

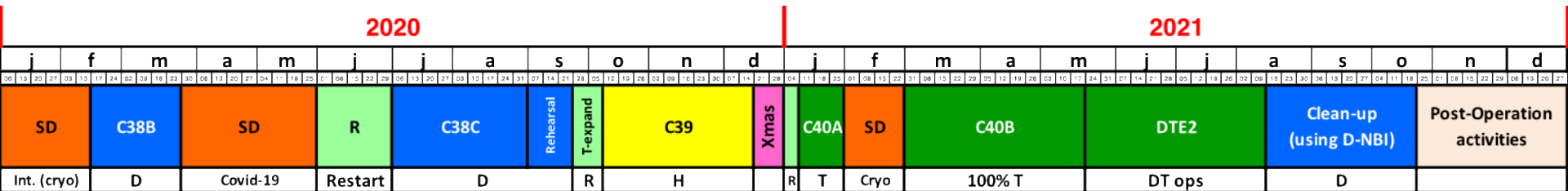
Summary of JET 2021 programme

M. Baruzzo



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JET campaigns 2019-2021

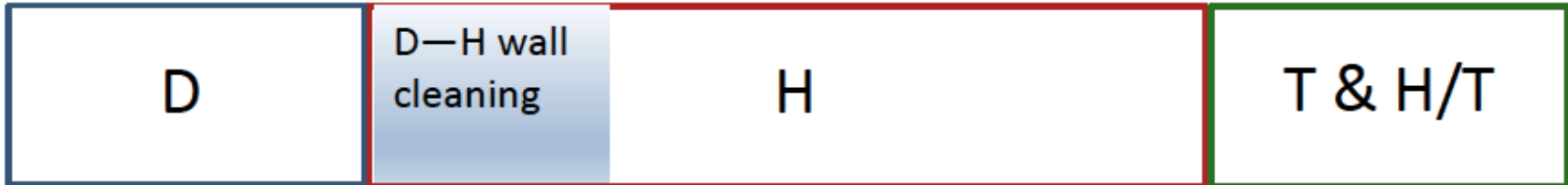


Call for experimental proposals for DTE2 and subsequent clean-up phase in D (C42) launched on 4th August, deadline 9th October

Isotopic Campaigns



C39 - no NBI heating:



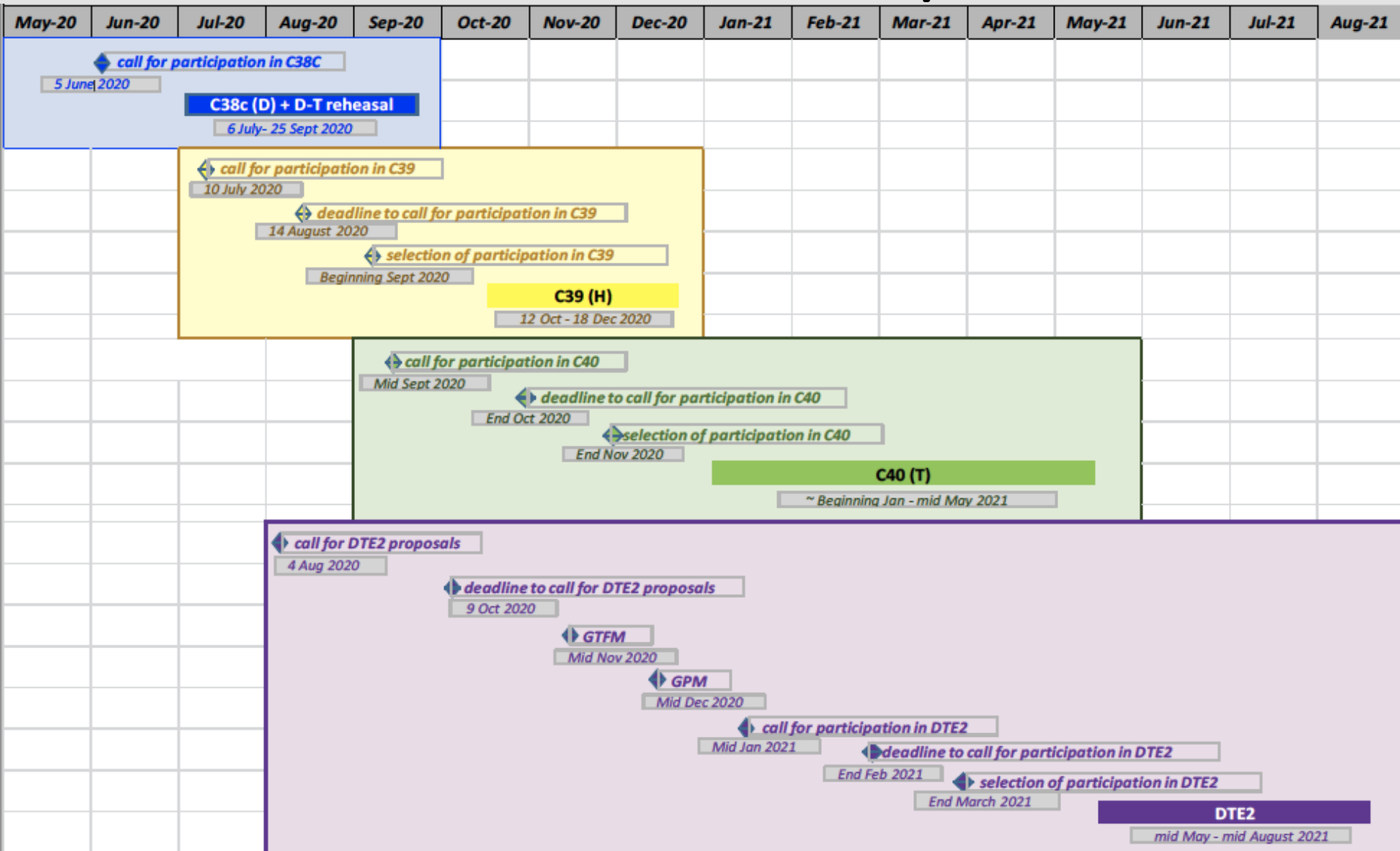
C40:

T campaign with T-NBI → no D allowed

44 Ops days

- Available T budget in C40 (with T-NBI) ~~44 Ops days]~~ **37** 1,936 bar L
- Leave 25% contingency 484 bar L
- **Estimate of available T for C40 timeline** **1,452 bar L**
- **14 MeV neutron budget (assuming 1%D): C39 + C40** **1 x 10²⁰ n|**

Deadlines for 2020/2021



D-T rehearsal



- **Main aim: rehearse *modus operandi* and procedures for T and D-T campaigns** (not the experiment sequence we will use in C39 and C40!)
- Accounting of T-consumption and its optimization wrt daily 44 bar L limit from AGHS
- D-T neutrons limit accounting (14 MeV neutron budget, assuming 1% D in T)
- TIMs refill before each pulse
- Daily regeneration of cryo-panels (PD and NIBs)
- Restricted diagnostic access to J1D
- All SCs of T experiments, SLs, control room staff ...
- Thus, rehearse a few pulses for each experiment planned in C40 or C39
- N.B: in order to optimize tokamak usage and allow for maximum participation from the TFs, during the D-T rehearsal, we will allow for extra pulses to be rehearsed on each day, beyond the daily 44 bar L limit

Priorities of T campaign –Scenarios for D-T

- Baseline scenario for D-T (M18-01)
- Hybrid scenario for D-T(M18-02)
- Scenario for energetic particles and EP driven instabilities in D-T(M18-03)
- Optimization of D-T fusion in T-rich plasmas(M18-10)
- Integrated high performance Ne seeded scenario (M18-39)

+ experiments supporting the D-T scenario goals:

- ICRH scenario support in D and T plasmas (M18-05)
- Calibration of T-NBI power against D-NBI power(M18-50)

Skipped in T and done in D-T:

- ICRH concept development for JET D-T scenarios and for ITER(M18-11)

Deselected or amalgamated in M18-01 and M18-02:

- Plasma termination and disruption avoidance for scenarios(M18-04)
- Control of core W accumulation & impact of W radiation on pedestal(M18-07)
- Pellet injection for ELM pacing and isotope ratio control(M18-25)

Priorities of T campaign –Isotope physics (i)

- Isotope dependence of L-H transition PL-H(M18-14)
- **Isotope effects on H-mode confinement and transport**
 - Isotope effects on confinement and transport(M18-19)
 - Confinement and transport in mixed isotope plasmas(M18-21)
 - Access to type I ELMs with reduced torque(M18-15)
- **Isotope effects on pedestal (stability, inter-ELM transport, ELM losses), SOL**
 - Elements of M18-19, M18-21, M18-15
 - Power width scaling & ELM losses at high IP(M18-17)
 - Dependence of ped structure on fuelling at constant beta(M18-20)
 - Impact of neutrals on pedestal and SOL at high ne(M18-16)
- **Isotope effect on core heat, particle and momentum transport**
 - Electron and ion heat threshold and stiffness (M18-22)
 - Particle transport in pure and mixed isotopes(M18-24)
 - Rotation shear effect on ion transport with different isotopes(M18-23)
 - Intrinsic rotation and momentum transport(B18-08)

Priorities of T campaign –Isotope physics (ii)

- ***Isotope effects on impurity seeding***
 - Max divertor radiation(M18-38)
- ***Isotope effects on detachment and density limit***
 - Effect of divertor geometry on SOL and detachment (M18-41)
 - H-mode detachment and DL(M18-26)
 - L-mode detachment and DL(M18-27)
- ***Isotope dependence of plasma wall interaction***
 - Isotopic effects on W source(M18-18)
 - Isotopic effect of Be erosion and migration to divertor (M18-29)

DTE2 goals

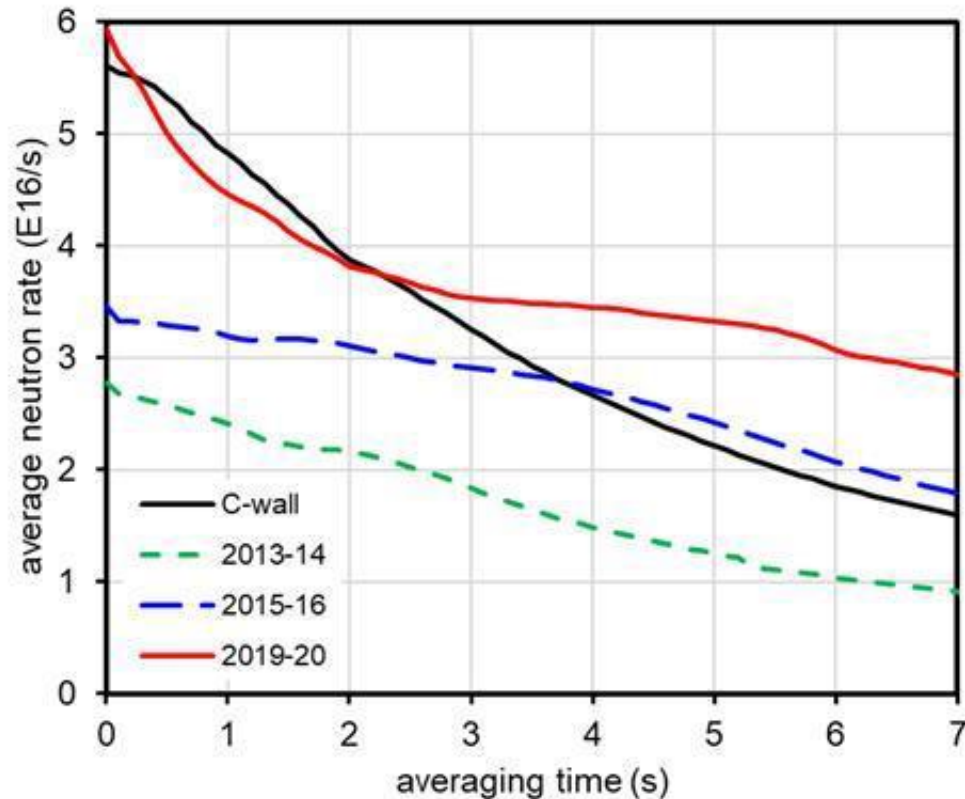


1. Demonstrate P_{FUS} up to 15 MW, sustained for 5 s
2. Demonstrate integrated radiative scenarios in plasma conditions relevant to ITER
3. Demonstrate clear alpha-particle effects
4. Clarify isotope effects on energy and particle transport and explore consequences of mixed species plasma
5. Address key plasma-wall interaction issues
6. Demonstrate RF schemes relevant to ITER D-T operation
 - Make use of new scenarios, higher heating power, new diagnostic capabilities, JET-ILW
 - Aim at answering key questions for ITER

Progress towards DTE2 goals



- Significant progress with reliable & steady high NBI power
- Peak (50ms) neutron rate significantly higher than in 2016, slightly above C-wall reference



DTE2 management



- C40-like management will apply, in keeping with regulatory requirements and budget control
- Daily Tritium gas budget is 44barl as in C40, thus limiting number of pulses/day
- 14 MeV neutron budget = 1.3×10^{21} neutrons limits number of sustained high P_{DT} pulses
- Pulsed-based approach needed, with each pulse addressing specific scientific goal(s) and prepared well in advance
- Piggy-back rather than dedicated pulses encouraged where suitable to meet goal, so please consider now how to make best use of likely reference pulses
- DT Pulses will have to have deuterium references in advance
- DT experimental proposals can be found here:

https://users.euro-fusion.org/tfwiki/index.php/DTE2_and_C42_Proposals



Proposal document

Proponent(s)

[DT scenario with optimized non-thermal fusion](#)

[Mikhail Maslov](#)

[Impact of pellet fuelling and pacing on ELMs, impurities, core confinement and SOL, including comparison with vertical kicks](#)

[Christian Perez von Thun](#)

[Hybrid scenario for high fusion performance in DT](#)

M18-02 SCs and Team

[Demonstration of high fusion power baseline plasmas](#)

M18-01 SCs and Team

[DTE2 proposal: Tritium NBI Power Comparison](#)

[Damian King](#)

[DTE2 proposal: Maximize thermonuclear fusion power generation in DTE2](#)

[Yevgen Kazakov](#)

JET DT proposals: Demonstrate integrated radiative scenarios in plasma conditions relevant to ITER



Proposal document

Proponent(s)

[Integrated high performance seeded scenario](#)

M18-39 Scs and Teams

[Impact of edge plasma opacity on fueling inside the separatrix](#)

[Bart Lomanowski](#), [Nicola Vianello](#),
[Mike Dunne](#)

[JET ITER power exhaust similarity](#)

[Sven Wiesen](#)

[Investigation of H-mode divertor detachment in He plasmas](#)

[Gennady Sergienko](#)

[Study of H-L transition in high radiation plasma scenarios](#)

[Gennady Sergienko](#)

[Impact of neutrals and impurities on SOL and pedestal](#)

[Carine Giroud](#)[Fulvio Militello](#)

JET DT proposals: Demonstrate clear alpha particle effects



Proposal document	Proponent(s)
Testing the power transfer between alphas and electrons by direct ICRH heating of alphas (4He) in a D-T plasmas.	Francesco Paolo Orsitto , Alessandro Cardinali Carmine Castaldo
Investigation of differences in Electron Temperatures measurements by ECE emission and Thomson Scattering in high performance DT Plasmas	Francesco Paolo Orsitto , Marco Zerbini , Edmondo Giovannozzi , Alessandro Cardinali , Gerardo Giruzzi , Matteo Fontana , Elena de la Luna , Riccardo Rossi , Pasquale Gaudio , Rory Scannell , Didier Mazon
resolve the origin of the anomalous ion heating observed in DTE1	Duccio Testa
observe alpha heating via Ti modulation and its effect on Te response	Paola Mantica Fulvio Auriemma Ernesto Lerche Dirk Van Eester
Study of energetic particles and EP driven instabilities in DT plasmas	Remi Dumont David Keeling Michael Fitzgerald
Observing alpha particles via knock-on ions	Jari Varje
Excitation of AEs by alpha-particles with bump-on-tail distribution in JET	Sergei Sharapov Yevgen Kazakov Jeronimo Garcia
JET-TFTR Similarity Experiment on Alpha-driven Alfvén Instabilities	Sergei Sharapov Raffi Nazikian Remi Dumont
Fusion power measurements and alpha particles physics with gamma-ray spectroscopy	Massimo Nocente Yevgen Kazakov
Application of 3-ion ICRF heating schemes in hybrid H-mode D-T plasmas	Krassimir Kirov Yevgen Kazakov M18-11, M18-12, M18-48, M18-02 SCs and Teams
Observe alpha heating through its effect on the electron energy distribution	Carlo Sozzi Matteo Fontana Lorenzo Figini Ignacio Pastor
Plasma heating by alpha particles	Henri Weisen
Improvement of plasma performance by external torque and spatial channelling	Yaroslav Kolesnichenko
Non-linear coupling between fast ions, microturbulence and AE modes in D-T plasmas and 'anomalous' ion heating	David Zarzoso Samuele Mazzi Jeronimo Garcia Yevgen Kazakov Jozef Ongena

JET DT proposals: Clarify isotope effects on energy and particle transport and explore consequences of mixed species plasma



Proposal document

Proponent(s)

[Isotope effect in DT plasmas](#)

[D.B. King](#)[E. Viezzer](#)[Philip A. Schneider](#)[Mikhail Maslov](#)

[Isotope effects on core particle transport](#)

[Tuomas Tala](#)

[Control of isotope mix and ELM pacing by pellets](#)

[Martin Valovic](#)

[Isotope effects on L-H transition power threshold](#)

[Emilia R. Solano](#)

[Investigation of EHO and QH-mode](#)

[Eleonora Viezzer](#), [Emilia R. Solano](#)

[Isotope effect on pedestal stability and pedestal turbulent transport at constant beta_N](#)

[Lorenzo Frassinetti](#)

[Impact of D/T fuel mixture on H-mode density limit](#)

[Gennady Sergienko](#)

[Determine the maximal reachable density in H-mode including impact of isotopes \(H,D, mixed species\)](#)

[Gennady Sergienko](#)

[Physics basis of detachment and density limit in D/T L-mode plasmas](#)

[Mathias Groth](#)

[Isotope dependence of W sputtering \(based on M18-18 with DT mixutre\)](#)

[Sebastijan Brezinsek](#)

JET DT proposals: Address key plasma-wall interaction issues



Proposal document	Proponent(s)
Enter a new line and edit your title!	Edit your Name
Spectroscopic observation of Be-hydrogen species in DTE2 and C42	Timo Dittmar
DT effects on the FW erosion	Dmitriy Borodin Henri Weisen
Be erosion with combipulses in C42	Timo Dittmar Dmitriy Borodin
Alpha particle heat loads	Henri Weisen
Plasma-Wall Interactions with Be/W Plasma-Facing Materials in He-dominated Plasmas	Sebastijan Brezinsek
Assessment of Tritium Removal Techniques before Vessel Opening	Sebastijan Brezinsek
ITER-like Divertor Plasmas in JET: Final Operation, Modelling, and Tile Analysis	Sebastijan Brezinsek
T removal in JET-ILW utilising vessel baking, GDC, ICWC and plasma operation (=> M18-30)	Tom Wauters and Dmitry Matveev
Controlled long-term outgassing of H, D, T from the JET-ILW (at the end of an operational cycle with T injection)	Sebastijan Brezinsek
High Surface Temperature Operation go Bulk Tungsten	Jan W. Coenen
Fuel removal at ITER-relevant surface temperature in JET-ILW by GDC, ICWC (=> M18-30)	Tom Wauters and Dmitry Matveev
T removal from divertor tiles by GDC in combination with poloidal magnetic field	Gennady Sergienko
Measuring and monitoring H/D/T isotope ratio	Jari Varje
Detachment in He plasmas	Mathias Groth
Monitor global in-vessel inventory during tritium operations and clean-up	Anna Widdowson
Controlled Global Gas Balance in DT plasmas	Sebastijan Brezinsek and Thierry Loarer

JET DT proposals: Demonstrate RF schemes relevant to ITER D-T operation



Proposal document

Proponent(s)

[Characterization of second harmonic heating of T \(ITER main ICRF scheme for D-T\)](#)

[Mervi Mantsinen, Philippe Jacquet, Ernesto Lerche, Dirk Van Eester](#)

[Large D minority fundamental ICRF scenario in T-rich plasmas with intrinsic Be impurity in JET-ILW](#)

[A. Krasilnikov, D. Van Eester, E. Lerche, M. Maslov, P. Jacquet, Mervi Mantsinen, P. Dumortier](#)

[The impact of ICRH antenna phasing on fusion performance, MHD and PWI](#)

[Dirk Van Eester, Philippe Jacquet, Ernesto Lerche, Mervi Mantsinen](#)

[The impact of ICRH-NBI synergy and the choice of beam species on fusion performance](#)

[Dirk Van Eester, Philippe Jacquet, Ernesto Lerche, Mervi Mantsinen](#)

[C42 proposal: IC assisted breakdown for ITER](#)

[Tom Wauters](#)

[Demonstration and applications of 3-ion ICRF scenarios \(with 9Be/Ar, T-NBI and D-NBI resonant absorbers\) in D-T plasmas on JET-ILW](#)

[Yevgen Kazakov, Massimo Nocente, Jef Ongena, M18-11, M18-12 and M18-48 Teams](#)

C42 goals



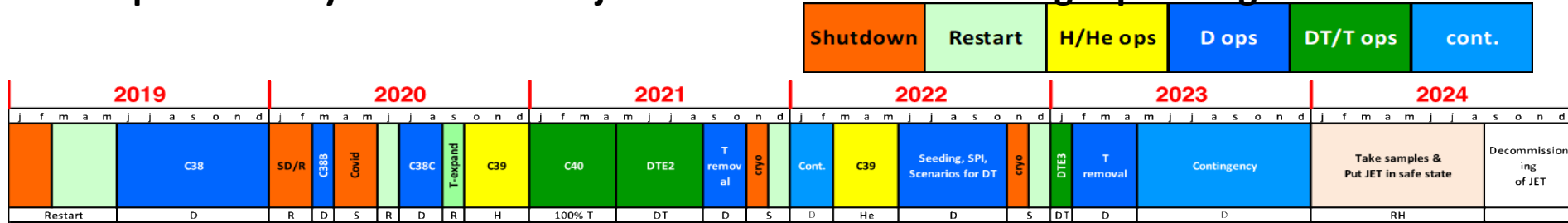
- Constraint: key goal of the post-DT campaign C42 is to clean up T
- Opportunity for investigations on T cleaning
- But also offers opportunity for:
 - Completing reference plasmas for better comparison to T, DT
 - Completing C38 experiments scope
 - Small number experiments with He4
- Proposals must be consistent with DTE2 goals and JET C38-C40 objectives
- Priority will be given to those exploiting JET uniqueness, and with highest impact
- Jan 2019 assessment of impact of loss of H and D campaigns between T and DTE2 identified several deliverables suitable for performing in C42
- However, after new experiments and analysis, situation has evolved sufficiently that need for these must be re-evaluated, must be submitted alongside the other proposals

Revised JET programme 2022-2024



10 months of contingency by removing the shutdown foreseen after the DTE2 and the installation of SPI2 and related diagnostics, ITER mirror

- JET operation beyond 2021 is subject to decisions for the budget planning for FP9



Programme elements ~fixed

