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Coordinated underground measurements of gamma-ray emitting radionuclides for plasma physics research

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Content

A coordinated measurement campaign was conducted in four European underground laboratories aiming to assist in analysing the plasma conditions in the KSTAR (Korea Superconducting Tokamak Advanced Research) thermonuclear fusion facility. Forty-eight samples made of CaF2, LiF and YVO4 (12 samples of each type) and each with a 1-cm2 area were placed inside the KSTAR Tokamak. A special feature of this experiment was that seven individual plasma pulses were studied. This was realised by turning the sample holder inside the Tokamak between each pulse so that only one set (six samples, two of each type) of samples at a time was exposed to the charged particles leaking from the plasma. The eighth set of samples was exposed solely to neutrons. The radionuclides produced by neutron and charged particle activation were measured with HPGe-detectors. Due to the short duration of plasma pulses (between 5 and 40 seconds) and the relatively low power (compared to what is planned for ITER) the activity of activation products of interest was very low and ultra low-level gamma-ray spectrometry was necessary. To be able to measure all 48 samples (plus 3 blank samples) in a reasonable time and to search for possible short-lived radionuclides (half-life of a few days) a coordinated action between several underground laboratories was launched. Four laboratories from the network CELLAR (Collaboration of European low-level underground laboratories) contributed with measurements. Details of the underground measurements are presented together with metrological data on the quality control and calibrations. The activation technique is today the only possible way to monitor charged particles inside Tokamaks. The present work aims to both improve the technique for future use in ITER and to study plasmas produced in existing Tokamaks.

About the Presenter

Mikael Hult is Swedish and Head of the Radionuclide Metrology Sector at the European Commission's Joint Research Centre in Geel (IRMM). He is also the coordinator of the ICRM low-level measurement techniques working group. His PhD (Lund University, Sweden) and postdoc work was about ion beam analysis of GaAs-structures. After working a few years on primary standardisation techniques Dr. Hult was put in charge of the low-level radioactivity group of IRMM and as such leading the work in the 225 m deep underground laboratory HADES. As a consequence of this work he initiated the network CELLAR in 1999 triggered by discussions at the ICRM-LLRMT conference in Mol the same year.

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