EUROfusion
ITER PHYSICS DEPARTMENT

Preamble to the 2015 MST1 Call for proposal

By the Medium Size Tokamak Task Force Leaders

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Background

The 2015 Medium Size Tokamak (MST) Call solicits proposals for experiments and modeling activities related to the attached 2015 EUROfusion-ITER Physics Department Annual Work Plan. For the 2015 experimental campaign two devices will be in operation: ASDEX Upgrade (AUG) in Garching (Germany) and TCV in Lausanne (Switzerland).

Proposals presented in response to this call may address experiments to be performed in one or both devices and modeling activities connected with the topics of the experiments.

While the exact numbers of run days in AUG and TCV will be defined at a later stage and will be constrained by the available budget, it is expected that for 2015 the campaign will be based on a number of run days in the range 30 to 35 for AUG and 20 to 40 for TCV.

The design of the experimental campaign and of the associated timeline will start after the closing of the present call. The proposals will be analyzed by the MST1 Task Force Leaders, who will then present to the Community a set of experiments and tasks and their relation to the selected proposals for discussion at the 2015 General Planning Meeting, to be held jointly with the JET Task Forces in Lausanne on January 19-23, 2015.

After the General Planning Meeting, a final list of the selected experiments will be generated and will be used as the basis for establishing the manning of the 2015 campaign.

Key criteria that all proposals need to meet are: innovation; consistency with the 2015 Annual Work Plan and the Fusion Roadmap in general; clarity of goals, deliverables, milestones, and measures of success; inclusiveness and breadth of the proposing team; and feasibility within the 2015 campaign.

Experimental proposals must specify the experimental strategy, and in particular the operational scenario they plan to address, the auxiliary heating systems and diagnostic tools they need and all the information necessary for the machine operators to assess their technical feasibility. Proponents must clearly and carefully state what systems are *necessary* and what systems are merely desired. The feasibility of the proposed experiments within the 2015 run time will in fact be judged also in terms of their risks, i.e. of their estimated failure rate. A shot will be judged to have failed if not all *necessary* systems were available.

The proposal must specify:

a) The minimum number of shots that are needed to achieve the scientific goals, as justified in the experimental strategy *(scientifically successful shots)*

b) An estimate of the number of development shots needed to obtain the scientifically successful shots. *(scenario development shots)*

Proponents should not account for technical failures, which will be covered by contingency allocated by the Task Force Leaders up to a reasonable extent.

Experimental proposals should also present clearly the data analysis and modeling strategy and the analysis tools that are expected to be used. Those that include a well-specified modeling effort improving the comparability between MST devices, JET and ITER predictions are particularly welcome.

Modeling activities are also part of this call. The modeling proposals should address the deliverables of the 2015 Annual Work Plan and should be connected to either continuing effort needed to exploit the data of the 2014 campaign (including projection to future devices) or to the 2015 campaign (preparation and post-analysis). Modeling proposals must have a tight connection with experiments, and we expect that modelers involved in the MST1 campaign will spend time in Garching and/or Lausanne to interact with the experimentalists. Modeling proposals are subject to the same key criteria as the experiments proposals listed above. We particularly welcome modeling proposals encompassing MST and JET experiments.

High priority experiments

To construct a 2015 campaign that is focused on the science deliverables identified in the MST1 2015 Annual Work Plan (attached to this call) – and in particular the top three 2015 objectives -, exploits the contribution of the community and ensures synergies with other parts of the EUROfusion program and in particular with JET, JT-60SA and ITER, we propose in the following a list of topics that we plan to address with higher priority. These experiments are often continuations of successful 2014 proposals and will constitute the building blocks for the implementation of the 2015 Annual Work Plan. We expect to reserve a significant fraction of the experimental time for these topics, which will represent the flagships of our program.

We recommend that, whenever relevant, proposals on these topics foresee experiments in both AUG and TCV and are connected with similar work performed at JET. The high priority experiments that we have identified for the 2015 campaign are the following (relevant headlines are specified in brackets for each):

- Development of integrated ITER baseline scenario (at low $\beta_N \approx 1.5\text{-}1.8$) with impurity seeding and ELM mitigation (HL1.1, HL1.2)
- Development of high radiative power fraction scenarios with good confinement for both low and high triangularity plasmas at high $\beta_N = 2.5\text{-}3$ (ITER improved H-mode and DEMO relevant) (HL1.1, HL2.1)
- Operation close to the density limit with high confinement and tolerable ELMs (HL1.2, HL1.1)
- ELM mitigation via magnetic perturbation at low collisionality with extrapolation to ITER (HL1.2)

- Demonstrate combination of individual control algorithms into integrated control scenarios, and in particular demonstrate integrated control of three or more among NTMs, sawteeth, ELMs, disruption mitigation and divertor detachment, using diagnostic observers and real-time modeling and assessing the minimal necessary observer set (HL1.8, HL1.4, HL1.2, HL2.1)
- Advance fast ion physics, exploring in particular the influence of fast ions on current drive and the use of actuators to influence fast ion driven instabilities (HL1.7, HL1.8)
- Disruption and runaway electron mitigation and avoidance (HL1.3, HL1.8)
- Exploration of the interaction of 3D magnetic field with plasma at high beta and/or close to no-wall limit (HL1.4, HL1.8)
- Maximize core, SOL and divertor radiation and develop multiple low- and medium-Z species radiation with detachment control (HL2.1)
- Exploration of the scrape-off layer structure and the first wall particle and heat load (HL2.2)
- Plasma Facing Component studies in the divertor (HL2.2)
- Comparison between snowflake and conventional divertor configuration with respect to target heat loads, divertor/SOL radiation, L-H threshold and pedestal performance (HL2.4, HL1.1, HL1.2)
- Investigate the impact on plasma performance (e.g. confinement, pedestal pressure, ELM mitigation etc.) where relevant with a He concentration comparable to that in a fusion reactor (across many headlines).

Other experiments

Proposals in other areas are of course possible and will be judged on their scientific merit and relevance with respect to the 2015 Annual Work Plan. Moreover, we are aware that the exploration of new science and of diverse experimental paths may lead to precious scientific contributions to the WP deliverables. Therefore we also encourage proposals classified as “proof of principle”, which address the work-plan science through alternative or unexplored paths. While we accept a higher degree of risk in these experiments, it is nevertheless necessary that these proposals show a solid scientific basis and that the proponents make a convincing case for their feasibility. In the spirit of “proof of principle”, these proposals should aim to reach the first significant results within a limited number of shots – with the possibility of an upgrade in case they are successful.

Helium campaign

To inform the ITER IO on non-nuclear operation, it is planned to have a dedicated He campaign under MST1 depending on the number and strength of proposals received for such a campaign. Characterization of He H-modes and study of scenario compatibility issues remains at a very basic level and has to be the key focus of new experiments for ITER. The minimum campaign duration with plasmas that have He as the main ion species is expected to be two weeks to allow for a complete exchange of the wall inventory. Proposals for this campaign should speak not only to the deliverables in the Annual Work Plan 2015, but also to the urgent ITER needs:

- Study requirements to achieve high pedestal pressures and the change of the MHD stability in Type I ELMy H-modes and H-mode access in He compared to D plasmas
- Medium and high Z impurity behaviour in He H-modes compared to D
- Transferability of risk mitigation strategies such as disruption and ELM mitigation
- Determination of possible detrimental effects of He on W divertor surface
- Radiative divertor operation in He H-modes
- SOL transport and power exhaust in low radiating scenarios.

It should be noted that running with He as the main ion species imposes certain operational constraints such as limited pumping speed or the availability and duration of certain heating systems.

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