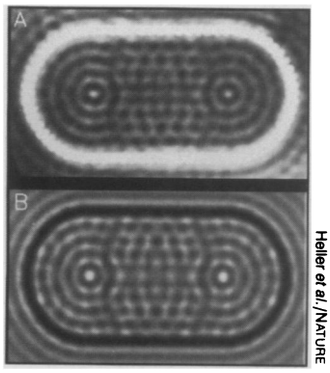
Quiet times in iron-walled quantum corrals

A stone tossed into a placid pool generates ripples, which spread out in concentric rings and rebound from the pool's rim and from any obstructions breaking the water's surface. These disturbances overlap to create complex interference patterns.

Electrons confined to small spaces act like waves and produce similar patterns when scattered by impurities and edges on a crystal surface (SN: 5/21/94, p.327) or reflected by "walls" of atoms (SN: 10/9/93, p.228). The resulting standing-wave patterns can be observed with a scanning tunneling microscope.

Now, researchers have worked out a way of predicting with great accuracy the standing-wave patterns produced by electron waves bouncing around inside enclosed structures, or quantum corrals, of particular shapes. The theory also indicates that certain types of atomic walls readily absorb electron waves, reducing reflections.



Heller et al./NATURE

Experiment (top) and theory (bottom) produce similar standing-wave patterns for electrons within a stadium-shaped quantum corral 285 angstroms long.

Eric J. Heller of Harvard University, Michael F. Crommie of Boston University, and Christopher P. Lutz and Donald M. Eigler of the IBM Almaden Research Center in San Jose, Calif., describe their findings in the June 9 NATURE.

To test their theory, the researchers computed the standing-wave pattern that would result from electron motion within a stadium-shaped enclosure. They compared the results with the behavior of surface electrons within a quantum corral created by placing 76 iron atoms in an elongated-ring formation on a copper crystal surface.

"The theory gives excellent agreement with the experiment," the team concludes.

The calculations also reveal that the iron atoms soak up a large proportion of the electron waves that impinge on them. This suggests that electrons are shunted from the surface via iron atoms into the copper crystal.

"In an acoustic analogy, the corral is therefore a rather quiet chamber," the researchers say.

This absorption of electron waves limits the usefulness of such nanostructures for studying various quantum effects. However, it may be possible to make highly reflective walls by building these structures on extremely thin layers of material instead of on thick copper crystals. *– I. Peterson*

Implants almost exonerated

More than 1 million U.S. women have received silicon-gel breast implants since the early 1960s – some for cosmetic breast augmentation, others to simulate a breast lost to cancer. However, 2 years ago the Food and Drug Administration triggered a moratorium on the use of these implants when sporadic reports began linking them to connective-tissue disease and autoimmune disorders. A new study finds little evidence to support that link.

Researchers at the Mayo Clinic in Rochester, Minn., compared the health of 749 area women who had received an implant between 1964 and 1991 to that of twice as many local women of the same ages without implants. Five women with implants developed some form of connective-tissue disease, as did an equal proportion of women (10) without implants. Sherine E. Gabriel and her coworkers report their findings in the June 16 NEW ENGLAND JOURNAL OF MEDICINE (NEJM).

Included among the many disorders that the group defined as connective-tissue disease were various forms of arthritis (including rheumatoid), vasculitis, systemic sclerosis, and systemic lupus erythematosus – several of which have been linked previously to silicone breast implants (SN: 12/12/92, p.414). The researchers also scouted for unusual rates of cancers originating in sites other than the breast, cirrhosis of bile-conveying tissues, and one type of thyroid inflammation.

Though there were higher reports of joint swelling and morning stiffness among women in the implant group, the authors suspect that such symptoms actually traced to a woman's having had breast cancer. Indeed, they point out, "the incidence rates of these events were similar to those among the control women with breast cancer who did not receive a breast implant."

An editorial by Marcia Angell, NEJM's executive editor, supports the Mayo group's contention that a study the size of theirs cannot fully exonerate implants. However, Angell adds, the data do indicate that "any possible risk from breast implants in this population could not be large." *– J. Raloff*

Babies head toward budding vocabulary

If you call a 4½-month-old baby names, will he or she care? Usually, no. But give the child credit: By that age, infants recognize their own names upon hearing them and favor their names over similar-sounding monikers, according to a study presented last week at an Acoustical Society of America meeting in Boston.

"This suggests that infants are beginning to build a vocabulary in their native language even during the first few months of life," asserts Peter W. Jusczyk, a psychologist at the State University of New York at Buffalo. Jusczyk conducted the study with Buffalo colleague Denise Mandel and David Pisoni of Indiana University in Bloomington.

The findings coincide with other evidence gathered by Jusczyk and his coworkers, also described at the Boston meeting, that babies begin to pick individual words out of spoken language by 9 months of age, although they don't utter their first words until later.

In the first study, 24 mothers sat with their 4½-month-olds in a three-sided enclosure. A flashing green light on the center panel first drew each infant's attention. When that light stopped, a flashing red light on either of the side panels attracted a baby's gaze. Four names, including the child's own, then played in random order through a loudspeaker in the panel for about 20 seconds each or until the infant turned away for more than 2 seconds.

Two names the infants heard differed markedly from their own, while the third name contained the same rhythm and intonation as the child's. For example, a baby named "Corey" might hear "Henry" as a name with corresponding rhythm and intonation and "Marie" and "Elaine" as more dissimilar names.

Over three consecutive presentations of these names from both sides of the enclosure, infants listened for an average of 16 seconds to their own names and 12 seconds to each of the other names.

Infants quickly develop a sensitivity to emotional qualities of speech, such as intonation and rhythm, Jusczyk says. Other words that repeatedly get spoken with emotion, such as "daddy" and "mommy," may also elicit recognition by 4½ months of age, he suggests.

"It's clear that babies rapidly latch onto many regularly occurring features in the sound structure of a native language," the Buffalo psychologist contends.

In the second study, Jusczyk's team found that 8½-month-olds who heard a simple recorded story several consecutive times then listened much longer to words that had been repeatedly mentioned in the story, such as "ant" and "jungle." *– B. Bower*