Hydrogen reunion mediated by light

Two groups of researchers have independently succeeded in using laser light to coax electrons and protons in overlapping beams to reunite and form hydrogen atoms. The achievement represents an important step toward creating the antimatter counterpart of hydrogen by merging beams of antiprotons and antielectrons, or positrons.

These experiments give researchers a precise idea of the crucial role that laser light may eventually play in the production of antihydrogen, says physicist Farook B. Yousif of the University of Western Ontario in London.

Yousif's team and a group of physicists at the University of Heidelberg in Germany describe their observations of laser-induced recombination in separate papers in the July 1 PHYSICAL REVIEW LETTERS.

A close encounter between an electron and a free proton can sometimes produce a state in which the electron briefly moves in some kind of high-energy orbit around the proton. A hydrogen atom results if, during that short time, the electron can slip to a lower orbit and the system can emit a photon to carry away the excess energy. The electron then has insufficient energy to escape from the proton.

However, because the proton-electron interaction time is generally much shorter than the time typically required for the emission of radiation, collisions between electrons and free protons rarely result in the formation of hydrogen atoms. Under normal circumstances, the electrons nearly always escape and continue on their way.

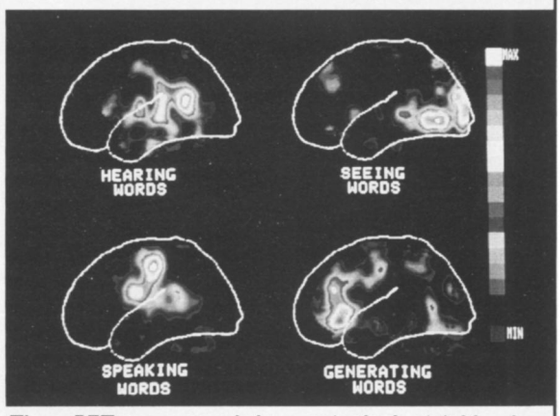
More than a decade ago, theorists predicted that the probability of electron capture would increase significantly if such collisions took place in an intense laser beam of an appropriate wavelength. The new experimental results confirm this prediction.

"We found out that the [rate of hydrogen production] was several thousand times bigger when a laser was used than when the experiment was done without a laser," Yousif says.

To get this result, he and his co-workers directed light from a carbon dioxide laser, operating at a wavelength of 10.6 microns, across a merged beam of electrons and protons. The Heidelberg team performed the same feat using merged beams of protons, electrons and laser photons in an apparatus known as an ion storage ring. Both groups found that they could adjust experimental conditions, such as the initial speed of the electrons, to obtain recombined hydrogen atoms in well-defined final states, in which electrons occupy specific orbits. — *I. Peterson*

'Mind map' would guide brain explorers

Big science should tackle its biggest task: unraveling the secrets hidden in the 100 billion neurons of the human brain, asserts a panel of neuroscientists and computer scientists in a report released June 27 by the Institute of Medicine. To expedite that process, the panel proposes an ambitious, federally funded "Brain Mapping Initiative" that would coordinate the vast amount of emerging data on the brain's molecular biology, pharmacology and function.



These PET scans reveal changes in the brain's blood flow during word-related activities. The growing importance of such images was one motivation for the brain-mapping proposal.

Inst. of Medicine/Natl. Academy of Sciences

Organized by brain region, this "information atlas" would integrate a variety of neuroscience databases containing text, raw data and images. A researcher exploring a specific part of the brain could call up a plethora of relevant information — such as journal articles, gene sequences and MRI images or PET scans — all from a computer workstation in the lab. Such a comprehensive reference tool, says the panel, could help scientists unlock such mysteries as vision, pain, schizophrenia and Alzheimer's disease.

To determine the plan's feasibility, the panel recommends a five-year, $50 million initial phase to set up pilot programs across the nation for testing software and creating databases. The overall project, potentially international in scope, might take 20 years and assumes major advances in computer networking. Panelists say they cannot yet estimate a total cost. — *J. Travis*

Forever Fortran: Digital language renewed

Few issues arouse the passions of computer programmers more than the relative merits of different programming languages, and the veteran language Fortran has certainly endured its share of criticism over the years. Nonetheless, Fortran remains the stalwart workhorse of scientific and engineering computation, retaining its appeal by periodically putting on a fresh face.

The latest version, dubbed Fortran 90, was approved last month as the international standard for Fortran by the International Organization for Standardization, based in Geneva, Switzerland. This new edition extends and replaces Fortran 77, adding a number of features that make it more flexible for scientific applications and better suited for running on computers consisting of dozens or even thousands of processors.

Fortran 90 offers "greater safety, expressive power and convenience" than its predecessor, says John K. Reid of the Rutherford Appleton Laboratory in Didcot, England. Reid, who served on the committee that established the Fortran 90 standard, described some of the new version's advantages this week at the International Conference on Industrial and Applied Mathematics, held in Washington, D.C.

Developed in the 1950s, Fortran was the first programming language widely used to solve scientific and engineering problems. Equipped with a set of carefully defined commands and symbols, it permitted computer programmers to escape the tedious, error-prone chore of writing out instructions directly in the language of a computer — that is, as strings of ones and zeros.

Fortran 90, the result of a 14-year effort, brings the language up to date. It contains new instructions that allow the manipulation of arrays, such as tables of measurements, as single units. It also makes it easier for users to switch from one level of numerical precision to another. At the same time, the revised version retains all the features necessary to ensure that existing software written in Fortran 77 still works.

One company has already developed the first compiler that meets the Fortran 90 standard. Written by Malcolm J. Cohen and his colleagues at Numerical Algorithms Group Ltd. in Oxford, England, this special computer program translates statements written in Fortran 90 into the computer language C, which can then be transformed into instructions a computer understands. Additional Fortran 90 products are in the works. — *I. Peterson*