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Authors: P.W.

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Abstract: Discusses how an electron can effect the nucleus of an atom. Observation of nuclear excitation by electron transition (NEET) in gold atoms by Shunji Kishimoto and reported in the August 28 edition of 'Physical Review Letters'; Evidence of bound internal conversion (BIC) by French researchers as reported in the August edition of 'Physical Review C'; How these phenomena may affect isotope identification.

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Electrons get a crack at the nucleus

Physicists generally regard an atom's nucleus as immune to the tumult of the electron cloud that surrounds it. To excite the nucleus, electrons leaping between energy states would have to emit a million times more energy than they typically do. What's more, that energy would have to be in just the right megadoses.

Still, researchers have long suspected that there are exceptions to those rules. Two experiments have confirmed those suspicions for the first time.

Shunji Kishimoto of Japan's High Energy Accelerator Research Organization in Tsukuba and his colleagues have shown that in gold atoms, an electron jumping between two widely separated energy levels can release enough energy to excite the nucleus. The Japanese team reports its observation of so-called nuclear excitation by electron transition, or NEET, in the Aug. 28 Physical Review Letters.

"It's the first really believable demonstration of the NEET phenomenon," which was first predicted 27 years ago, says Donald S. Gemmell of Argonne (Ill.) National Laboratory.

Nuclei that receive large amounts of energy often emit gamma rays. So, researchers have proposed that NEET may someday provide a mechanism for developing gamma-ray lasers, with output far more energetic than existing laser beams.

In a related test conducted at a heavy-ion accelerator, called GANIL, in Caen, France, researchers have found direct evidence of another long-suspected nucleus-electron interaction.

While some nuclei emit a gamma ray as they settle down from excited states, others energize a nearby electron, booting it from the atom. The new GANIL findings show that under certain conditions, the pumped-up electron leaps to a distant orbit rather than escape the nucleus. The experimenters describe their results in the August Physical Review C.

Theorists had predicted this phenomenon, known as bound internal conversion, or BIC. They've also proposed that it would dramatically shorten the time it takes for an excited nuclear state to die away, says Jean-Francois Chemin of Centre d'Etudes Nucleaire de Bordeaux-Gradignan, the study's leader.

Researchers use those decay times to identify isotopes in space as well as in the laboratory. However, the new finding suggests that such labels may sometimes be misleading.

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By P.W.

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