whether the meditation training influences attention, emotional regulation, and various brain measures. —B. BOWER

Degrees of Quantumness

Shades of gray in particle-wave duality

Is light made of particles or waves? The answer, according to quantum physics, is both. Depending on the situation, particles of light—and particles of matter too—sometimes contradict themselves and act like waves. But between these two extremes, there's a range of behaviors. Scientists have now demonstrated those intermediates in a conspicuous way.

The new research is a variation on the so-called double-slit experiment, a staple of introductory quantum theory courses. In the classic version, light passes through two slits in an opaque screen and hits another screen some distance away. Crests and troughs of light waves emerging from each slit add together or cancel each other out, depending on how they overlap, and create an interference pattern of light and dark stripes on the screen. This phenomenon has been demonstrated not only with photons but also with electrons, and even whole atoms.

From the quantum perspective, however, light is a stream of photons. To explain the interference pattern, physicists say that each photon travels through both slits simultaneously and then interferes with itself on the other side.

The additional twist is that, according to quantum theory, the interference pattern—a wave phenomenon—would disappear if one knew for sure through which slit each photon went. In principle, detectors at the slits would register a photon's passage without capturing the particle. In that situation, the photon would have chosen one slit or the other, thereby behaving like an old-fashioned, classical-physics particle.

Physicists suspected that it's possible to extract only partial information about a particle's route. They predicted that different degrees of certainty about the path would blur the interference pattern by different amounts.

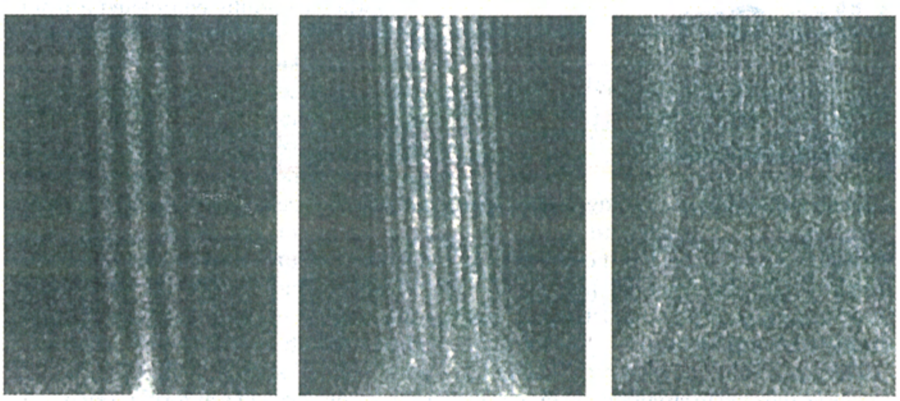
In the mid-1980s, theoretical physicist Wojciech Zurek of the Los Alamos (N.M.) National Laboratory proposed a way to use beams of electrons to explore this idea. More than 20 years later, Franz Hasselbach and Peter Sonnentag of the University of Tübingen in Germany have put Zurek's idea to the test.

In their setup, electric fields play the role of the slits, steering electrons along two possible paths parallel to an underlying horizontal plate. As each electron passes, its electrostatic field moves charges inside the plate. Those movements, acting against the plate's electrical resistance, generate a tiny amount of heat.

By detecting that heat, an experimenter could locate the electron's path and make it lose its wavelike behavior. But this detection can be accomplished to different degrees. The closer the beam is to the plate, the larger the dissipation, and the easier it will be to tell apart the two trajectories. The Tübingen team's images reveal that with increasing certainty, the interference fringes become progressively blurred.

"The visibility of the fringes changes," Sonnentag says. The results appear in an upcoming *Physical Review Letters*.

Zurek says that he's pleased to see his predictions confirmed. "The nice thing is that you can quantify this leakage of information," he says. "You can turn the knob and vary the quantumness of the system." —D. CASTELVECCHI



FRAYING FRINGES Electrons traveling via two possible paths act like waves, forming interference fringes. As the beams pass increasingly closer to a surface (top to bottom of each image), their paths are revealed with greater certainty, smearing out the fringes. The effect increases (left to right images) with increasing separation of the paths.

SONNENTAG/UNIV. TÜBINGEN

Cells' Root

Adult stem cells have a master gene

A person's body constantly sheds dead skin cells, and new cells well up to take their places. Stem cells in the skin generate this continuous stream of biological units. Now, researchers have identified a master gene that enables these stem cells to retain their regenerative capacity.

The gene, called *p63*, is crucial for the maintenance of stem cell lines in epithelial tissues including skin, thymus, prostate, and breast, say Frank McKeon of the Harvard Medical School in Boston and his coworkers. An adult stem cell spawns a daughter cell that then develops into one of the various cell types within a particular organ. This process raises the possibility of treatments in which doctors would use stem cells to regenerate damaged tissues.

But each time a stem cell divides, only one daughter cell matures into a specific cell type. The other must retain its flexibility and remain in the reservoir of adult stem cells in an organ. The *p63* gene orchestrates this action in epithelial tissue, the researchers say. Earlier work identified other master genes for stem cells for blood and for sperm.

The team found that mouse embryos lacking *p63* began forming skin but soon stopped. In early stem cell divisions, both daughter cells matured into specialized skin cells, thereby depleting the supply of skin stem cells. Many of these mice were born almost skinless, the researchers report in the May 4 *Cell*.

"It's a very dramatic effect," says McKeon. "I think we've definitely shown now that *p63* is the crux of stemness."

The gene acts as a master regulator, controlling the activity of about 2,000 other genes in the stem cells. Scientists don't yet know the pattern of gene activity that *p63* triggers or how that activity makes a cell capable of spawning another stem cell.

The role of *p63* in epithelial stem cells has been controversial. Other research groups had concluded that *p63* is essential for the maturation of the daughter cells, not for the maintenance of the stem cell lineage. But those groups had looked at newborn *p63*-deficient mice delivered vaginally. McKeon says that the mice's passage through the birth canal had sloughed off the small amount of skin that had formed, leading the scientists to conclude that no skin cells had matured.

McKeon and his colleagues looked instead at the skin and thymus of mid- to