EC Grant Agreement No. 654166
Project duration: 1.9.2015-31.08.2018

CREMLIN WP2 Informal exchange meeting

The Russian-Italian IGNITOR Tokamak Project: Design and status of implementation

Thursday, 13 July 2017; 9:30-16:00 CEST
DESY Hamburg
Notkestrasse 85, 22607 Hamburg
Building No. 1; Seminar room 1

Topic:

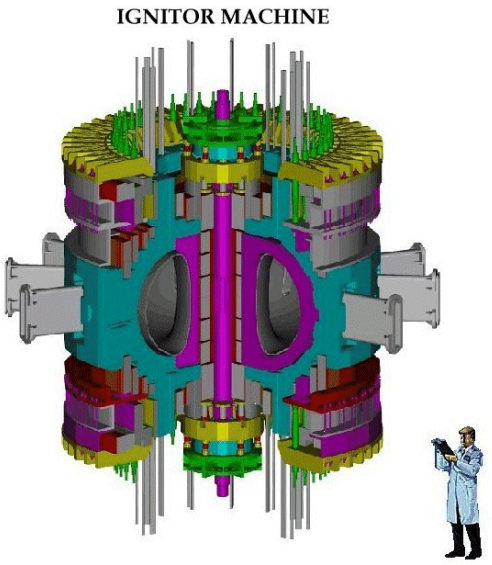
This informal CREMLIN exchange meeting is devoted to the Russian-Italian tokamak project IGNITOR. IGNITOR is one of the six Russian "megascience projects". Its main purpose is "to achieve the ignition of controlled thermonuclear fusion reactions under strong / superstrong magnetic field up to 13 Tesla by Ohmic heating only". IGNITOR is intended to be constructed at the Troitsk Institute for Innovation & Fusion Research "TRINITI", near Moscow.

The exchange meeting provides an informal platform for a discussion and an exchange on the status and the technical parameters of the IGNITOR project, mainly by representatives of the Russian-Italian bilateral project team.

The meeting is realised as an exercise of Task 2.1 of the CREMLIN project, Work package 2 "Exchange platform": https://www.cremlin.eu/work_plan/work_package_2/ .

Participants:

- Francesca Bombarda, INFN, Rome
- Ralf W. Engels, Forschungszentrum Jülich, JCHP / Institut für Kernphysik, Jülich
- Alexander Gostev, Troitsk Institute for Innovation and Fusion Research (TRINITI), Troitsk
- Petr Khvostenko, NRC "Kurchatov Institute", deputy head of Fusion Department, Moscow
- Ekaterina Kolesnikova, NRC "Kurchatov Institute", Moscow
- Vladimir Kravchuk, NRC "Kurchatov Institute", Moscow
- Frank Lehner, DESY, Hamburg
- Giancarlo Spigo, CERN, Geneva
- Mikhail Subbotin, NRC "Kurchatov Institute", deputy head of Fusion Department, Moscow
- Martin Sandhop, DESY, Hamburg
- Peter Wibbeling, DESY, Hamburg



Picture: NRC KI. The IGNITOR machine.

Main Outcome:

After the welcome (Frank Lehner, DESY), a short introduction into the CREMLIN project and the positioning of IGNITOR-related issues within CREMLIN has been provided by Martin Sandhop (DESY) and Vladimir Kravchuk (NRC KI).

Francesca Bombarda (INFN) has given an overview talk, providing an overall picture of the IGNITOR project, including:

- History of high field tokamaks and history of IGNITOR
- Scientific goals
- Ignition strategy and stability issues
- Machine design principles
- Plasma wall interaction
- Reactor relevance and the High Filed path to fusion.

Giancarlo Spigo, CERN, has given a talk on: *"Main design features and engineering challenges of the IGNITOR project"*, including:

- Electrical and mechanical components
- Structural desdign concepts
- Closure of the vacuum vessel
- Toroidal coil turn
- Characterization of the shear strength properties of the insulating material for the solenoidal coils
- Mechanical and electrical tests on solenoid cables
- Poloidal coil wound with MgB_2 superconducting cable

Mikhail Subbotin, NRC KI, has given a talk on "*Recent Russian contribution to the development of the IGNITOR project"*, including:

- Brief history of the project
- CDR of IGNITOR (May 2015), Russian-Italian Intergovernmental Agreement on IGNITOR under preparation
- Joint working group on IGNITOR by representatives of NRC "Kurchatov Institute" (scientific coordinator); TRINITI/ ROSATOM (infrastructure); Istituto Nazionale di Fisica Nucleare (INFN) (tokamak load assembly)
- Main goal and mission of the project
- Three stages of the project
- Russian contribution to the development of the project since 2014

Petr Khvostenko, NRC KI, has given a talk on "*Tokamak 15MD: experience of scientific and technical project realization in Russia"*, including:

- Stage 1: physicists decided which tokamak is needed
- Stage 2: Concept design (NIIEFA, Saint Petersburg), magnet system and vacuum vessel
- stage 3: Preparation of requirements specifications
- Stage 4: PROJECT of Technical Reconstruction of TOKAMAK T-15 (T-15MD), including 14 institutions involved and detailed design
- Stage 5: Assignment for the development of the project
- Stage 6: Approval of the project in the Home State Expertise of Russia
- Stage 7: Implementation of the project (2011-2020); part of Russian Federal Target Programme "Nuclear energy-technologies of new generation for period 2010 - 2015 and to the prospect until 2020
- Allocated project funding: 5927,1 MRUB (~200 MUSD)
- Stage 8: Development of working documentation, construction of the tokamak, equipment procurement, constructing-and-mounting work
- Outlook: 2017-2018: assembling of T-15MD and adjustment of engineering equipment; 2019: connection of engineering systems to T-15MD; 2019-:Physical start-up.

Ralf W. Engels, Forschungszentrum Juelich (JCHP / Institut für Kernphysik), has given a talk as a guest contribution on "*Nuclear Fusion with Polarized Fuel"*, including:

- Introduction: Why is polarization important?
- The Quintet suppression factor
- The Experimental Setup in St. Petersburg
- The dd-Project at PNPI
- Important Questions for Polarized Fusion
- How to produce and to handle polarized fuel

- Conclusion: Due to technical development of polarized sources and targets in nuclear physics the production of polarized fuel for any kind of fusion reactors seems to be in range. This will create new options for coming fusion reactors
- Announcing of the Workshop: Polarized Fuel for Fusion 2./3. October 2017 in Ferrara (INFN and Unife of Ferrara) http://www.fe.infn.it/polfusion/2017/

Joint discussions have shown that all participants unanimously agree that:

1. The Russian-Italian IGNITOR fusion project should be seen and recognized as a project that is open for European contribution.
2. Within the Russian Federation, the IGNITOR project is recognized as an *international megascience project*, and is receiving respective funding by the Russian Federation.
3. It has been noted that the concept design study (CDR) for the IGNITOR project has been finalized during May 2015. It is intended to prepare a publication in the near future, providing an executive summary of the IGNITOR-CDR.
4. The next step will be to prepare the joint work on the technical design (TDR) for the IGNITOR. This can be started after the finalization of the Russian-Italian Intergovernmental Agreement on IGNITOR-collaboration. Russian and Italian scientists will support the work on the TDR. Moreover, it is expected that during the work on the TDR, some technological aspects will be better understood and ameliorated to be ready for a smoother manufacturing process.
5. It has become clear that – from a pure physics as well as technical and engineering point of view – there are no barriers currently detectable that would detain from achieving the physics goals and the technical implementation of the IGNITOR project.
6. The Russian scientific community – especially the fusion and tokamak physics experts – will highly welcome if the IGNITOR project and the efforts currently taken will receive a much broader European audience and the possibility for scientific exchange.
7. European-Russian scientific collaboration on physics related to the IGNITOR-project is very welcome. This includes explicitly also collaborative projects at a smaller level (less extensive).