

News Release

June 29, 2010

With TASCA on the search for superheavy elements:

Chemical Element 114: first verification in Germany

An international team of scientists at GSI Helmholtzzentrum für Schwerionenforschung (GSI) succeeded in the observation of the chemical element 114, one of the heaviest elements created until now. So far, this feat was achieved at only two other research centers, in Russia and in the USA. In the experiment at GSI, scientists employed the innovative new setup TASCA (Trans Actinide Separator and Chemistry Apparatus), which was developed by scientists from GSI and the Technische Universität München (TUM). The aim of future experiments with this new setup is to advance to yet heavier elements and possibly to discover new elements beyond element 118.

With the new TASCA setup, the research team observed 13 atoms of element 114 during the course of their four week long experiment. Despite being a small number of atoms, it corresponds to the highest ever measured production rate for element 114. This paves the way for future in-depth chemical, atomic, and nuclear physics studies.

“TASCA is currently the world's most efficient system for detecting superheavy elements produced with particle accelerators. This high efficiency is the key to future experiments, where we will also conduct chemical analyses of superheavy elements in the vicinity of element 114, to determine their correct position in the periodic table of the elements”, says Christoph Duellmann from GSI, head of the collaboration. Duellmann also works at the newly founded Helmholtz Institute Mainz, based at Johannes Gutenberg University Mainz.

Using the 120-meter long GSI particle accelerator, the scientists fired calcium ions onto a plutonium-coated titanium foil. In the course of the experiments, a calcium and a plutonium nucleus undergo fusion to form a nucleus of the new element. The element's atomic number (the number of protons in the atomic nucleus) is 114, hence its preliminary name “element 114”. Its atomic number corresponds to the sum of those of the reacting elements: calcium with 20 and plutonium with 94 protons.

The gas-filled separator TASCA separated the atoms produced by the accelerator with high selectivity from other reaction products. A special semiconductor detector, developed by scientists from the Institute for Radiochemistry at the Technische Universität München, identified the atoms of element 114 by the radiation pattern emitted during their decay. The scientists were able to identify two different isotopes of element 114 with the mass numbers 288 and 289. The measured half-lives are of the order of one second.

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Initial reports on the observation of element 114 were published about 10 years ago from the research center in Dubna, Russia. However, the commission of the International Union of Pure and Applied Chemistry (IUPAC) in charge has not yet officially recognized the discovery claim. Almost simultaneously to the GSI experiment, two atoms of element 114 were observed at a research center in Berkeley, USA. The results from GSI, Darmstadt, and Berkeley, USA now essentially confirm the results from Dubna.

Theoretical studies almost 50 years ago predicted an island of stability around the atomic numbers 114, 120 or 126. They initiated a worldwide race to produce super heavy elements. Recently, IUPAC officially recognized element 112, discovered at GSI, as the heaviest element thus far. Russian reports on the creation of elements up to atomic number 118 are yet unconfirmed. „With the identification of element 114 we have proven TASCA’s ability,” sais Alexander Yakushev, leader of the superheavy elements-group at the Institute for Radiochemistry in Garching. „Now we are heading for even heavier elements to open the new eighth row of the periodic system.“

The TASCA experiment on the production of element 114 was led by scientists from GSI, the Johannes Gutenberg University Mainz and the Technische Universitaet Muenchen. The collaboration also includes researchers from Berkeley (USA), Jyväskylä (Finland), Kolkata (India), Liverpool (UK), Lund (Sweden), Oslo (Norway) und Warsaw (Poland). This work was financially supported by the German Ministry of Education and Research (BMBF), the GSI-F&E , the Swedish Science Council, the U.S. D.O.E. and NNSA , the Norwegian Research Council and the government of India-XIth five year plan project TADDS.

Publication:

Production and Decay of Element 114: High Cross Sections and the New Nucleus ²⁷⁷Hs

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<http://prl.aps.org/abstract/PRL/v104/i25/e252701>

Picture:

<http://mediatum.ub.tum.de/node?cunfoid=981812&dir=981812&id=981812>

Detector for the identification of superheavy elements developed by scientists at the Institute for Radiochemistry of the Technische Universitaet Muenchen in Garching

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