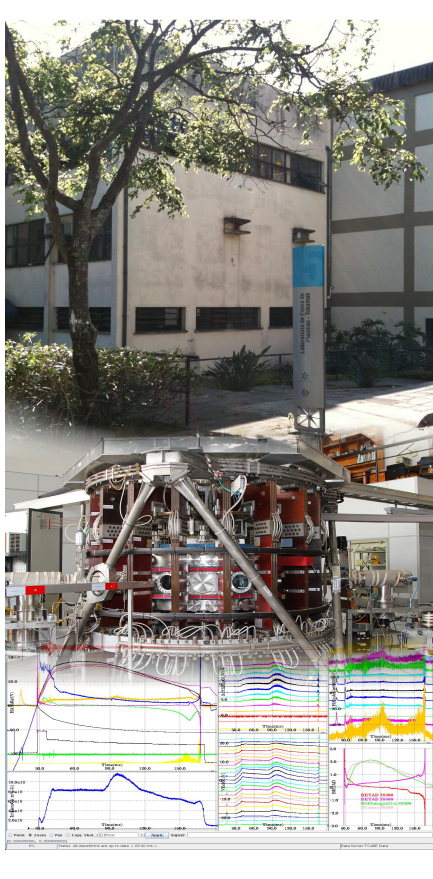
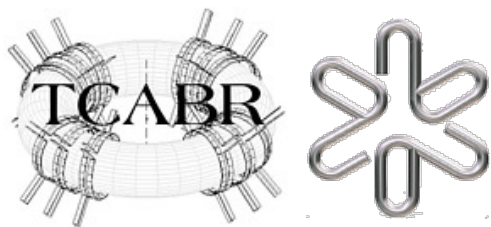


Development of a new CODAS for the TCABR tokamak



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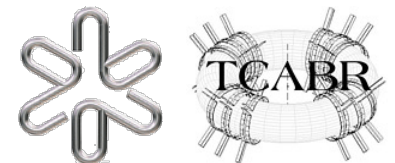


13th IAEA Technical Meeting on Plasma Control Systems, Data
Management and Remote Experiments in Fusion Research
Culham Science Centre - Culham, United Kingdom

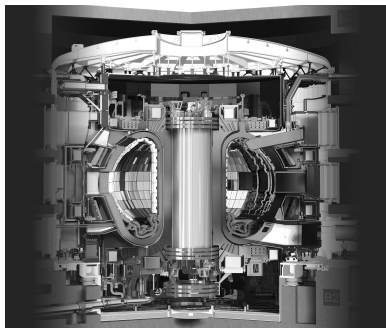
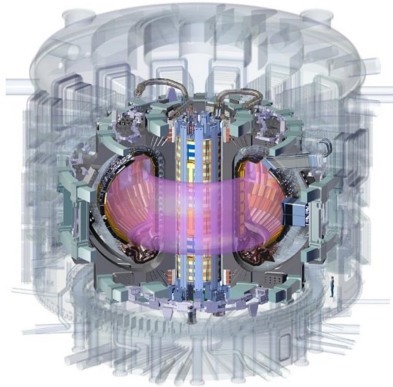
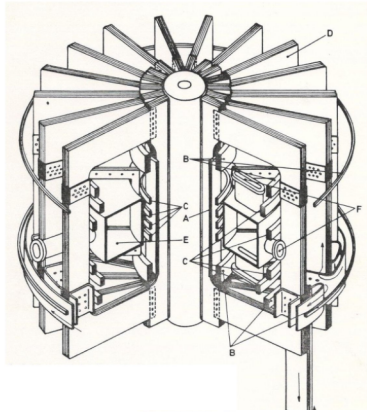
07/July/2021

Outline

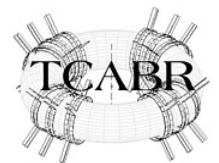
- 1. Introduction/Motivation**
- 2. TCABR tokamak**
 - 1. Operations under COVID-19 Restrictions**
 - 2. Small tokamak in the current scenario**
 - 3. TCABR Upgrade**
- 3. CODAS – Current system**
- 4. CODAS – Upgrade**
- 5. The future**
- 6. Summary**



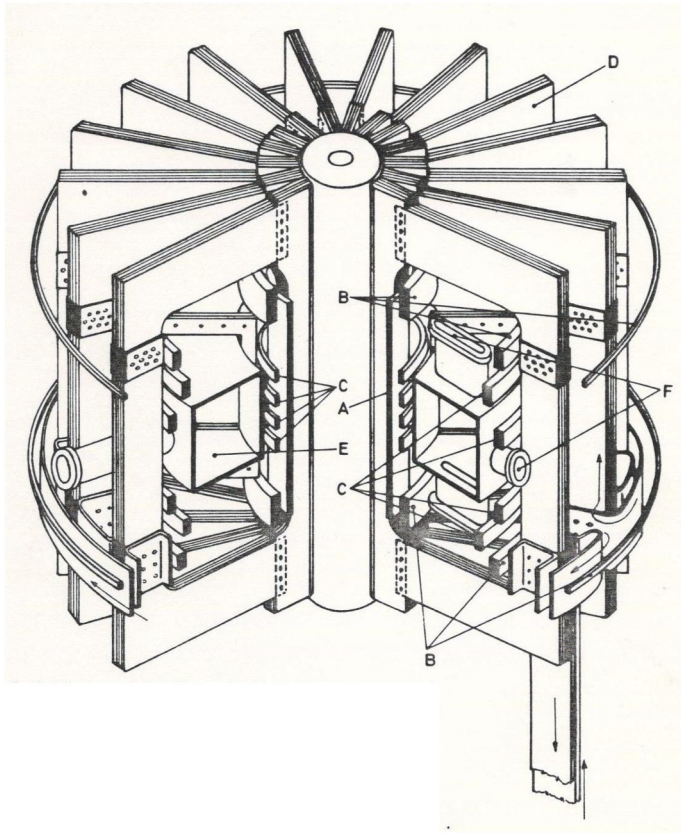
Introduction/Motivation



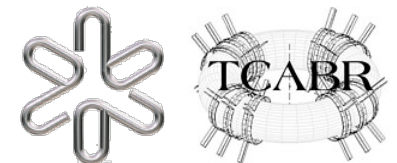
- ❑ Science is globalized
- ❑ Big science
- ❑ Big projects
 - ❖ ITER
 - ❖ CERN
 - ❖ ...
 - ❖ Big science?
- ❑ Research using small fusion devices
 - ❖ Big science?



TCABR tokamak

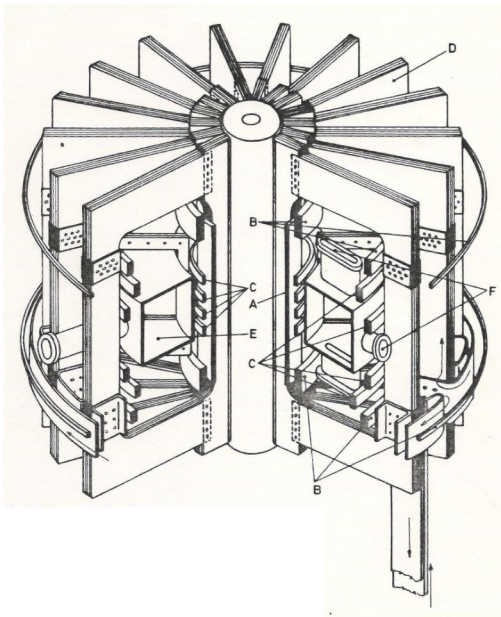


- ❑ TCABR is a small-sized tokamak ($R_0 = 0.62\text{m}$ and $a=0.2\text{m}$) of maximum $I_p=120\text{kA}$ and $B_0=1.5\text{T}$
- ❑ The configuration of magnetic fields allows only plasmas with circular plasma configuration.
- ❑ For position control a sophisticated control system is not required, since there is stability in vertical displacement.

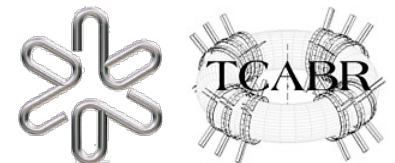


TCABR tokamak

Operations under COVID-19 Restrictions

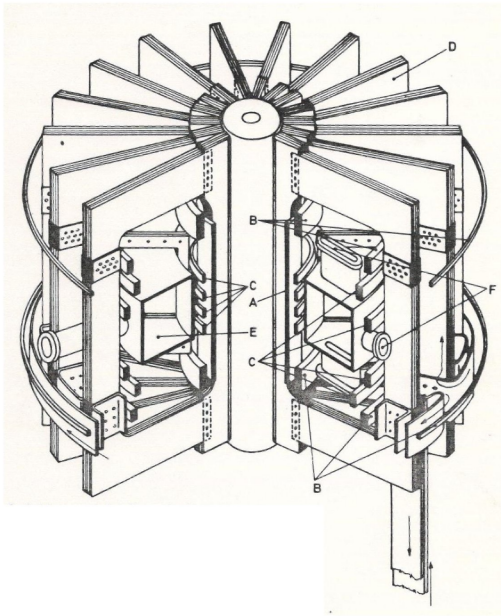


- ❑ TCABR tokamak shutdown in March/2020
- ❑ Updating codes and programs
 - ❖ SHOT Fire systems
 - ❖ Improvements and new implementations in the Logbook
 - ❖ Data Base System Upgrade
- ❑ Preparing projects
 - ❖ Pilot project for the future upgrade of the TCABR
 - ❖ ~\$ 3,000,000.00 (PILOT)
 - ❖ 70 people involved, including physicists, engineers, students
 - ❖ Several universities, several institutes...
- ❑ Activities will return in early 2022

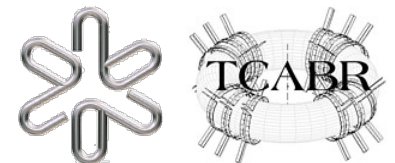


TCABR tokamak

Small tokamak in the current scenario



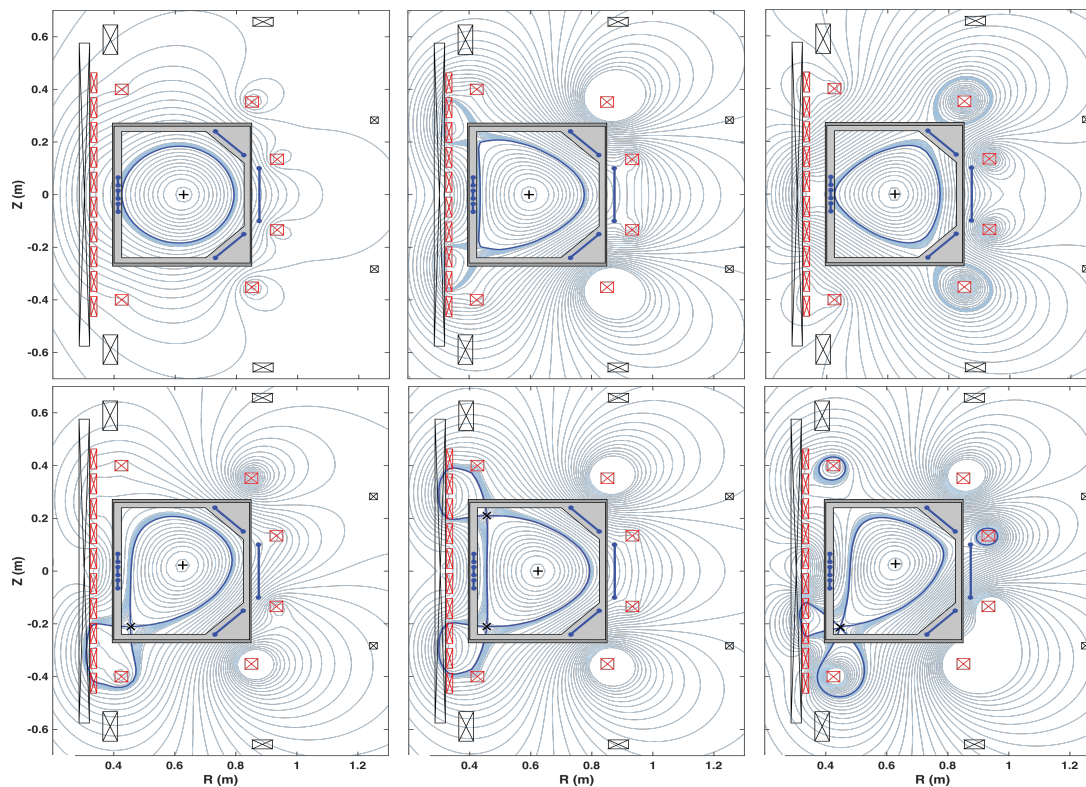
- ❑ Training of researchers specialized in Plasma Physics and Controlled Thermonuclear Fusion
- ❑ Why is small tokamaks important?
 - ❖ Ease of access to the machine and its various systems
 - ❖ Flexibility in programming experiments
 - ❖ Flexibility in developing diagnostics and their implementations
 - ❖ Trying new implementations without major damages



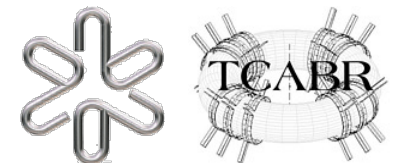
TCABR tokamak

TCABR Upgrade

A versatile plasma control system is being designed for TCABR to allow for a wide range of plasma configurations

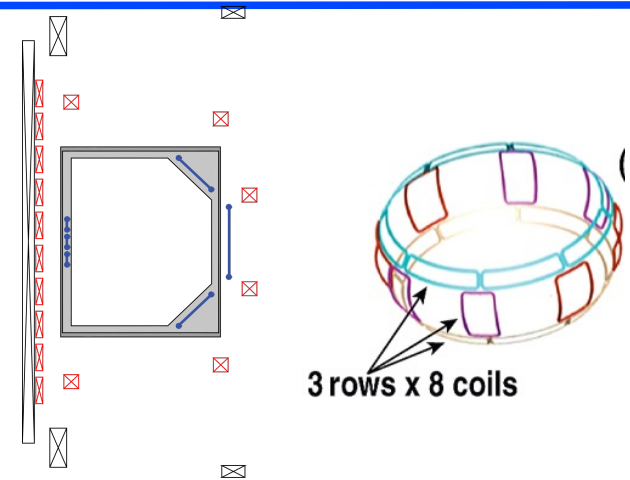
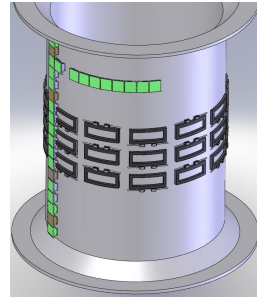


- ☐ Supervisory systems
- ☐ EPICS
- ☐ MARTe
- ☐ Improve the use of MDSplus
- ☐ Improve the Data Base system

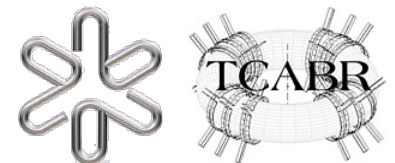


TCABR tokamak

TCABR Upgrade

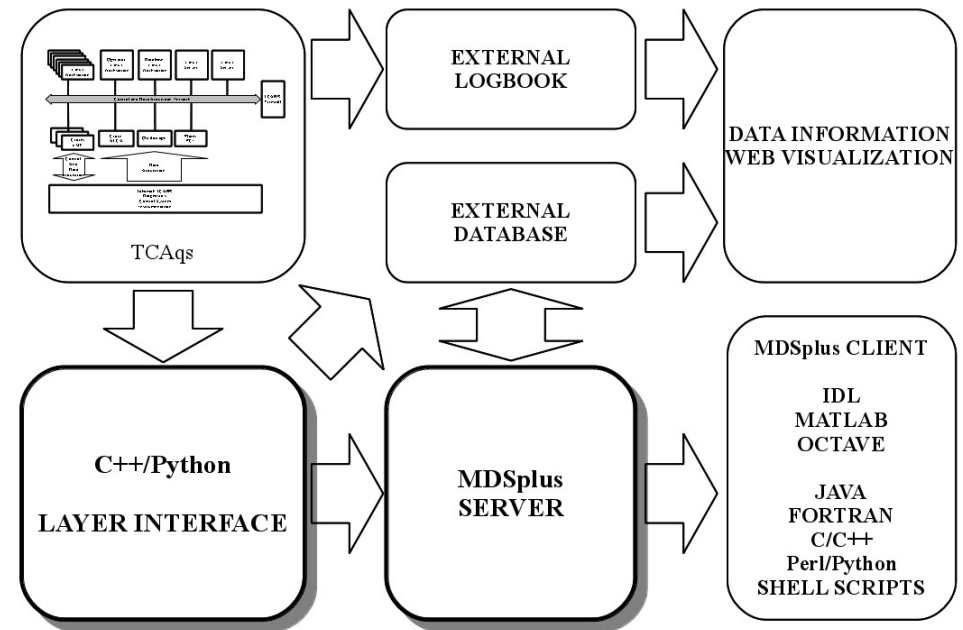
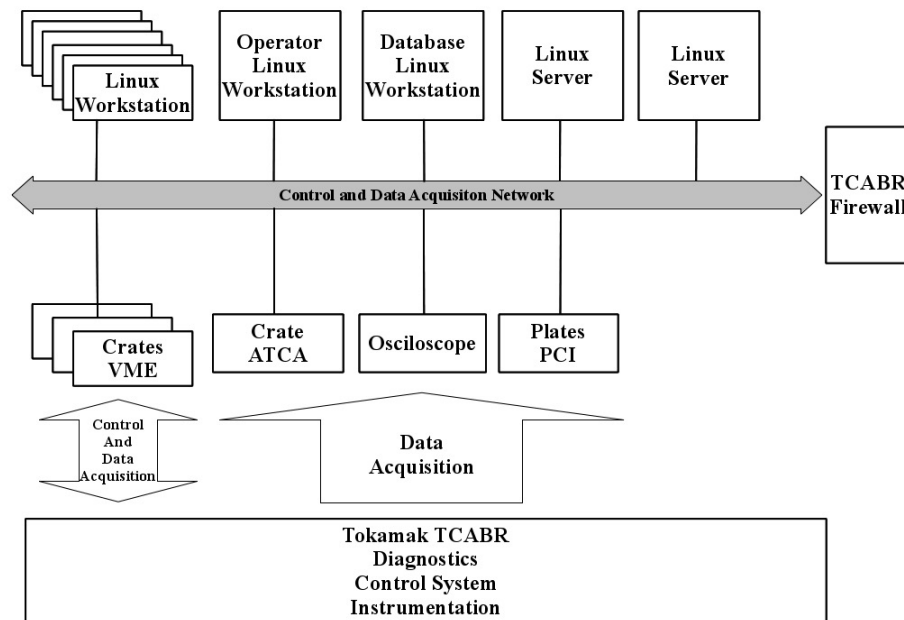


- ❑ An innovative set of RMP coils will allow for physics model validation of plasma response under a wide range of coil geometries and spectra
- ❑ graphite tiles to cover entirely the inner surface of the vacuum vessel wall
- ❑ new poloidal field coils to allow for the generation of various plasma configurations
- ❑ in-vessel HFS and LFS RMP control coils
- ❑ a coaxial helicity injection system

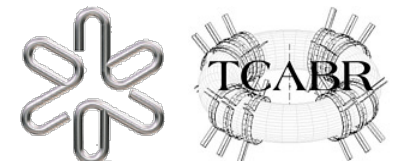


CODAS – Current System

❑ Patchwork – Why?

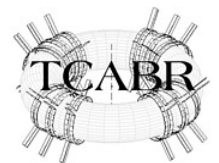


- ❑ few specialized technicians
- ❑ old system
- ❑ legacy system
- ❑ codes and programs with outdated technology



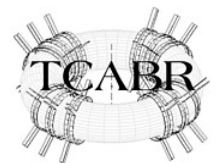
CODAS – Upgrade

- ❑ WEB technology
- ❑ Supervisory systems
- ❑ EPICS
- ❑ MARTe
- ❑ Improve the use of MDSplus



The future

- ❑ From pilot Project to complete TCABR Upgrade
 - ❖ ~ \$ 15,000,000.00 (TCABR Upgrade)
 - ❖ 5 years
- ❑ New scenarios, new challenges



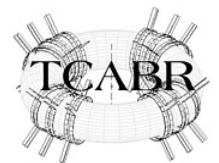
LFN – National Laboratory of Fusion

Brazil is moving towards the establishing of a national laboratory to coordinate and concentrate studies in nuclear fusion across the country



❑ TCABR tokamak

❑ ETE tokamak



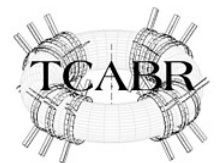
Summary

❑ TCABR Upgrade

- ❖ To place the tokamak in the international community of Plasma Physics and Controlled Thermonuclear Fusion, again.
- ❖ Update the complete CODAS (Engineering point of view)

❑ Create the National Laboratory of Fusion

- ❖ Bringing together the entire community of Brazilian researchers in the field of plasma physics



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IAEA

International Atomic Energy Agency

Atoms for Peace and Development

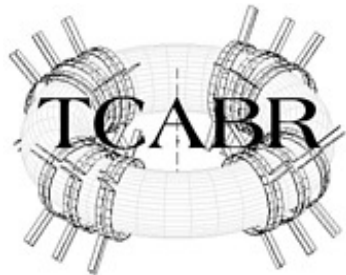


UK Atomic
Energy
Authority



CCFE

CULHAM CENTRE FOR
FUSION ENERGY



Thank you!



Conselho Nacional de Desenvolvimento
Científico e Tecnológico

