MAX PLANCK INSTITUTE
FOR PLASMA PHYSICS

Press release

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Nuclear fusion: European joint experiment achieves energy record

Frank Fleschner
Press officer
Phone: +49 89 3299-1317
E-Mail: press@ipp.mpg.de

At the Joint European Torus (JET) in the UK, a European research team has succeeded in generating 69 megajoules of energy from 0.2 milligrams of fuel. This is the largest amount of energy ever achieved in a fusion experiment.

Fusion power plants are designed to fuse light atomic nuclei, following the example of the sun, in order to harness huge amounts of energy for humanity from very small amounts of fuel. The European research consortium EUROfusion is pursuing the concept of magnetic fusion, which is considered by experts to be the most advanced. With the large-scale experiments ASDEX Upgrade and Wendelstein 7-X, the Max Planck Institute for Plasma Physics (IPP) is driving forward research into this in Germany.

For experiments with the fuel of future power plants (deuterium and tritium), Europe's scientists operated the JET research facility near Oxford together with the UK Atomic Energy Authority (UKAEA). A new world record was set there on 3 October 2023: 69 megajoules of fusion energy were released in the form of fast neutrons during a 5.2 second plasma discharge. 0.2 milligrams of fuel were required for this. The same amount of energy would have required about 2 kilograms of lignite – ten million times as much. JET thus beat its own record from 2021 (59 megajoules in 5 seconds).

"This world record is actually a by-product. It was not actively planned, but we were hoping for it," explains IPP scientist Dr Athina Kappatou, who worked for JET as one of nine Task Force Leaders. "This experimental campaign was mainly about achieving the different conditions necessary for a future power plant and thus testing realistic scenarios. One positive aspect, however, was that the experiments from two years ago could also be successfully reproduced and even surpassed." The latter was the case with the record-breaking experiment. The entire campaign is essential for the future operation of the international fusion plant ITER, which is currently being built in southern France, as well as for the planned European demonstration power plant

DEMO. Over 300 scientists and engineers from EUROfusion contributed to these landmark experiments.

The JET record did not achieve a positive energy balance – in other words, more heating energy had to be invested in the plasma than fusion energy was generated. In fact, an "energy gain" is physically impossible with JET and all other current magnetic fusion experiments worldwide. For a positive energy balance, these fusion plants must exceed a certain size, which will be the case with ITER.

The record-breaking experiment (JET pulse #104522) in the autumn was one of the last ever at JET. After four decades the facility ceased operations at the end of 2023.

Photos and videos for media coverage can be found in the UKAEA Press Kit.

About Max Planck Institute for Plasma Physics

The Max Planck Institute for Plasma Physics (IPP) in Germany (locations: Garching near Munich and Greifswald) is investigating the physical foundations for a fusion power plant that will generate energy from the fusion of light atomic nuclei. IPP's research is part of the European research consortium EUROfusion. With its workforce of approximately 1,100, IPP is one of the largest fusion research centres in Europe.

Max Planck Institute
for Plasma Physics (IPP)
Boltzmannstr. 2
85748 Garching
near Munich, Germany

Phone: +49 89 3299-1317
Email: press@ipp.mpg.de
Web: www.ipp.mpg.de