

**First ENEA-KFE Meeting on Bilateral Collaboration Activities
(28th of Nov. 2024, Remote)**

Meeting site: <https://agenda.enea.it/event/1065/>

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Introduction

The recent collaboration between ENEA and KFE initiated from the mutual interest in improving scientific understanding of burning plasma scenarios in tokamak reactors. This is timely due to the upcoming era of fusion devices which are under development world-wide. The scientific collaboration has been based on the virtual **Center for Nonlinear Plasma Science (CNPS) network**. As the Divertor Tokamak Test facility (DTT) machine design and construction is increasingly becoming more mature, both parties decided to extend this scientific collaboration to the areas of design, construction and exploitation of present and future devices in both countries, including KSTAR and DTT. This decision has led to the signing of the Memorandum of Understanding (MoU) between the two parties in March, 2004. The first ENEA-KFE meeting on bilateral collaboration activities was held under this MoU framework, aiming at providing a basis for “actual” implementation of technical collaborations.

Presentations and Discussions

The meeting was held in a remote mode and organized by the CNPS hub at ENEA. Its main focus was to provide **OVERVIEWS** of major technical activities being carried out by the two organizations. The goal of this meeting, meanwhile, was to share status of key resources, research trends, and possible plans for collaboration activities, aimed at providing information that could lead to tangible outcome in the future.

A total of eight talks were presented, four talks per each party, according to the following areas:

➤ Scientific collaboration through the CNPS network:

1. Introduction and background of recent scientific collaborations with focus on advanced concepts in burning plasma research (**F Zonca/ENEA**)
2. Overview of theory, modeling and simulation activities at KFE (**Jaemin Kwon/KFE**)

- **Discussions:**

1. More active participation of KFE theory group in the benchmark exercise of phase space zonal structure (PSZS) identification using the KFE delta-f gyrokinetic code → agreed by JM Kwon
2. Development of diagnostic tools to measure phase space zonal structures → imaging NPA emerges as a promising tool for it. This diagnostic is under development at KSTAR (YU Nam)
3. Using IMAS as a unified framework for database → KSTAR is converting data to IMAS format.
4. Interest in the EM version of the gkPSP code

➤ Overviews of existing (KSTAR) and future (DTT) machines:

3. Overview of DTT construction status and (near future) plan (**F Romanelli/DTT**)
4. Overview of KSTAR machine/experimental status and future plan (**Yong Un Nam/KFE**)

- **Discussions:**

1. Most updated DTT research plan is available online at the official DTT site. Invitation to elaboration of the DTT research plan to Korean scientists (F Romanelli)
2. Has the DTT team considered the segmented approach for the fabrication and operation of in-vessel control coils, like KSTAR? → No. DTT will use AUG and ITER style fabrication and installation procedure of coils. These issues may need further discussions.
3. Discussion of tungsten technology in KSTAR → conventional one as AUG
4. Feasibility of the scenario for increasing plasma volume in KSTAR.
What is the benefit for it? → The plan is still under discussion. It will be a big challenge in KSTAR hardware modification.

➤ Urgent technical challenge in superconducting tokamak construction

5. Experiences and lessons of Nb₃Sn superconducting magnet fabrication and test programs from KSTAR and ITER (**GS Lee/EnableFusion**)
6. DTT Superconducting magnet design, fabrication and test (**Gian Mario Polli/ENEA**)

- **Discussions:**

1. Testing all coils is viable? For what purpose? Test vs. schedule issue should be well-thought and balanced. → DTT plans to test all the coils.
2. Has the DTT team set up the actual implementation plan for integration (assembling) VV and ports? Assembly strategy must be thought over even during the design phase → DTT will follow ITER and/or JT-60 SA approach. DTT needs some help from experiences of KSTAR machine builders.
3. What is the plan for minimization of low-n error fields in DTT? → Under investigation.
→ Dr. GS Lee's presentation provided a useful technical approach to address this issue.

➤ Diagnostics

7. KSTAR diagnostics status, capabilities, and plan (**Jinseok Ko/KFE**)

8. Planning of DTT diagnostics (**M Ciotti/ENEA**)

- **Discussions:**

1. Advanced EP diagnostics in KSTAR? → INPA under construction and will be available from next campaign (YU Nam)
2. Has the DTT team established an integrated plan for grounding of signal lines in diagnostic systems? This will be of importance during machine operation. Thus, it must be carefully considered during the design phase → Technical helps in this practical problem will be welcome by the DTT team.
3. The total number of MDs in DTT seems to be excessive at present design. Can MDs be optimized by extensive exploitation of magnetic reconstruction and NNs? → same question raised during the DTT diagnostic review meeting. DTT will consider this. → KFE would cooperate on this issue if DTT requests.

Future plans:

Participants discussed possible further collaborative areas to be carried out in the near future. The following subjects have been proposed with key "contact persons", who agreed to serve as such.

- (1) Burning plasma research: F Zonca (ENEA) and Hogun Jhang (KFE)**
- (2) Scientific exploitation of existing and future devices: M Ciotti (ENEA) and Yong Un Nam (KFE)**
- (3) DTT Construction Related Issues including SC magnet and cold structures: Gian Mario Polli (ENEA) and Changho Choi (EnF)**

The exact date and format of the 2nd meeting have not been decided. After further discussions, 2nd meeting will be announced, with the proper “contact persons” in charge of the organization according to the subject of the meeting and the area of interest specified above. This approach will ensure that each area may be flexible in the practical implementation of the relevant collaboration activities, while MoU contact persons (F. Zonca and H. Jhang) will be informed. Another general meeting, similar to the first one in aim, will be mature, based on the progress of the different areas of the bilateral collaboration, the MoU contact persons will take care of its organization.