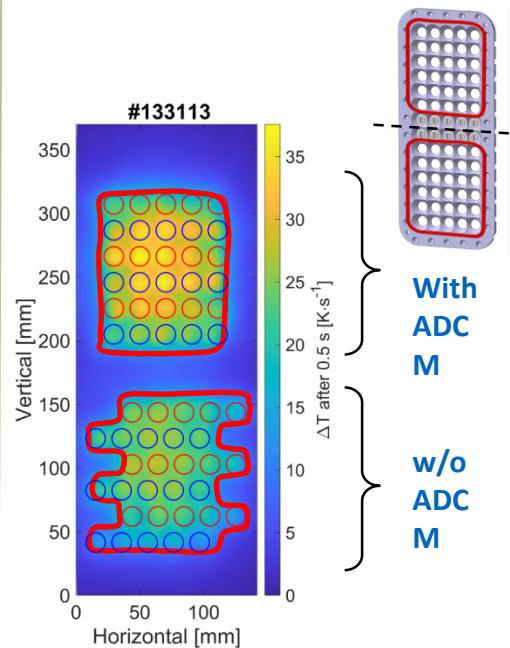
- co-extracted electrons deflected out of the beamlet by permanent magnets before acceleration: induce a row-wise zig-zag deflection of the beamlets.



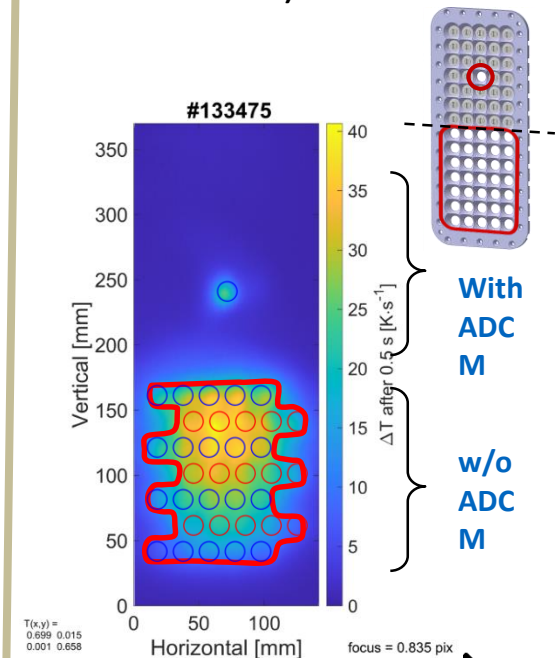
Correction magnets:
ADCM



Compensation of zig-zag deflection → Successful in a wide operational regime



Single beamlet divergence deflection → Measurement of footprint possible (new 1D CFC calorimeter)



Jul. 2021
Report sent to ITER

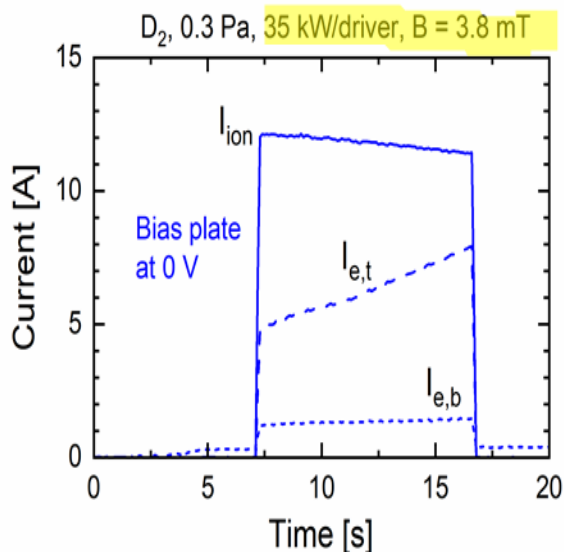
ELISE: Symmetry and reduction of co-extracted electrons in D



Change of potentials by biasing surfaces and adjusting magnetic filter field

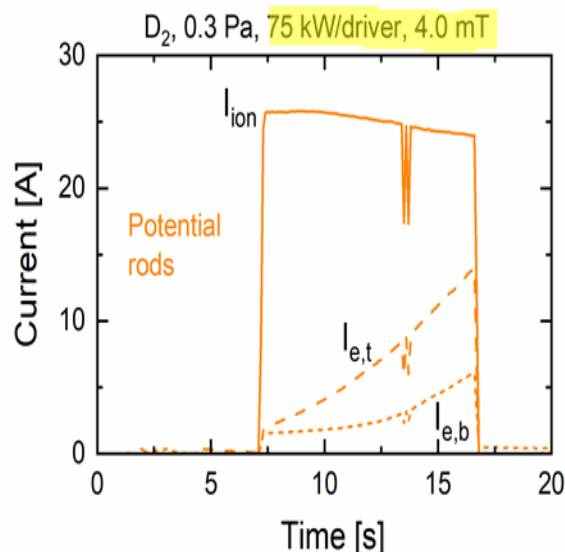
Reference scenario (ITER case)

PG positively biased, source at 0 V
bias plate connected to source



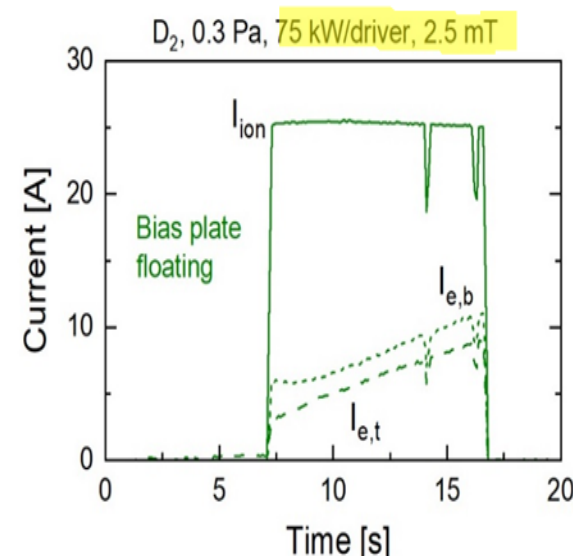
Performance limited by electrons

Additional potential rods
(introduced at ELISE
to achieve hydrogen target)



Strong reduction and improved symmetry of co-extracted electrons
High power pulses possible -> long pulses will be tested next

Bias plate floating
can replace additional rods
ITER relevant





SPIDER

- **Campaign up to Mid-July**
 - First campaign using caesium in H_2 and D_2
- **Issues with HV breakdowns that induce noises in the PS electronics and stop op.:**
 - dedicated campaign of 4-6 weeks (starting end of august) to understand/solve before long shutdown starting early Oct.
- **Long shutdown:**
 - Update SPIDER Beam source
 - Enhancement of vacuum system
 - Substitution of RF oscillators with solid state amplifiers

MITICA

- **Commissioning of PS**
 - integrated tests
 - No load tests
 - Load tests
 - Test simulating grid breakdowns
- **Complete inspection performed to clarify the reasons of the breakdown reported during the commissioning of 1MV PS.**
- **Schedule is being updated**
 - Objective is to complete investigation by September so that the plan for repair could be developed
- **High Voltage Holding Tests**



- **Assumption: JET operation ends in 2021**
- **2022 and 2023 resources allocated to complete DT analysis**
- **2021 elaboration of EUROfusion activities for ITER**
 - **Neutronics, nuclear instrumentation**
 - **Working group (EUROfusion, IO, F4E) to define the 2022-2025 activities**
 - **Rosaria Villari ENEA Chair**
 - Yannick Penelieu CEA
 - Lee Packer CCFE
 - Rafael Jaurez CIEMAT
 - Maurizio Angelone ENEA
 - Jerzy Mietelski IPPLM
 - Luka Snoj JSI
 - Dieter Leichtle KIT
 - Theodora Vasilopoulou NCSR
 - **M. Loughlin, IO and M. Fabbri, F4E**



- Collaboration extended for one year 2021
 - Benchmark Neutronics Simulation Computer Codes under the EURATOM – U.S. DOE Agreement
 - Exploitation of Advantage
 - optimization of ORNL tools for application EU DEMO analysis
- Decision on the collaboration extension beyond 2021 to be taken once clarity is provided on the JET extension & programme and « neutronics » activity under PrIO



PLANNING (Gantt chart), MILESTONES, DELIVERABLES



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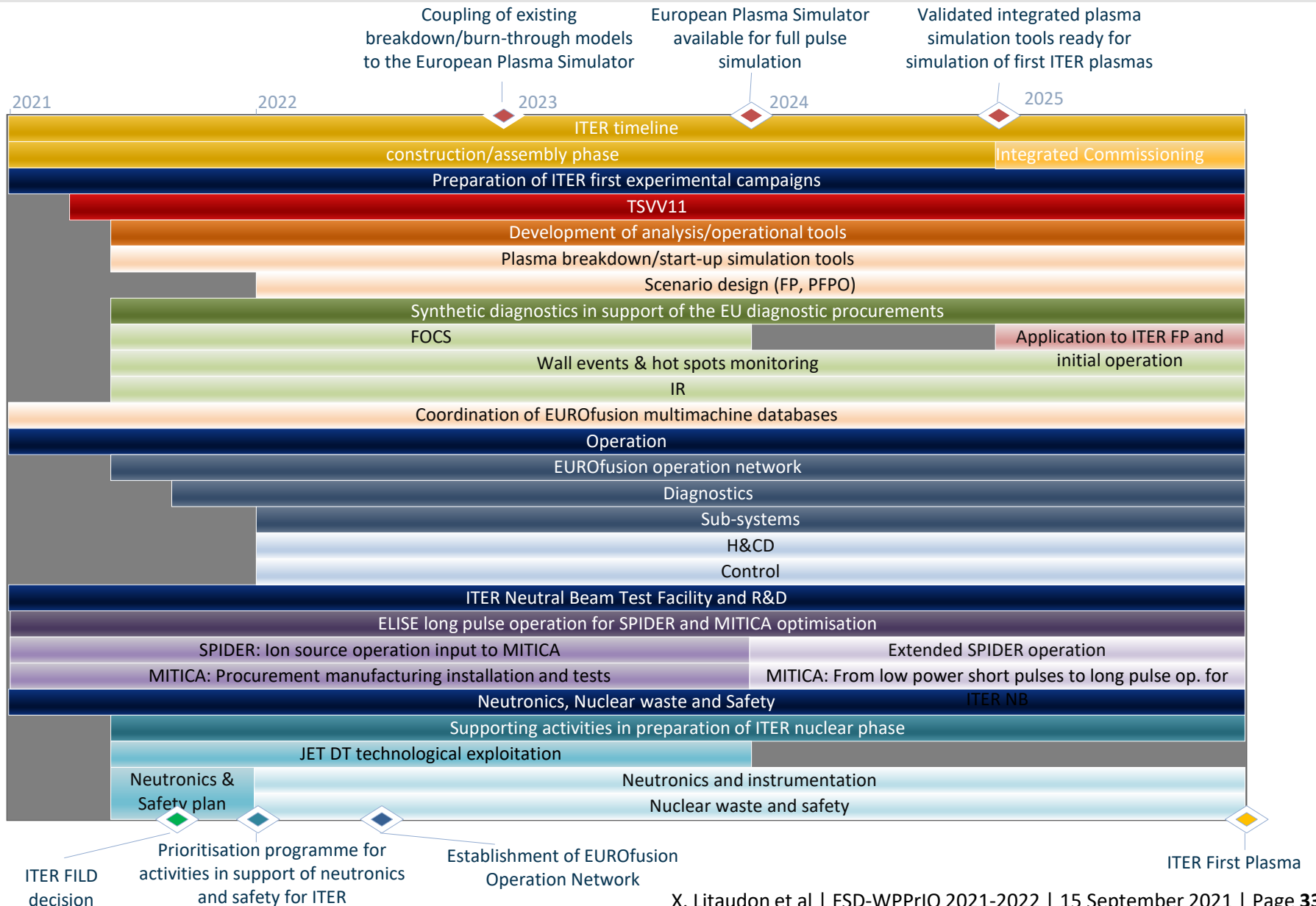
2021 Milestones and Grant Deliverables



no.	Milestones	Due Date
PRIO.M.01	All existing components of the European Plasma Simulator (Python workflow) hosted on the EUROfusion Git (TSVV11)	Dec. 2021
PRIO.M.02	First release of a user friendly interface for the European Plasma Simulator (Python workflow) (WPAC and TSVV11)	Dec. 2021
PRIO.M.08	Assessment of the EUROfusion human resources requirements and their implementation for the efficient EUROfusion participation in the NBTF completed	Jun. 2021
PRIO.M.09	Commission the new CW power supply on ELISE facility completed	Jun. 2021
PRIO.M.10	Installation and commissioning of CW diagnostic calorimeter on ELISE facility completed	Dec. 2021
PRIO.M.13	Prioritisation programme for 2022-2025 of activities in support of neutronics and safety for ITER	Dec. 2021

no.	Deliverables	Due Date
PRIO.D.11	Report on EUROfusion participation in ITER NBTF, ELISE and BUG activities	Dec. 2021

PrIO Baseline timeline - Gantt chart





Resources

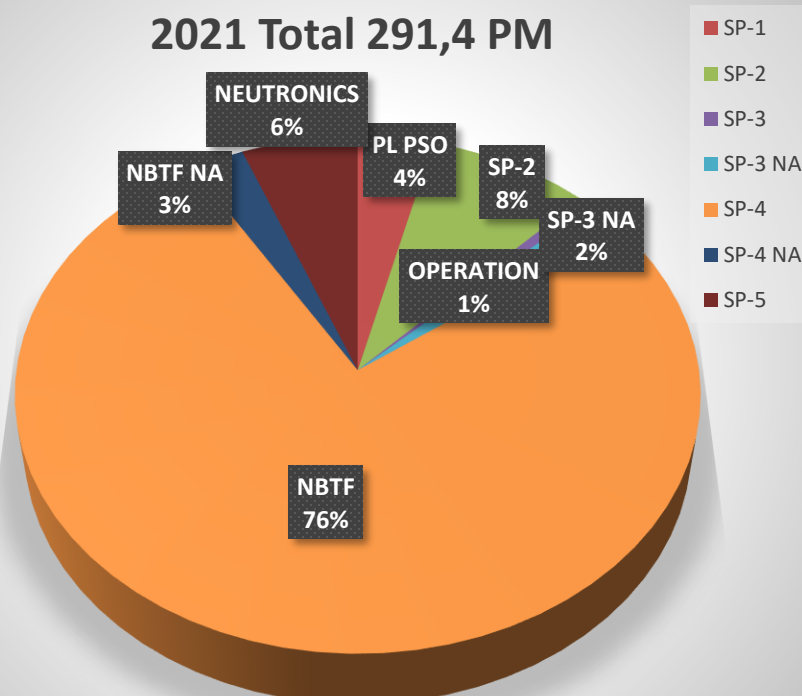


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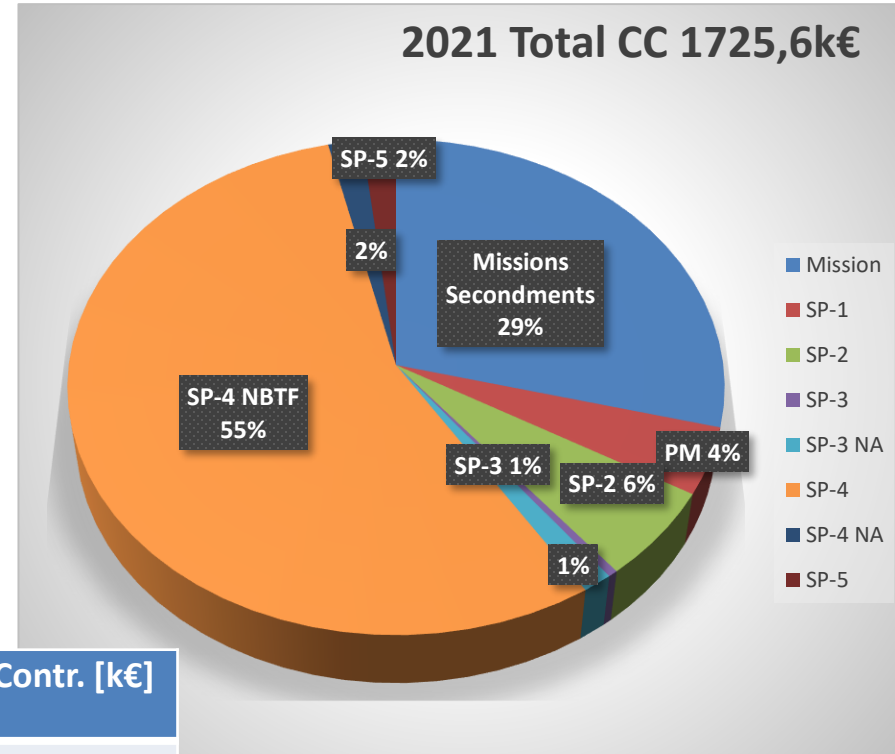
2021 Resources distribution per sub-project



2021 Total 291,4 PM



2021 Total CC 1725,6k€



	Total Cons. Contr. [k€] 2021
SP-1 PL & PSO	75,228
SP-2	101,247
SP-3 Operation	7,625
SP-3 NA	23,438
SP-4 NBTF	955,234
SP-4 NA	31,250
SP-5 Neutronics	31,294
Mission & Secondement	500,250
Total général	1725,567



Back-up



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- **“Whilst integration between work packages is essential for both ITER and DEMO, there are two convening work packages that bring together this breadth: **WPPrIO consolidates the preparation for ITER operation, though the contributions to ITER exist in every work package**, whilst the DEMO Central Team (supported by WPDES) coheres the design capabilities in each work package, whilst taking advantage of the capabilities and skills developed for ITER”**

WG recommendations on ITER operation and scientific exploitation



- **Divertor and Plasma Facing Components:**
 - Pursue and develop a comprehensive programme (EUROfusion/F4E)
- **Nuclear aspects (safety, licensing and neutronics)**
 - Actions on knowledge management to be elaborated
- **Neutral Beam Heating and CD system**
 - Ensure the success of NBTF operation
- **Diagnostics**
 - Promote actions to take advantage of the diagnostics provided by F4E
- **Analysis/operational/simulation tools**
 - Effort to be focused on scientific priorities
- **Knowledge Management**
 - managing proactively the involvement in ITER Operation and Commissioning in view of both developing experienced engineers and transferring knowledge to DEMO design

SP-2 : Pedestal Database People involved



In blue: people active in 2021 in the project via the database activity, via WPJET1 or via WPMST1/WPTE

- Coordinator: L. Frassinetti
- JET
 - **L. Frassinetti** (KTH): workflow, main scripts for local DB in IDL, pre-ELM data processing, script to transfers DB to IMAS, coordination
 - **P. Bilkova** (IPP.CR), **P. Bohm** (IPP.CR), R. Fridström (KTH) for pre-ELM data processing
 - S. Saarelma (UKAEA), **H. Nyström** (KTH) for PB stability analysis
 - E. Giovanozzi (ENEA), equilibrium
- TCV
 - **B. Labit** (SCP): main scripts in matlab, pre-ELM data processing, PB stability analysis, script to transfers DB to IMAS
- AUG
 - **M. Dunne** (IPP): main scripts in matlab, pre-ELM data processing, PB stability analysis, script to transfers DB to IMAS
- MAST-U
 - **R. Scannell** (UKAEA) main scripts in matlab, pre-ELM data processing, PB stability analysis, script to transfers DB to IMAS
- IMAS
 - **F. Imbeaux, M. Owsiak**

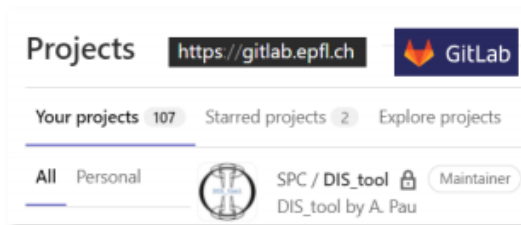
SP2: Confinement database 0D and 1D databases

- **0D:** Metallic wall machine are considered: JET, AUG are included (data to be updated). WEST has been contacted in August 2021.
- Quantities are labelled according to the ITPA standard; data will be provided to EUROfusion according to IMAS standards.
- **JET:** 938 entries from 853 pulses, with isotopic mixtures and high performing pulses ($I_p \in [1.0, 4.0] MA$, $n_e \in [2.0, 9.7] 10^{19} m^{-3}$, $B_t \in [1.0, 3.9] T$, $M_{eff} \in [1, 2]$, $\tau_{th} \in [0.13, 0.36] s$)
- **AUG:** 866 entries from 422 pulses. The fast particle contributions and confinement times have been corrected for specific pulses (313/422 pulses) by AUG experts using the RABBIT code ($I_p \in [0.6, 1.2] MA$, $n_e \in [3.7, 15.9] \cdot 10^{19} m^{-3}$, $B_t \in [1.6, 2.9] T$, $M_{eff} \in [1, 3]$, $\tau_{th} \in [0.03, 0.2] s$).
- **WEST :** Contacts with WEST started in 2021. Data will be added when available.
- **1D:** JET data have been chosen to build the starting nucleus of the DB.
- Preparatory meetings have been done with selected specialists; others, also with modelers (from TSVV11) are expected to be scheduled by the end of the 2021 activities to outline the required features to be added.

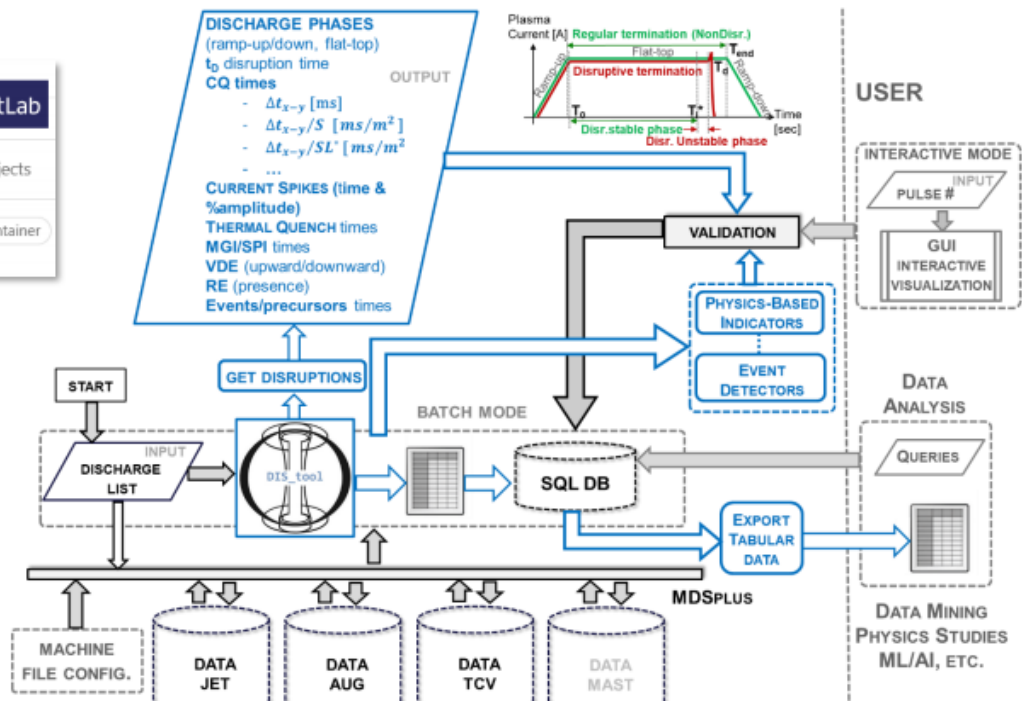
SP2: Disruption database



- Disruption database workflow has been finalized in a standardized/generic way , GUI for visualisation
- Automatic RE detection has been defined
- well-structured and standardized architecture: consistent data validation, provenance tracking and capability of reproducing analysis
- Support of disruption avoidance & modeling , Baseline scenario development at JET
- Future work: advance with disruption validation (several concrete applications so far and preliminary validation for hundreds/thousands of disruptions for AUG-TCV-JET) and fill Web catalogue



- Project under **version control**;
- Regularly maintained by SPC-EPFL (full pipeline implemented on "Lacs");
- The code can be run as well on FREIA, Heimdall (CCFE) and TOKI (IPP) computing clusters.





Risk Identification



This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

Risk Identification	Rating Pre-Mitigation					Strategy / Mitigation	
Risk Title, Category, Owner, Description & Details (a) "As a result of..." (b) "There is the risk that..." (c) "Resulting in..."	Likelihood ¹	Impact ²			Risk Level ³		Treatment Strategy & Risk Mitigation Actions (Comments, Details, Due Dates, etc.)
		Tech	Cost	Sched.			
Risk Title: European Plasma Simulator not sufficient to provide answers required for ITER Risk Category: Technical Risk Owner: C. Bourdelle Description: As a result of reduced resources there is a risk that European Plasma Simulator and IMAS workflows are not ready for ITER simulations	3	3	1	3	9	high	Treatment Strategy: escalate/transfer Risk Mitigation Actions: Increase resources for code development and for IMAS support
Risk Title: Lack of EU involvement in the participation in the EUROfusion Operation Network Risk Category: Project Management Risk Owner: E. Belonohy Description: As a result of low resources there is a risk of a lack of involvement and support in the participation in the EUROfusion Operation Network	2	1	1	1	2	Low	Treatment Strategy: avoid Risk Mitigation Actions: Increase coordination and resources on specific funded tasks. Prioritise activities
Reduced EUROfusion participation in the NBTF and ELISE/ BATMAN Upgrade facilities Risk Category: Project Management Risk Owner: X. Litaudon Description: As a result of lack of EUROfusion interest there is a reduction in the EUROfusion participation in the NBTF and ELISE/ BATMAN Upgrade facilities	2	3	1	3	6	medium	Treatment Strategy: reduce Risk Mitigation Actions: Promote this R&D activity (e.g. EUROfusion seminars, career development plan with ITER to attract and retain the new generation of engineers) at the EU level
Delay in the achievement of long pulse operation (up to 3600s) extraction on ELISE	2	3	3	3	6	medium	Treatment Strategy: reduce Risk Mitigation Actions: Focus EU effort to understanding

Risk Identification	Rating Pre-Mitigation					Strategy / Mitigation	
Risk Title, Category, Owner, Description & Details (a) "As a result of..." (b) "There is the risk that..." (c) "Resulting in..."	Likelihood ¹	Impact ²			Risk Level ³		Treatment Strategy & Risk Mitigation Actions (Comments, Details, Due Dates, etc.)
		Tech	Cost	Sched.			
Delay in the achievement of long pulse operation (up to 3600s) extraction on ELISE facility Risk Category: Technical Risk Owner: U. Fantz Description: For technical reasons it is difficult to achieve long pulse operation on ELISE	2	3	3	3	6	medium	Treatment Strategy: reduce Risk Mitigation Actions: Focus EU effort to understanding (including modelling) the limiting factors and consequences for ITER
JET DT does not provide enough data for neutronics analysis (Reduced performance of the JET DT campaigns and reduced level of 14 MeV neutrons) Risk Category: technical / external Risk Owner: R. Villari Description: For scientific reasons the level of D-T neutrons is lower than expected for neutronics analysis.	3	4	3	3	12	Very-High	Treatment Strategy: accept Risk Mitigation Actions: Revise the objectives in terms of irradiation of ITER materials and radiation damage. Revise the resources on the related modelling activities.
Low level of coordination between WPPrIO and ITER-IO on common topics (IMAS development, ITER simulation, neutronics, NBTF...) Risk Category: Project management Risk Owner: X. Litaudon Description: As a result of insufficient coordination there is a risk a divergence between the priority actions set within PrIO and the ones requested by ITER-IO or F4E	2	3	1	1	6	Medium	Treatment Strategy: avoid /escalate Risk Mitigation Actions: Increase the coordination level between WPPrIO and ITER-IO/F4E by setting-up specific coordination meetings.



Resources



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International Collaborations



ID	International Collaboration in WP Activities	Planned period(s) of engagement
IC01	<p>US:</p> <ul style="list-style-type: none"> - Collaboration on integrated modelling with SciDac initiatives - Collaboration on neutronics code development and validation with Oak-Ridge National Laboratory and University of Wisconsin 	2021-2025
IC02	<p>IO:</p> <p>Coordination and support to the participation to the International Tokamak Physics Activity (ITPA), ITER fellow network, ITER operation network and specific ITER Task Forces</p>	2021-2025
IC03	<p>IO/F4E:</p> <ul style="list-style-type: none"> - Scientific collaboration that needs to be developed to ensure that WPPrIO Programme remains focused on the ITER Research Plan -Collaboration on integrated modelling 	2021-2025
IC04	<p>IO, F4E, India, Japan: Collaboration on the NBTF operation and scientific involvement</p>	2021-2025

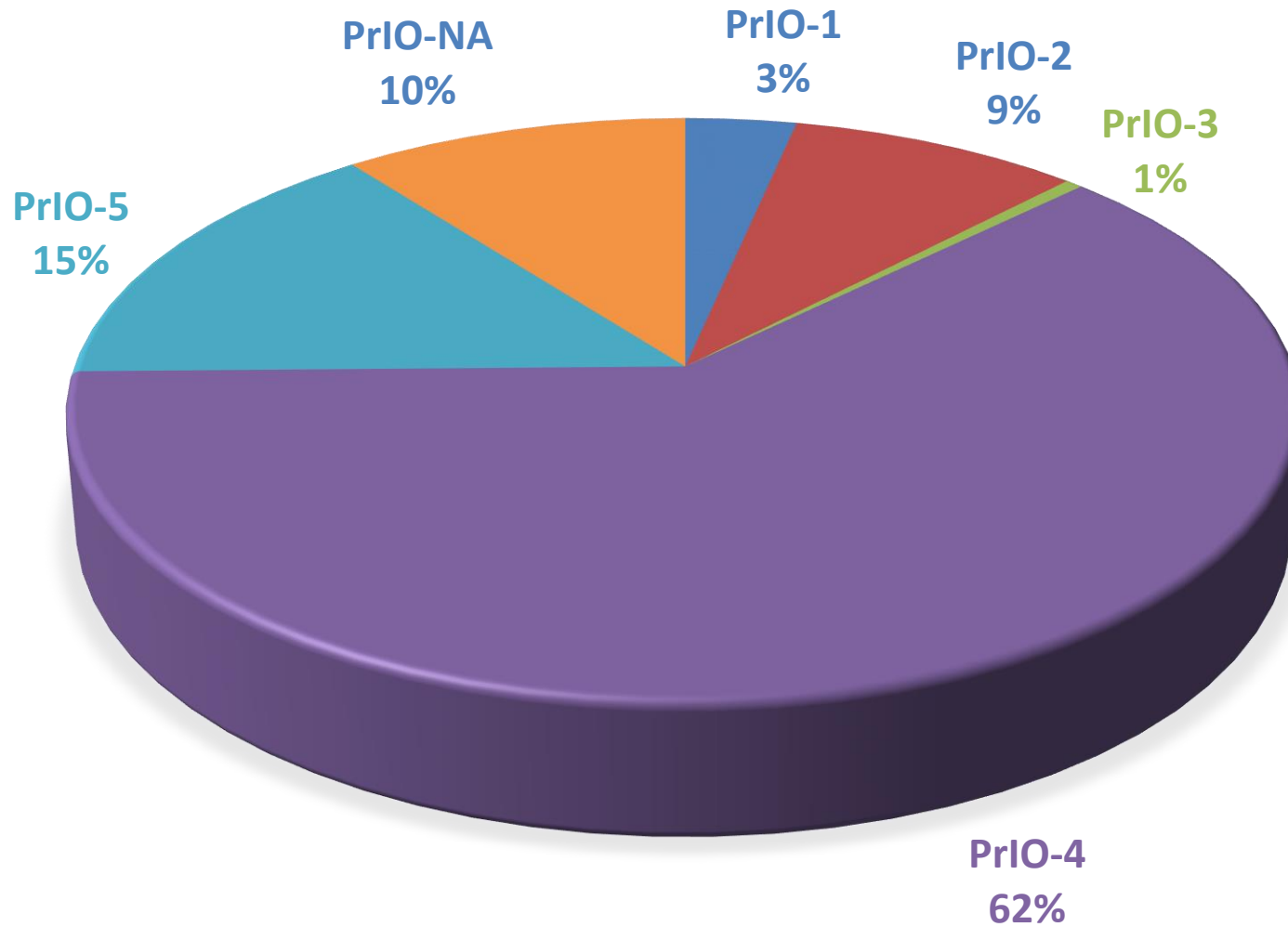
Resources 2021-2025 per sub-project



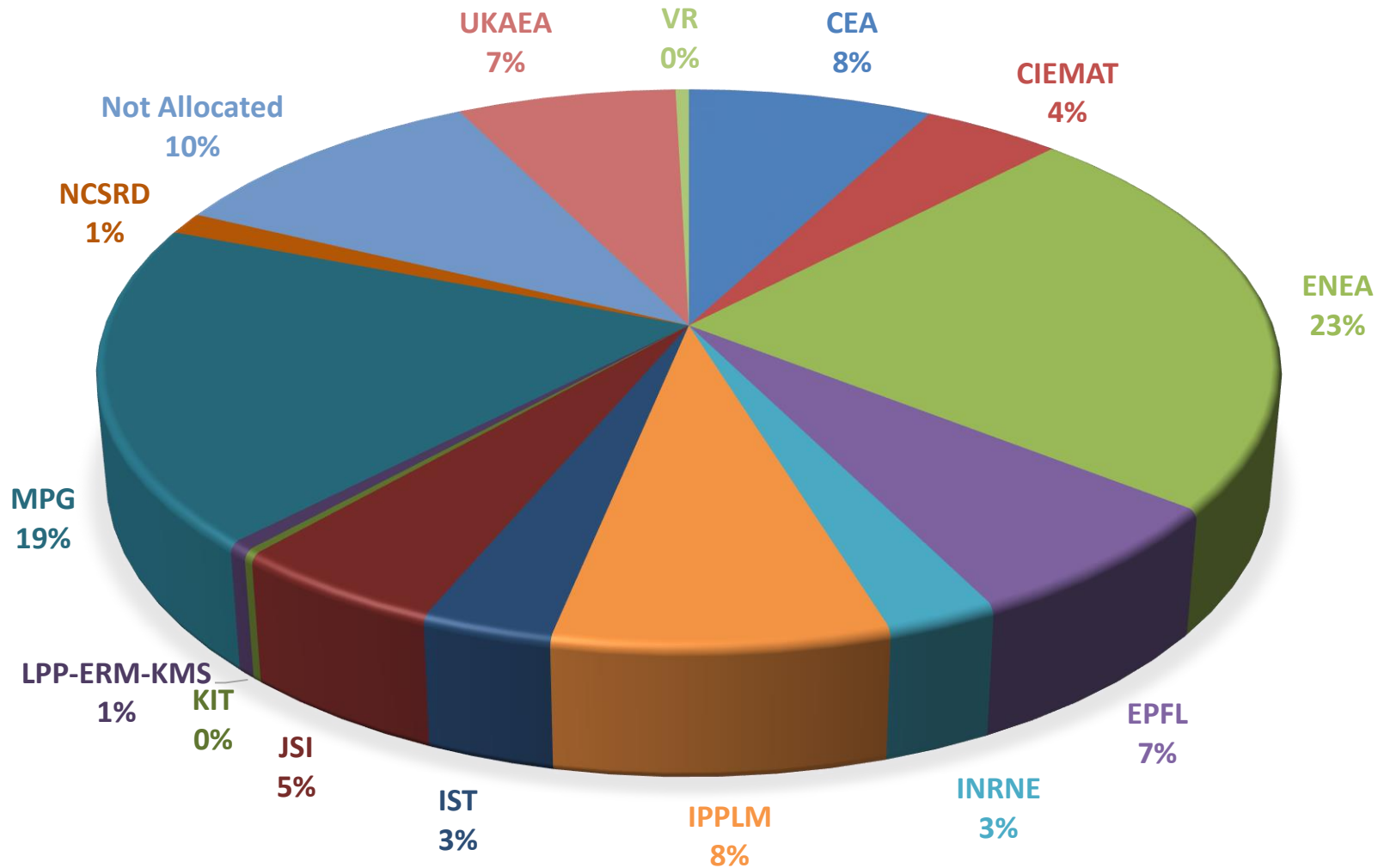
Sub-project	PM	Total Resources [k€]	Total Cons. Contr. [k€]	
SP-1		64,0	622,7	435,9
SP-2		168,5	1484,7	742,4
SP-3		10,0	78,6	39,3
SP-4		1182,0	12943,8	7560,1
SP-5		282,3	1773,2	743,2
PrIO-NA ³		199,4	1601,8	809,6
Sum		1906,2	18504,8	10330,5

³PrIO-NA covers all the non-allocated resources (mission, NBTF secondment, human resources)

PM Resource 2021-2025 per sub-project



PM Resources 2021-2025 per beneficiaries



Resources 2021-2025 per beneficiaries



Beneficiary	PM	Total Resources (k€)	Cons. Contr. (k€)	
CEA		148,0	1439,0	844,0
CIEMAT		84,0	507,2	253,6
ENEA		446,0	3229,4	1613,0
EPFL		133,0	1711,5	855,7
INRNE		51,0	111,0	55,5
IPPLM		153,0	702,1	190,6
IST		60,0	319,0	159,5
JSI		98,0	498,3	249,2
KIT		5,0	44,9	22,4
LPP-ERM-KMS		10,0	97,2	48,6
MPG		354,0	4498,6	2123,4
NCSRD		24,0	124,1	61,2
UKAEA		132,8	1077,7	535,1
VR		8,0	68,0	34,0
Secondment		0,0	2475,0	2475,0
Non-allocated		199,4	1601,8	809,6
Sum		1906,2	18504,8	10330,5

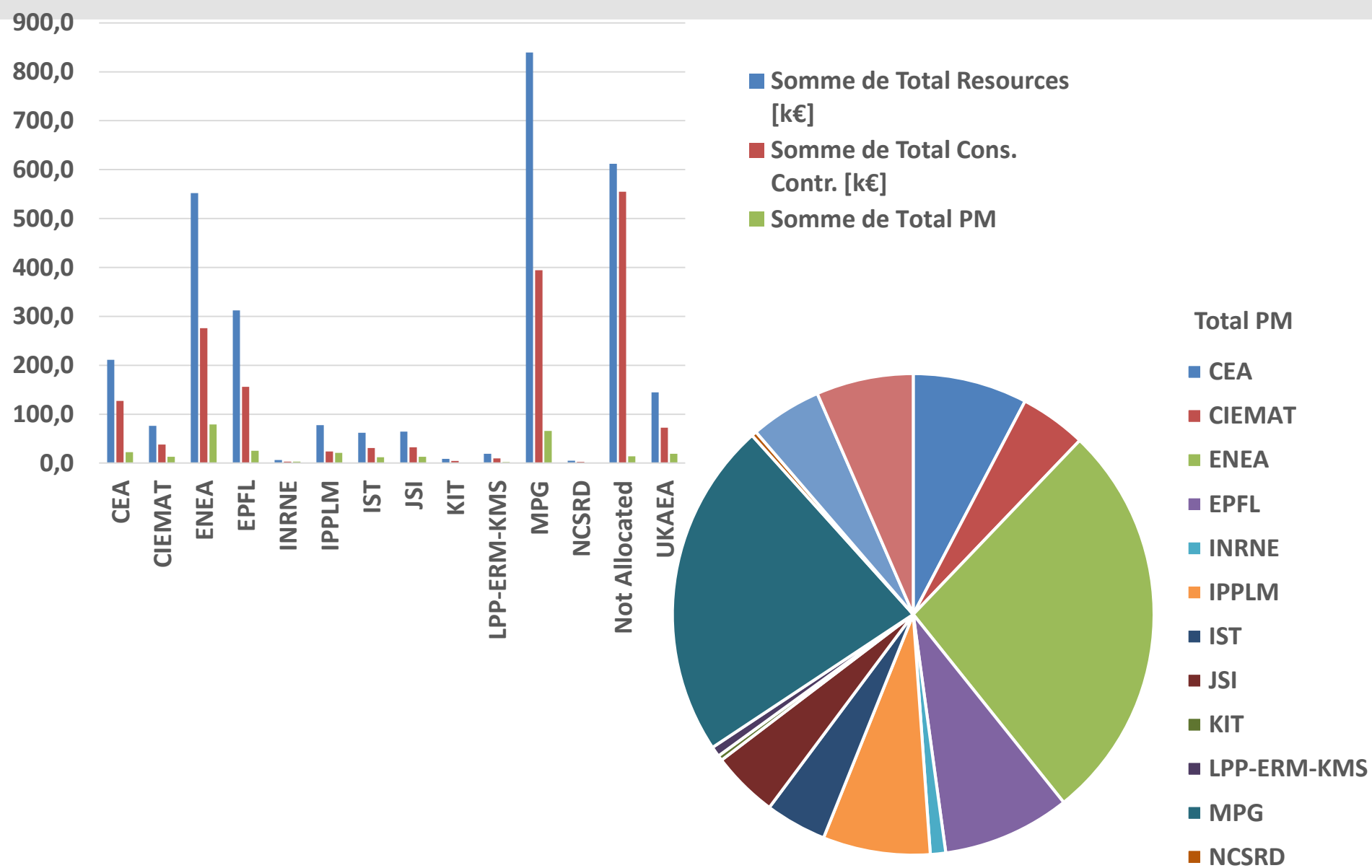
Resources Breakdown for 2021



Beneficiary	PM	Total Resources [k€]	Total Cons. Contr. [k€]
CEA	22,4	211,2	127,1
CIEMAT	13,0	76,4	38,2
ENEA	79,0	552,2	276,1
EPFL	25,0	312,0	156,0
INRNE	3,0	6,3	3,1
IPPLM	21,0	77,7	24,0
IST	12,0	61,9	30,9
JSI	13,0	64,2	32,1
KIT	1,0	8,8	4,4
LPP-ERM-KMS	2,0	19,0	9,5
MPG	66,0	839,5	394,4
NCSR	1,0	4,7	2,4
UKAEA	19,0	144,9	72,4
Non-Allocated	14,0	611,9	554,9
Sum	291,4	2990,5	1725,6

non-allocated resources: mission, NBTF secondment

Resources Breakdown for 2021

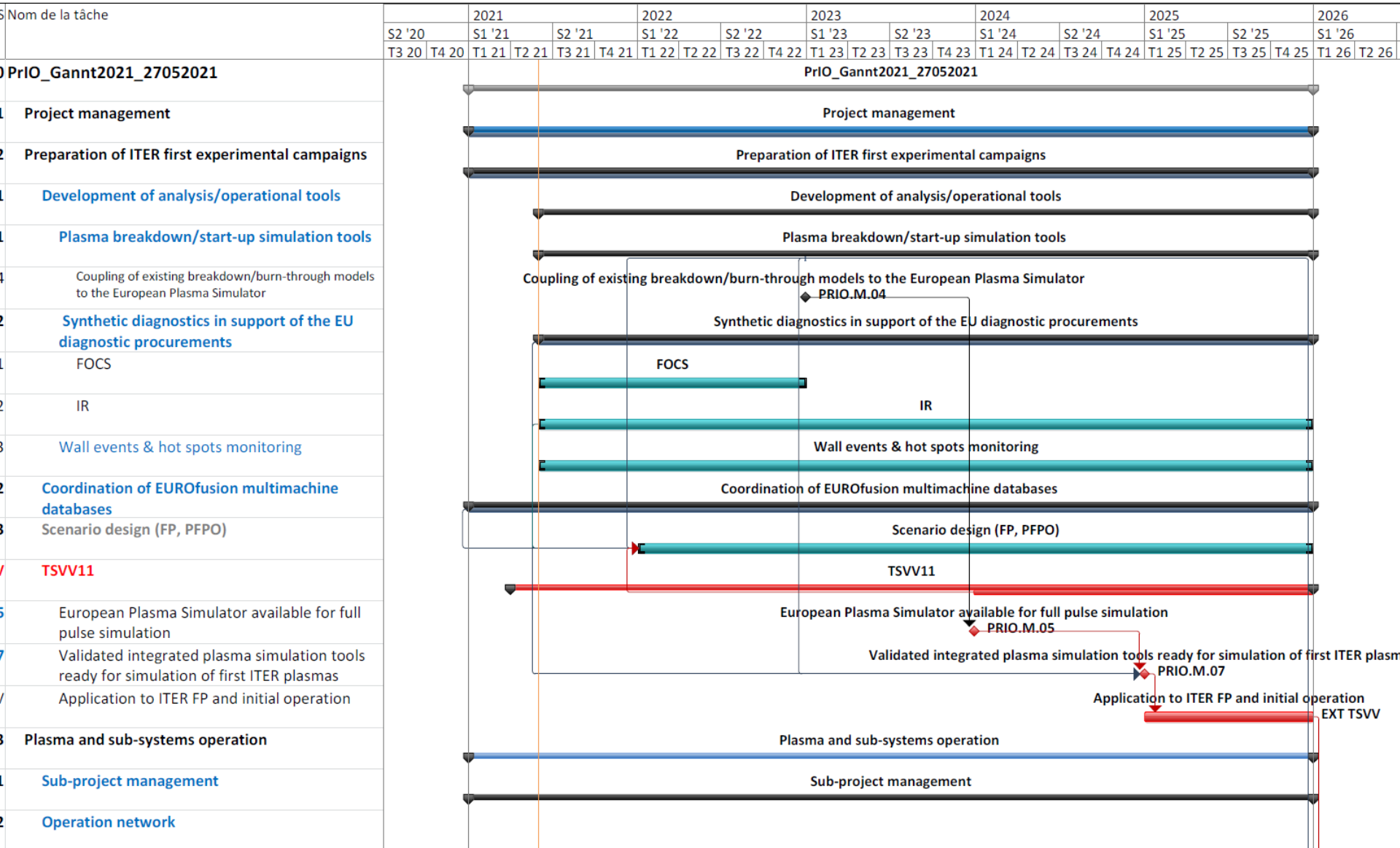


Key assumptions



- **Prioritization following recommendations of the white paper on the preparation of EUROfusion role in ITER operation**
- **Synthetic diagnostics and data analysis tools**
 - Focus on a very limited number of activities mainly on the topic on the “Divertor and Plasma Facing Component”
 - EUROfusion participation in the design of ITER Fast Ions Lost Detectors diagnostic on hold pending peer review by ITER-IO
 - EUROfusion Database coordination under FP8 resources in 2021
- **ITER scenario design for first plasma & PFPO**
 - Activity to be initiated in 2022
 - TSVV#11 under WPAC
- **Neutronics**
 - JET operation ends in 2021. If JET is extended with a third D-T campaign further resources need to be allocated
 - 2021: JET neutronics funded with FP8 resources (WPJET3)
 - 2022-2023: WPPrIO cover JET neutronics, materials and waste analyses

Gantt chart



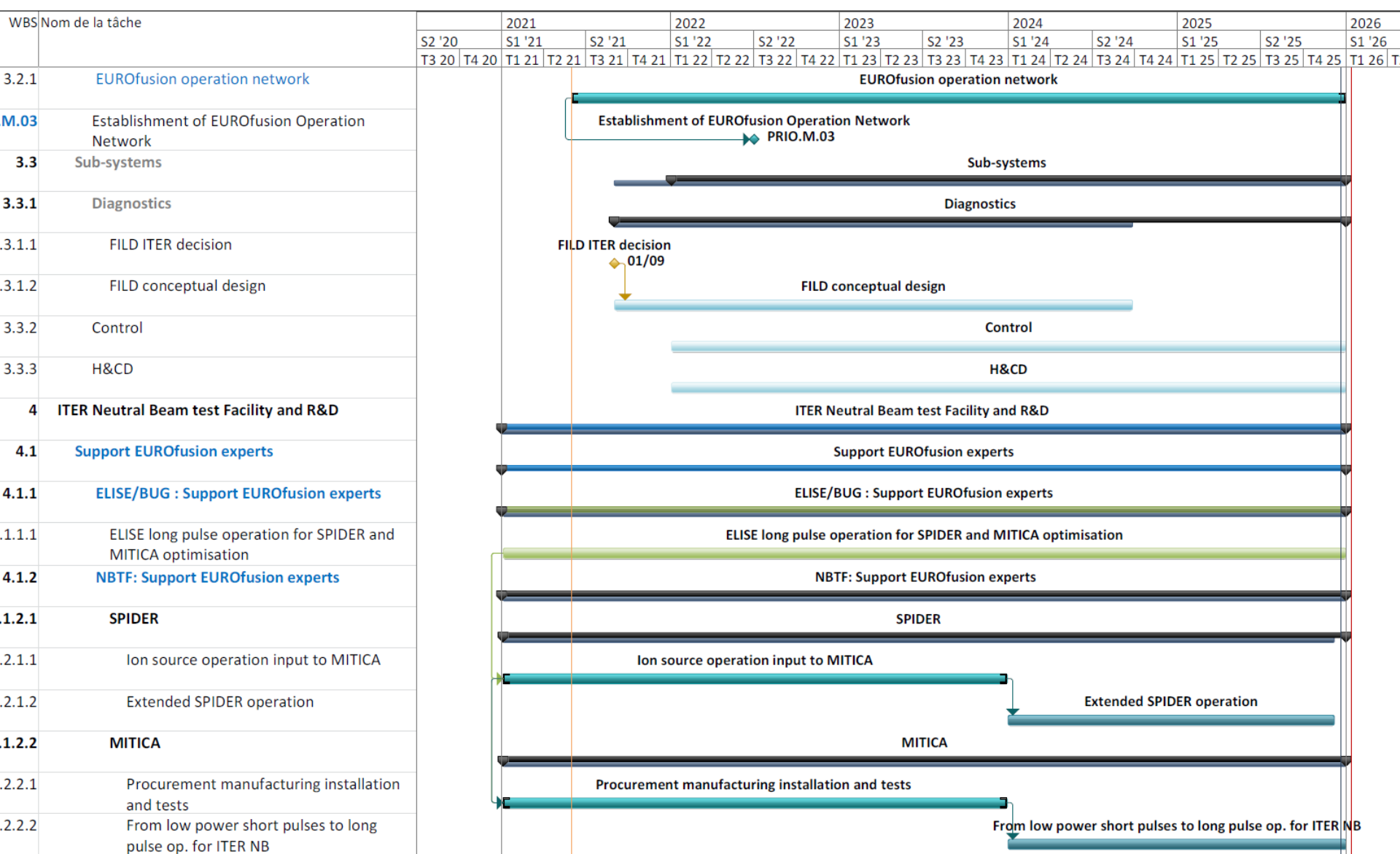
Tâche

Tâches externes

Tâche manuelle

Fin uniquement

Gantt chart



Tâche



Tâches externes



Tâche manuelle



Fin uniquement



Gantt chart

