Actinide research published in Reviews of Modern Physics

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(PhysOrg.com) -- A Livermore researcher who teamed with a United Kingdom collaborator has published an article in Reviews of Modern Physics that refines decades of actinide science and may just become the preeminent research paper in the field.

Kevin Moore of LLNL and Gerrit van der Laan at the Diamond Light Source in the United Kingdom wrote “Nature of the 5f States in Actinide Metals,” which describes the electronic, magnetic and crystal structure of actinides and demonstrates the importance of actinide science to a broad class of scientists. It appears in the Feb. 6 edition of *Reviews of Modern Physics*.

Actinides encompass the 15 chemical elements that lie between actinium and lawrencium included on the periodic table, with atomic numbers 89-103. The actinide series derives its name from the first element in the series, actinium. The 5f states are complicated electron wave functions.

Reviews of Modern Physics is the premier journal for physics research. It is the fifth highest ranked journal out of all fields and only publishes 32 invited papers a year. Each year, one or more of the invited papers are used in part as acceptance speeches for the Nobel Prize in physics.

Moore and van der Laan’s paper points out that the heaviest actinides have almost no experimental data, generating only a rudimentary level of understanding.

“The actinide series as a whole is modestly understood, with the level of comprehension decreasing with atomic number,” Moore said.

While theoretical work on the actinides is substantial, the lack of experiments is due to the toxic and radioactive nature of the materials, which makes handling difficult and expensive. In addition, the cost of the materials themselves is exceedingly high, meaning experiments that need a large amount of materials further increase the expense of research.

Progress in understanding the theoretical calculations has its limits as well. It’s been hampered by the extreme difficulty of the physics and the lack of a healthy body of experimental data from which to validate the theory.

However, Moore and van der Laan explain the progress in understanding the electronic structure of the 5f states in the actinide metal series by sifting through decades of research in the theoretical and experimental fields and condensing the data in a definitive article on actinide science.

“This establishes LLNL as a frontrunner in actinide science and highlights the work done at defense labs by having that research in a world-class journal,” Moore said.

Provided by Lawrence Livermore National Laboratory

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