EFDA
EUROPEAN FUSION DEVELOPMENT AGREEMENT
JET

EFDA-JET Bulletin


Journalists interview JET scientist Dr Phil Morgan

July 2006

Journalists visit JET prior to ITER ceremony

On Sunday 21 May 2006, twenty journalists from all over Europe visited JET, their first stop on a trip to European ITER-relevant locations, prior to attending the ITER Agreement initialling ceremony in Brussels on 24 May. The other sites visited were Cadarache in France, where ITER will be constructed and Barcelona, Spain, where the European Domestic Agency for ITER will be based. The response from journalists was very positive, with significant coverage in the European media, for example a large feature article in the "The Guardian" newspaper on 24th May.

New EFDA Associate Leader for JET

At its meeting on 4 May 2006, the EFDA Steering Committee appointed Dr Francesco Romanelli as EFDA Associate Leader for JET, following Dr Jérôme Paméla who was recently appointed as EFDA Leader. Dr Francesco Romanelli graduated in Physics in 1980 and started his career as a research scientist at ENEA, Italy, in 1983. In 1996 he became leader of the Magnetic Confinement Fusion Physics Section at ENEA, with responsibilities for the FTU experiment, theoretical activities, participation in JET and activities of R&D for ITER physics. In 2003, Dr Romanelli became Co-Chairman (for Physics) of the Science and Technology Advisory Committee of the European Fusion Development Agreement (EFDA STAC).

Dr Francesco Romanelli will take over operational responsibility from 1 July.

" I am really honoured to lead the largest fusion facility in the world. I am convinced that JET has played and will continue to play a key role in the world fusion programme, in particular preparing the operation of ITER "

Dr Francesco Romanelli, EFDA Associate leader for JET

"I am very pleased with the news of the appointment of Francesco Romanelli as the new EFDA Associate Leader for JET. I am confident that under his leadership JET will succeed in implementing a very challenging programme in support of ITER.

Dr Jérôme Paméla, EFDA Leader

JET Experimental Campaigns launched

After a long shutdown and restart, JET experimental campaign C15 started on 24 April and ended on 25 May. An intervention to repair a water leak that occurred on one of the Neutral Beam systems has been completed, with the start of the JET Campaigns C16-C17 on 3 July 2006.

The C15 campaign was devoted to studies of plasmas with ITER-like configurations. In this Bulletin, some of the achievements of the C15 campaign are highlighted.


24th May, Brussels: ITER parties come to an agreement on the world's largest international scientific partnership

The 2006 JET experimental campaigns aim at taking advantage of the latest enhancements of the JET facilities to address ITER high priority issues.

The objectives of the 2006 EFDA-JET Workprogramme, with experiments spanning the period 24 April 2006 to 20 October 2006, are to study issues which could impact on the detailed design of ITER components, such as the first wall, heating & current drive systems and diagnostics; to optimise ITER operating scenarios, including the ELMy H-Mode, the Advanced Scenario and the Hybrid Scenario; and to study ITER-relevant physics such as burning plasma physics, transport, MHD and the effects of toroidal magnetic field ripple.

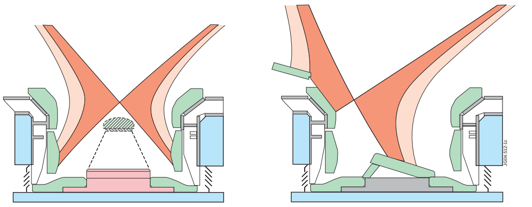

Figure 1: Magnetic configurations in the previous (left), and new (right) JET divertors. The new divertor allows the strike points to be shifted inwards, to form configurations with high triangularity.

In order to conduct these studies with the most ITER-like plasmas, during the 2004/5 shutdown, the auxiliary heating power available on JET was increased, and a new divertor (see Figure 1) was installed, which allows high power operation with an ITER-like, higher triangularity plasma shape (see, e.g., Figure 2). In addition a set of 15 new or upgraded diagnostics were installed, allowing the necessary measurements to achieve the goals of the programme. During the early part of operations in 2006, high priority was given to bringing these enhancements to full performance.

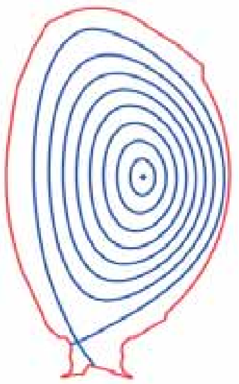

Figure 2: Example of an ITER-like high-triangularity configuration, made possible by the new divertor

Power upgrades

A 3dB coupler was installed on a pair of ion cyclotron resonance heating (ICRH) antennas to improve coupling to the plasma in the presence of Type I edge localised modes (ELMs). This has been tested successfully at low power, and requires progress with arc detection for a demonstration at high power. In addition, a septum was installed in the neutraliser of the neutral beam (NB) system, to increase the neutralisation efficiency. This resulted in an increase in NB power by ~10%. Subsequently, an ELMy H-mode was achieved with a peak of 29MW of additional heating power (21.5MW NB power and 7.5MW ICRH power), and delivery of 115MJ of energy to the plasma, in Pulse No. 66424.

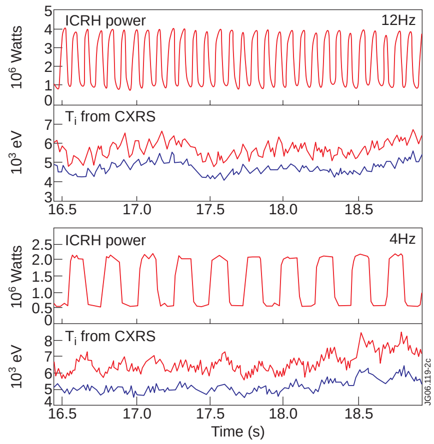

Figure 3: Ion temperature modulation at 12Hz and 4Hz, using modulated RF power. With the enhanced time resolution of the CXRS system, the ion temperature response at the modulation frequency is clearly distinguished in both cases.

New or upgraded diagnostics

New or upgraded diagnostics to study interaction of the plasma with the first wall include a divertor bolometer, a wide-angle IR camera and quartz microbalances (QMBs) in the divertor. As examples of preliminary observations with these: the bolometer shows radiating structures in the divertor region (see Figure 4); the IR camera shows power loss to the main chamber during ELMs and disruptions; and the QMBs show a correlation between strike point position and erosion/deposition in the private flux region. A new charge exchange recombination spectroscopy (CXRS) system, with a time resolution of 10ms, was installed to provide core data for scenario optimisation and physics studies. This system has been used in unique transport studies to measure ion temperature modulation with modulated ICRH, applied at up to 20Hz (see examples in Figure 3). This is expected to yield a quantitative estimate of the ion temperature profile stiffness. Optimisation of the Advanced Scenario will also benefit from an X-mode reflectometer, which can localise Alfvén Cascades to determine the location of zero magnetic shear in reversed-shear discharges (see Figure 5). This reflectometer makes use of new, low-loss (~0.005 dB/m) waveguides, which are necessary to obtain an adequate signal-to-noise ratio. New diagnostics for burning plasma studies include a time-of-flight neutron spectrometer for 2.45MeV neutrons, and a scintillator probe and Faraday cups to measure fast particle losses. The neutron spectrometer clearly shows the high-energy deuterium tail during ICRH, and the scintillator probe and Faraday cups show losses of high-energy particles correlated with magnetohydrodynamic (MHD) activity (see Figure 6). In addition, on one channel, the data acquisition rate for gamma-ray spectroscopy has been successfully upgraded from a few tens of kHz to 450kHz.

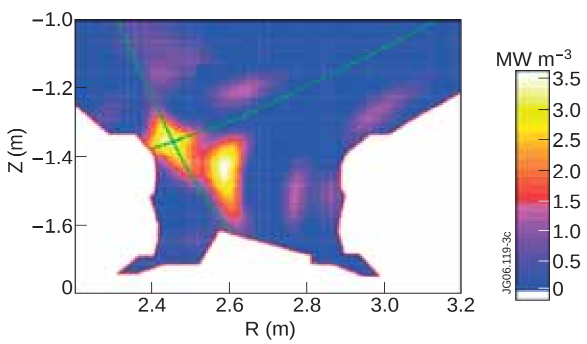

Figure 4: Results from the new bolometer, showing localised radiating structures in the divertor region (data taken between ELMs)

Scenario optimisation with the new divertor

The task of demonstrating the performance of the new divertor is integrated with the scenario optimisation activity. Studies are underway to characterise the H-mode and the Advanced Scenarios in high-triangularity configurations, which are possible with the new divertor. Confinement in the ELMy H-mode is being investigated in two high-triangularity configurations, including the ITER-like plasma shape. This shape has been successfully tested up to a plasma current of 2.5MA and heating power of 20MW, with initial studies focussing on the effects of the new divertor geometry on performance, and on ELM type. This is the first step in a programme which will continue into 2007, to develop a 4MA, high power plasma in the ITER shape, which will be closer in absolute parameters to ITER than previously possible. It will also be possible to discriminate the effects of the lower and upper triangularities on the behaviour of ELMs more finely than was possible previously. The search for mild, Type II ELMs, as seen on ASDEX Upgrade, is also continuing in a quasi-double-null (QDN) configuration, which can now be matched more closely to the QDN configuration on ASDEX Upgrade, in which Type II ELMs are observed.

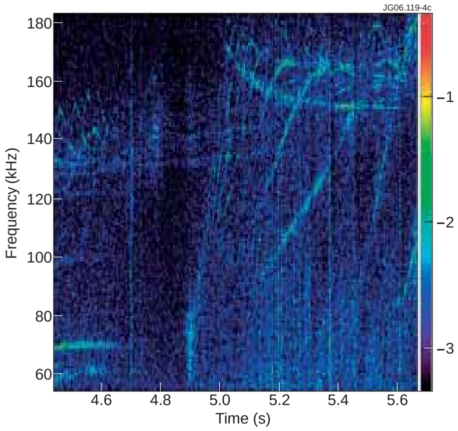

Figure 5: Alfvén Cascades observed with the X-mode reflectometry using the new microwave access. Unlike O-mode reflectometry, X-mode reflectometry can localise the modes, and thereby determine the location of zero magnetic shear in discharges with reversed shear.

Initial experiments have also been performed to investigate potential Advanced Tokamak regimes in an ITER-like plasma shape, and in a configuration with high lower triantularity, but low upper triangularity. First results suggest improvements in performance in the latter shape, with respect to previous high-triangularity Advanced Scenario operation. Studies in both configurations are ongoing.

Reducing the probability of disruptions in ITER scenarios remains a high priority. The intrinsic error field on JET has been determined in the ITER-like configuration, enabling the Error Field Correction Coils to be used for this purpose. In the ELMy H-mode scenario measurements have been made to make the vertical speed measurement more reliable during ELMs, to reduce the risk of disruptions due to vertical displacement events. Studies are also underway to reduce the risk of disruptions due to neoclassical tearing modes (NTMs), by reducing the size of sawteeth using ion cyclotron current drive (ICCD) or by improving NTM stability using lower hybrid current drive.

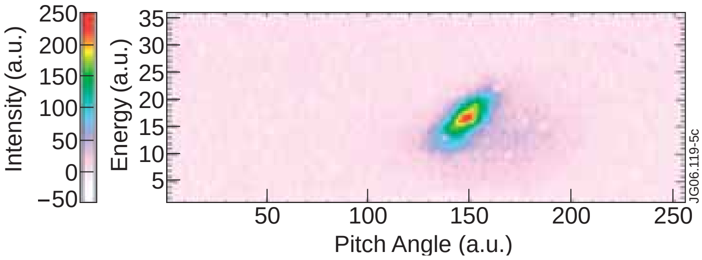

Figure 6: Losses of energetic particles, as seen by the new scintillator probe, observed at the time of a Sawtooth crash.

JET's new ITER-like antenna delivered

Final inspection of the new ITER-like Ion Cyclotron Resonant Heating (ICRH) antenna was carried out in Italy on 23 May 2006. Following the inspection, the antenna was transported to JET where it will be commissioned on a testbed prior to its installation on JET at the end of this year.

The novel design of the antenna is expected to be resilient to fast varying loads due to Edge Localised Modes (ELMs) and deliver 8MW/m^2 for 10s.

The photograph taken at JET during the inspection shows the antenna housing fully fitted with straps, faraday screens and private limiter tile supports.

L to R : Frank Briscoe (JET Operations Director), Robert Pearce (Head of Vacuum Systems & Machine Operations Group), Jérôme Paméla (EFDA Leader), Kaname Ikeda (ITER Director General), Shunsuke Ide (Assistant to the ITER DG).

ITER Director-General Nominee Kaname Ikeda visits JET Facilities

On Friday 21 April, the ITER Director General Nominee Kaname Ikeda with his assistant Dr Shunsuke Ide visited JET. Staff working on fusion here at Culham appreciated DG Ikeda's talk about his extensive professional experience and his mission at ITER.

The ITER Director General Kaname Ikeda was nominated by the ITER Parties in November 2005 and started working at Cadarache in March 2006. Dr Shunsuke Ide joined his office from JAEA, bringing experience gained with the JT-60U team.

L to R : Jérôme Paméla (EFDA Leader), Norbert Holtkamp (ITER Principle Deputy Director General), Duarte Borba (Head of the Office of the EFDA Associate Leader for JET).

N. Holtkamp at the JET Remote Handling control

Dr Norbert Holtkamp visits JET Facilities

On Friday 28 April, the ITER Principal Deputy Director General Nominee Dr Norbert Holtkamp visited JET. In his talk to staff, Dr Holtkamp presented his experience from the Oak Ridge National Laboratory, where he was Director of the Accelerator Systems Division of the Spallation Neutron Source, and outlined his vision of the ITER construction process.

"Let me thank you very much for this excellently organized visit to JET. I found the interaction with your staff very fruitful and I can only congratulate you to this very engaged group of people," said Dr Holtkamp after his visit.

Academician E.P. Velikhov, who was behind the initiative to promote fusion at the Reagan-Gorbachev summit in 1985, receives 2006 Global Prize from President Vladimir Putin.

Global Energy Prize goes to ITER personalities

Academician Evgeny P. Velikhov (Russia), Dr Yoshikawa Masaji (Japan) and Dr Robert Aymar (France) were awarded the "Global energy" prize (known as the "Russian Nobel") in 2006 for the development of scientific and engineering foundation of the ITER project. Global Energy International Prize is a unique award intended to assist international cooperation in solving the most important problems of today in the field of power generation.

The formal award ceremony for the 2006 prize took place on 13 June in St Petersburg. The winners received the prize from the President of Russia, Vladimir Putin, who said: "As far as I know, this is the first time that a collective (Global Energy) prize has been awarded. Dear gentlemen, this confirms the unique value of your joint scientific research."

Close Support Unit in Culham

In the second quarter of 2006 the CSU Enhancement Department was reinforced by Ray Handley from UKAEA in April, and by Vincent Hennion from CEA in May. 2006 is a year of major CSU renewal, requiring uninterrupted availability of trained staff, in particular with regard to the new JET enhancement projects.

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