Technology Collaboration Programme on Tokamak Programmes (CTP TCP)

Strategic Work Plan 2022-2027

1 Introduction

In the next decade fusion research will take decisive steps towards the demonstration of fusion energy as ITER enters the commissioning phase and first plasma operation. Since, there are many scientific and technological aspects that need to be addressed, the main mission of the tokamak research programmes worldwide is to assist ITER in achieving these goals, towards the demonstration of burning plasmas in a magnetic confinement device and to serve as a testbed for key fusion technologies towards the design of a Fusion energy demonstration power plant (DEMO). Therefore, the tokamak experiments operating or under construction around the world, with the accompanying theory and modelling programmes, work together via collaborative frameworks in addressing collectively these challenges. As part of this effort, one of the most important activities is the International Tokamak Physics Activity (ITPA) and the respective Joint Experiments (JEX) programme. The ITPA, which now operates under the auspices of the ITER organisation (ITER IO), contributes substantially to enhance the understanding of the complex fusion science and its link to engineering issues. As one of the main agreements for the implementation of the ITPA, the Technology Collaboration Programme on Tokamak Programmes (CTP TCP) supports scientific exchanges among all tokamaks operating within the ITER Members' research programmes, by enhancing the planning and efficient implementation of such experiments. Complementary to the activities directly related to ITPA, the CTP TCP co-ordinates, in addition, the exchange of personnel and equipment for other key associated activities, with the most recent example being the successful implementation of the Shattered Pellet Injection on the Joint European Torus (JET) tokamak and the support of the personnel exchanges linked to these and other connected experiments carried out also in the Doublet III D-shaped Tokamak (DIII-D), Superconducting Tokamak Advanced Research (KSTAR), Axisymmetric Divertor Experiment (ASDEX) Upgrade tokamaks and the new HuanLiu-2A (HL-2A) tokamak.

2 Objectives and Programme

The CTP TCP will continue to support the development of fusion energy by contributing to the ITER operational basis and DEMO design optimisation. The CTP TCP enhances close cooperation and coordination of tokamak research, including experiments, theory, advanced computing, and scientific exchanges. These activities provide valuable insights on the complex and non-linear coupling among the different scientific issues, integration to achieve high-performance plasmas in steady-state conditions, and to extrapolate them to burning plasmas in support of the ITER experiments. The CTP TCP maintains strong links with all the other fusion-related TCPs. This close cooperation helps to ensure complementarity between research programmes executed by the Contracting Parties. It enables the co-ordinated exchange of personnel and equipment, avoiding unnecessary duplication of effort. Considering the recent advances in tokamak research, the CTP TCP will continue to assist ITER by supporting research in priority areas, addressing the avoidance, control and mitigation of the key plasma instabilities, protection of the plasma facing components and access to good confinement plasma regimes in ITER. For this purpose, the ITPA topical group structure is effective in organising the joint research activities under the CTP TCP, namely: transport and confinement physics, divertor/sol physics, integrated operating scenarios, pedestal physics, MHD, and energetic particles and diagnostics. The CTP TCP Executive Committee meets annually in December at the ITER Headquarters. These meetings are organised together with the ITPA Joint Experiments Workshop (JEX) in order to maximise the synergy between the two activities. International workshops on “Theory and Simulation of Disruptions” (one of the most critical areas for ITER operation) are organised annually together with IAEA, as well as workshops on the coordination of tokamak programmes such as the KSTAR conference.

3 Impact

Fusion energy is an environmentally responsible technology that can make a major contribution to the reduction of CO_2 emissions in the second half of the 21st century ensuring the sustainability of the energy transition needed to curb climate change. Fusion research under the CTP TCP is well aligned with the IEA’s goals of energy security, economic growth, environmental protection, and engagement worldwide. Fusion energy research under the CTP

TCP is also highly relevant to the IEA Medium-Term Strategy for Energy Research and Technology to help to accelerate the development and deployment of a broad range of energy technology options and to support continued research and development collaboration efforts and innovation for basic science and frontier or emerging technologies for long-term solutions. Under the context of this worldwide collaborative research and development programmes, the CTP TCP provides a forum for tokamak programmes of the ITER Members to work closely together in coordinating their tokamak research. The CTP TCP carries out scientific and technological exchanges and holds workshops and meetings for the purpose of advancing the tokamak concept towards fusion energy and supports ITER physics and technology needs.

4 TCP Modernisation

The CTP TCP is in the process of implementing the April 2020 decision of the IEA Governing Board to approve the new Framework for the Technology Collaboration Programmes. The aim is to carry out these modernisation steps during the request of extension. The CTP TCP is working with the IEA office of legal counsel to define the needed amendments to the Implementing Agreement and to implement the new framework. The CTP TCP expects to take advantage of the new Framework, in particular, regarding the process for IEA Accession and Association countries to join the TCPs, as part of the strategy to extend the activities to other members and Partner countries.

5 Summary

The CTP TCP will continue to play an important role in strengthening worldwide collaborative fusion research, supporting ITER as it enters the commissioning phase and first plasma operation; and supporting the physics research and development across the Tokamak experiments towards the development of a Fusion energy demonstration power plant (DEMO). It offers a formal framework for the scientific exchanges and the organisation of worldwide joint Tokamak experiments, including but not restricted to those conducted under the ITPA. The CTP TCP Executive Committee will continue their efforts to extend the activities to other members and Partner countries and observers will be invited to attend Executive Committee meetings when appropriate.