PHYSICS

New Particle Detected

A particle that is a molecule made up of two electrons and two positively charged "holes" has been detected

➤ THE MOST "sophisticated" particle without a nucleus ever observed has been detected in experiments at Bell Telephone Laboratories.

The particle is actually a molecule consisting of two electrons and two positively charged "non-particles," which scientists call "holes." It is called an "excitonic molecule."

Existence of this stable combination of a pair of excitons was foreseen 20 years ago when Dr. John A. Wheeler of Princeton University predicted the existence of a related molecule called positronium.

Holes are the unoccupied energy levels that electrons, the negatively charged carriers of electric current, can fill. Holes also serve to conduct electricity, as in such solid-state devices as transistors.

The first experimental observation of the excitonic molecule was made in silicon by the late J. Richard Haynes of Bell Telephone Laboratories, Murray Hill, N.J. He died Sept. 4, two weeks after he reported his discovery to the Physical Review Letters, 17:860, 1966.

The observational evidence for the existence of the excitonic molecule was obtained in measurements of recombination radiation in silicon at temperatures within a few degrees of absolute zero, which is 459.7 degrees below zero F.

At such low temperatures, two excitons join together to form a stable excitonic molecule. At higher temperatures, the molecule breaks up into two excitons.

A single exciton is essentially an electron-hole pair linked to each other by what scientists call Coulomb force. Although a single exciton may move through a crystal lattice, it does not act as a carrier of electricity because the electron and the hole are bound together, thus canceling each other's influence.

SPACE

Laser Watches Space

➤ SPACE-WALKING astronauts may soon be seen from earth as they go through their paces in orbit, by utilizing a new technique developed by a team of Stanford University engineers.

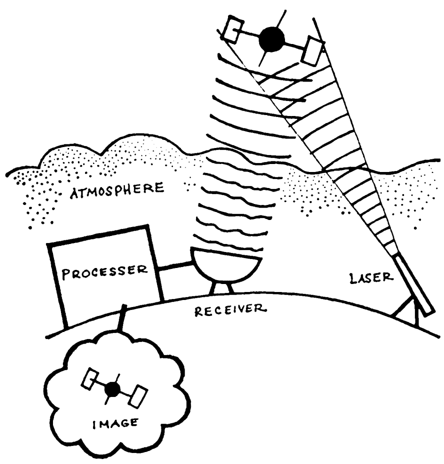
The two main obstacles to direct viewing from the ground—atmospheric distortion and telescope "jiggle"—would be eliminated by their development, the Stanford engineers said. A telescope would not even be needed, and they should be able to discern clearly small objects as high as 200 miles.

Such a viewing system might have told Gemini 9 astronauts, for example, that the orbiting target vehicle for their mission's docking plans had turned into an "alligator."

Though instruments indicated something wrong, astronauts Stafford and Cernan had to go aloft to find out what it was. Telescopes could not resolve it.

They discovered the target's fiberglass nose shrouds snagged and hanging open from the vehicle in a kind of reptilian grin. The docking operation was canceled.

The Stanford viewing trick takes advantage of the "vellum effect," a phenomenon observed in photographs of earth taken from heights well above the atmosphere. Such photos are phenomenally sharp and far more detailed than the aerial photos taken at much closer range by planes flying through the earth's atmosphere.



Stanford University

VIEWING BY LASER—The system proposed by a group of Stanford University engineers for viewing objects in space by laser is shown here in diagrammatic form. The technique may be able to overcome optical distortions caused by the earth's atmosphere and produce clear pictures of satellites as high as 200 miles.

The vellum effect can be demonstrated by holding a sheet of artist's tracing paper above a drawing—it fogs or blots out the image beneath. But when the paper is placed flat on the drawing, the image is clearly seen. In the same way, astronauts get a much clearer view of us on earth than we get of them.

The Stanford engineering team proposes using the laser's "coherent" light—one-color (single-wavelength), non-spreading, and far brighter than the sun—to illuminate the satellite. The reflected light rays would be caught in a hologram—a film record of the reflected light patterns from the satellite.

Holograms bear no visible resemblance to the scenes they record. They look rather like a fogged piece of film. But when laser light is shone through a hologram, the original scene it recorded reappears as if by magic.

Similarly the hologram of satellite reflections would bear no resemblance to the satellite itself. Instead it would faithfully record the interference pattern of reflected laser light rays. The distortions caused by the atmosphere do not affect the interference pattern.

Then, by laser illumination of the hologram and use of a lens to "reconstruct" or focus the rays properly, a clear image of the satellite could be obtained.

What happens is a reversal of the vellum effect. The technique produces the clearest pictures when the apparatus is closest to the distorting medium—the very point at which the vellum effect causes the worst fogging with conventional viewing methods.

It is as if one could put ground beef backwards into a meat grinder and produce a steak.

The Stanford engineers, Dr. Joseph Goodman and research engineers, Wright Huntley, David Jackson and Matt Lehmann of the Systems Techniques Laboratory have proved the system will work in the laboratory.

Though the laboratory distance was short, and a piece of wavy shower glass was used instead of the atmosphere, their "wavefront reconstruction imaging" technique produced astonishingly clear pictures.

"It should work exactly the same with a satellite," said Mr. Huntley, "but we will try it first over long distances at ground level."

"It could be used to see small distant objects on the ground, too, with the same improvement of resolution over telescope viewing," he said.

He added that in a fully developed system, foil-lined parabolas and television cameras might replace the film. The reflections would be recorded by the TV camera and fed directly into a computer for processing.