Institute for Magnetic Fusion Research

Newsletter N°21 - May 2018

Scheduled Pit Stop

Since mid-February, plasma experiments have been temporarily stopped to complete a number of different services on the WEST facility.

Some damaged coated tiles have been replaced while six new ITER-like plasma facing units have been installed in the divertor target (see box below). The first ICRH antenna which was installed in 2017 (WNL18) encountered some mechanical problem during its first operation which had to be fixed during this shutdown. In parallel, as planned, the second ICRH antenna has been integrated (see image) taking into account the teething problem faced on the first of kind.

Measurement systems have also been significantly upgraded during this stop with the installation of two in-vessel telescopes for divertor visible spectroscopy and two additional endoscopes for infrared thermography of RF antennas and divertor target. Note that all these systems are connected to the primary water cooling loop.

Today mechanical works are completed. After a thorough cleaning of the plasma facing components surface the last flange has been closed and the machine is ready to start racing again. Vacuum vessel is now evacuated and wall conditioning procedures are ongoing, plasma operations are foreseen before the end of May. Again, pit crew completed its tasks in due time!

The European PFU are in place !

6 new ITER like Plasma facing Units (PFU) provided by the European Domestic Agency (F4E) have joined their Chinese and Japanese counterparts on the WEST divertor test sector.

The test divertor sector is now equipped with 12 ITER like PFU procured by a number of potential manufacturers for ITER divertor, allowing for a comparison between various PFU manufacturing options (such as sharp or chamfered monoblocks, different tungsten grades and assembling technologies ...).

They will be exposed in the coming C3 experimental campaign, providing a first insight on their performance in terms of power handling under tokamak conditions.

2 additional EU PFU are expected for the C4 campaign.

WEST Science

Enigmatic Turbulence

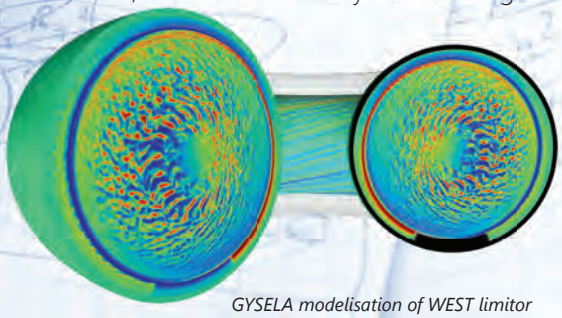
Fusion plasmas are subject to instabilities, driven by gradients of density, velocity and pressure.

If the spectrum of instabilities is broad, the plasma enters a turbulent phase characterized by fluctuations over a wide range of space and time scales. Turbulence produces a heat transport that is undesirable in core plasmas because it degrades the confinement. On the other hand, a large transport can be favorable if it widens the region at the interface with the tokamak wall, thereby spreading heat deposition and thus avoiding damages.

A large velocity shear induces a reduction of turbulent transport. In the plasma edge, this process takes the form of a LH transition (for «Low to High confinement»). An LH transition requires a minimum heating power, the value of which depends on the characteristics of the plasma and its geometry.

Turbulence modeling is important to understand the plasma behavior but demands large computer resources. The number of mesh points needed to describe turbulence in a fusion reactor is of the order of a thousand billion. A simulation on such a large mesh can only be done on the next generation exascale computers (1018 operations per second). An alternative approach is a multi-scale computation, which relies on a set of connected models that describe different scales or physics.

Spectroscopy, probes, imaging and radar techniques are diagnostics used in WEST to measure fluctuations. Their specificity is the large amount of data they produce, the analysis of which constitutes a field of study in itself. The past decade has seen dramatic progress in comparing measurements with models. However, turbulence certainly remains enigmatic.



GYSELA modelisation of WEST limitor

Planning the WEST 2018 experimental campaigns

The 2nd WEST Experiment Planning meeting was held in Aix-en-Provence, March 20-21.

The workshop was targeted at reviewing WEST start up and achievements during the first campaigns, presenting WEST capabilities for the upcoming campaigns and planning the 2018 summer and autumn campaigns.

The meeting gathered a wide audience, with more than a hundred participants, among which ~40 external collaborators (in particular, experts from the ITER organization (IO), the French Federation of Research on Magnetic Fusion (FR-FCM), Europe (EUROfusion, CCFE, ERM, FZJ, IPP. CR, IPPLM, JSI, VTT), Japan (NIFS) and USA (ORNL)).

The output of the meeting was a detailed timeline for the C3 campaign (presently planned May -August 2018) and the main lines of the C4 fall campaign, to be presented to the WEST partners at the 5th WEST Governing Board on May 18, 2018.

The focus of the C3 campaign will be on increasing the injected power towards 5 MW (H-mode) and performing first experiments on ITER-like PFU prototypes towards 10 MW/m^2. The first part of the C4 campaign will be devoted to the preparation for long pulse experiments, while a dedicated Helium campaign is proposed for the end of C4.

For more details, check the WEST users portal (https://westusers.partenaires.cea.fr/).

Representatives of the institutions that funded the transformation of Tore Supra into WEST (European Fund (Feder), State, PACA Region and Department of the Bouches du Rhône), as well as some members of parliament, local elected officials and Bernard Bigot, IO DG, honored the invitation with the CEA team.

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