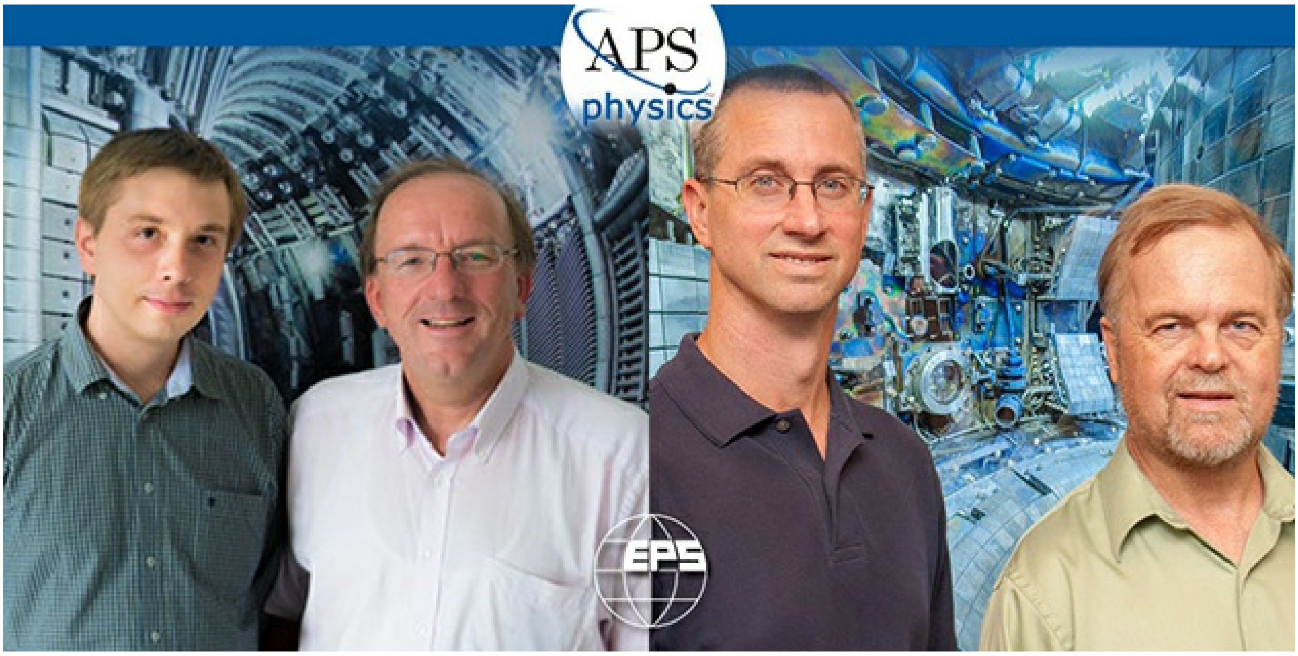
The 2018 APS-EPS Landau-Spitzer Award on the Physics of Plasmas

J. Ongena 26-09-2018 http://www.primapagina.sif.it/article/834



The four winners of the Landau-Spitzer Award 2018 From left to right : Yegven Kazakov, Jef Ongena (with the interior of JET in the background), Steven Wukitch, John Wright (with the interior of Alcator C-Mod in the background).
Acknowledgements (pictures supplied in separate high resolution files):
For the left picture : S. Kirtz, IEK-4, Forschungszentrum Jülich, Germany
For the right picture : P. Rivenberg, Plasma Science and Fusion Centre, MIT, Boston, USA.

For the development of the new and highly efficient 3-ion heating scenario for heating of fusion plasmas using Ion Cyclotron Resonant Heating (ICRH), the joint team consisting of Yevgen Kazakov and Jef Ongena, from LPP-ERM/KMS (Brussels, Belgium) and John Wright and Steven Wuktich from the Alcator C-Mod group at MIT (Boston, USA) received last July the prestigious Landau-Spitzer Award *"for experimental verification, through collaborative experiments, of a novel and highly efficient ion cyclotron resonance heating scenario for plasma heating and generation of energetic ions in magnetic fusion devices"*. The award recognizes an individual or group of researchers for outstanding theoretical, experimental or technical contributions in plasma physics, and for advancing the collaboration and unity between the European Union (EU) and the United States of America (USA) by joint research, or research that advances knowledge which benefits the EU and USA communities in a unique way.

The efficiency of the theoretically derived new ICRH scenario was demonstrated by accelerating a small amount of ^{3}He ions in a plasma containing 80%H and 20%D on the largest tokamak in the world JET (Joint European Torus, Culham, UK) and the high magnetic field tokamak Alcator C-Mod (MIT, Boston, USA). The presence of ^{3}He ions with MeV-range energies was confirmed using several fast-ion diagnostics on both devices. Effective plasma heating was also seen, as a result of the slowing-down of the fast ^{3}He ions. Three-ion heating scenarios open promising new avenues for the application of ICRH in present and future fusion devices as *e.g.* ITER and DEMO. The common work resulted in a joint publication in the Nature Physics issue of October 2017. The physical mechanisms that underpin this heating technique also provide a simple explanation for the existence of solar flares with a high ^{3}He abundance. The efficiency of the method was also recently shown on a third fusion device, the tokamak ASDEX Upgrade in Garching, Germany.

The developed technique is relevant for heating various multi-ion plasmas containing not only hydrogen or helium isotopes but also so-called intrinsic impurity ions that are anyhow present in the plasma. Further experiments are planned in the coming months on JET and ASDEX Upgrade in view of promising applications of the novel scenario in future JET D-T experiments and in ITER. For instance, three-ion schemes in ^{4}He-H plasmas offer new possibilities for ITER half and full field operations and for H-Mode access studies during the non-active phase of ITER; intrinsic ^{9}Be ions can be used as a resonant species for ICRH startup phases in 50%D-50%T plasmas and thus reduce the need for scarce and expensive ^{3}He in ITER; acceleration of fast D or T ions from the Neutral Beam Injectors (NBI) to higher energies in synergetic ICRH+NBI three-ion heating scenarios can contribute to maximizing the steady-state Q-value and boosting the fusion performance in future D-T experiments on JET. These examples illustrate the large range of applications of the new ICRH scenario and its potential to contribute to the development of fusion energy.