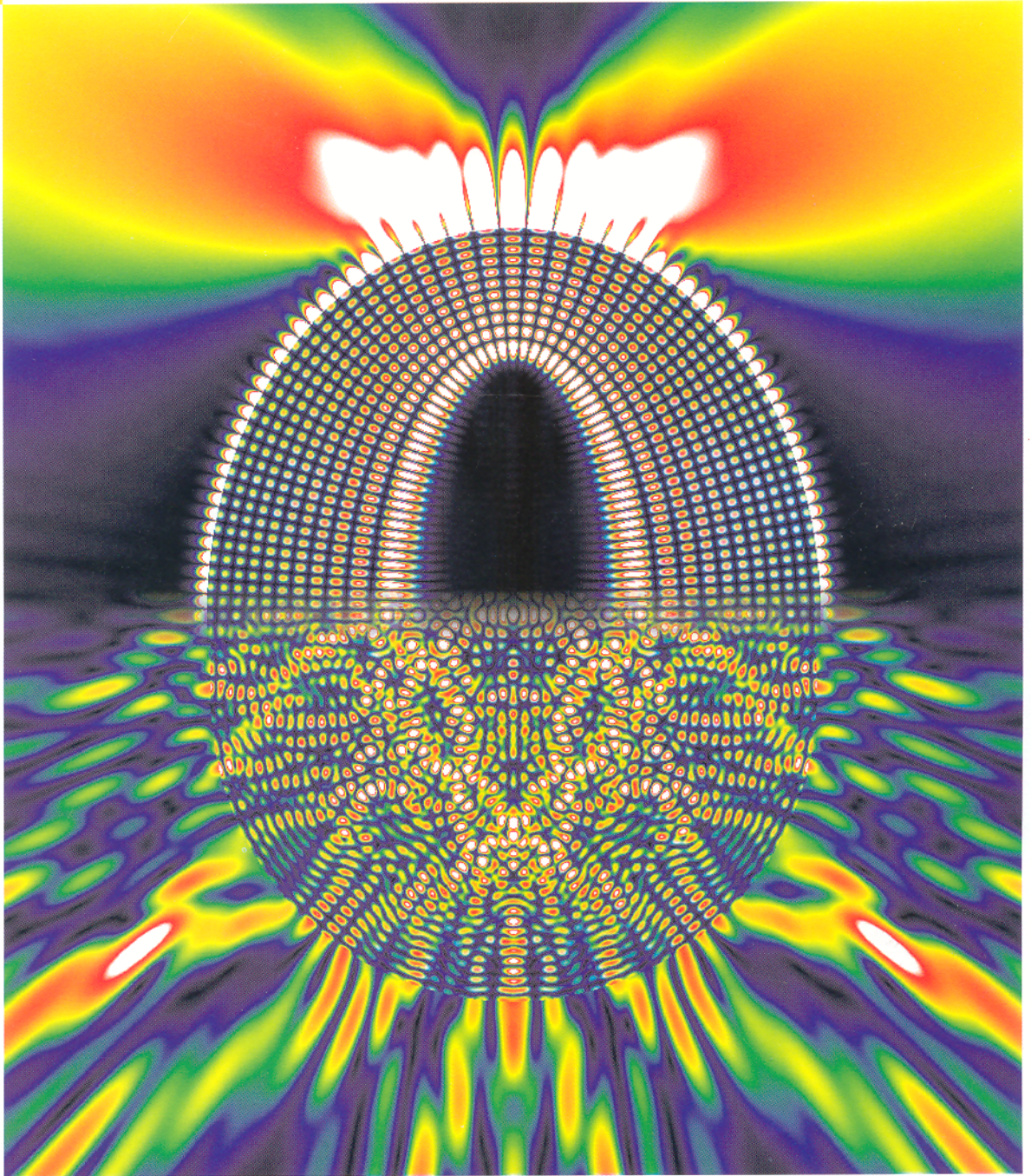


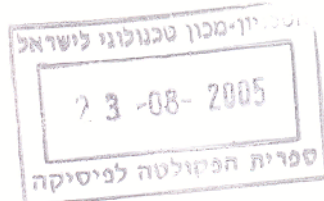


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Einstein versus chaos



Asher Peres

Asher Peres, one of the founders of quantum information theory, died on 1 January 2005 in Haifa, Israel.

Asher Peres was born Aristide Pressman in Beaulieu-sur-Dordogne, France, on 30 January 1934 to Shlomo (Solomon) and Shulamit (Salomea) Pressman, Jewish émigrés from Lemberg, which is now L'viv, Ukraine. The family was deported to Poland soon after Asher's birth but was allowed to return to France shortly before the outbreak of World War II.

After the fall of Paris, the family fled to Asher's birthplace to hide from the Nazi regime. Following exposure of their Jewish identity by local anti-Semites and after extortion attempts, Asher's father joined the Resistance and mother and son went into hiding. Asher related his wartime experiences in a memoir entitled "I Am the Cat Who Walks by Himself," after Rudyard Kipling's tale (see <http://arXiv.org/abs/physics/0404085>).

Reunited after the war, the family immigrated to Israel in 1949; Asher



Asher Peres

enrolled at the Technion–Israel Institute of Technology in Haifa in 1952. His father, a down-to-earth electrical engineer, believed there were no job opportunities for a physicist in the new country and persuaded his son to study mechanical engineering.

Asher was a brilliant but challenging student. After he had pointed out an embarrassing error in a proof, one of his math professors promised him

For PHYSICS TODAY to consider an obituary for publication, we must be notified within five months of the scientist's death.

the highest grade on the condition that he not attend the lectures. Asher's first article in theoretical physics, written when he was a second-year undergraduate, was recommended by Louis de Broglie for publication in the *Comptes Rendus*. The article was accepted and appeared in the journal in 1954. A few years later, the physics department got a major boost when Nathan Rosen, the "R" of the celebrated EPR (Einstein-Podolsky-Rosen) gedanken experiment, joined the faculty. Asher became Nathan's graduate student, and their association grew into a lifelong mutual admiration. (Asher outlived his mentor and asked to be buried next to him.)

For his doctoral thesis, Asher calculated the gravitational radiation from an orbiting star. Although the existence of such radiation is indirectly proven by the decreasing periods of binary pulsars, antennas sensitive enough to measure it directly are only now being built. Making a precise calculation of gravitational radiation from astrophysical sources is a topic of much current interest because of its relevance to LIGO, the Laser Interferometer Gravitational Wave Observatory, and the planned LISA, the Laser Interferometer Space Antenna.

Asher joined Technion after receiving his PhD in 1959. He was rapidly promoted to full professor and remained at the university for the rest of his career. He was appointed Distinguished University Professor in 1988.

His work ranged from solving practical problems to tackling visionary and foundational issues. Work with one graduate student on the statistical properties of matrix elements of chaotic systems led to what is now known among mathematicians as the Feingold-Peres conjecture and among physicists as the Feingold-Peres theory. But Asher's greatest impact was on the foundations of quantum theory and the theory of quantum information. He was one of six authors of the 1993 quantum teleportation paper published in *Physical Review Letters*. That paper showed that even though no direct measurement can extract complete information about the state of a quantum particle, a combination of entanglement and classical communication can be used to transfer the state perfectly to another particle that has never been near the first particle. Quantum teleportation has since been experimentally confirmed in several laboratories. When a reporter asked Asher if quantum teleportation could teleport the soul as well as the body, Asher answered, characteristically, "No, not the body, just the soul."

In another important contribution, Asher showed that if conceptually re-

versing the direction of time for just one of two particles results in a nonphysical situation with negative probabilities, the two particles must be entangled. This criterion of entanglement (in mathematical terms, nonpositivity of the partial transpose of the system's density matrix) has since spawned a rich qualitative and quantitative theory of entanglement and other manifestations of nonlocality in quantum mechanics. Asher's last two students, Natan Lindner and Petra Scudo, worked on the problem of efficiently communicating a different kind of information, namely, spatial directions and reference frames, using quantum particles.

Asher was a man of strong opinions, which he encapsulated in aphorisms such as

- ▶ Unperformed experiments have no results.
- ▶ Quantum phenomena do not occur in a Hilbert space, they occur in a laboratory.
- ▶ Quantum mechanics needs no interpretation.
- ▶ Never underestimate the ingenuity of experimental physicists.

His textbook *Quantum Theory: Concepts and Methods* (Kluwer Academic, 1993) is arguably the modern successor of John von Neumann's book *Mathematical Foundations of Quantum Mechanics* (Princeton U. Press, 1955). The uncertainty principle, for which Asher had little use, is relegated to a single entry in the index that points to the same page of the index.

In most arenas, Asher feared no one and did not aim to please. In 1983, while chairman of the physics department at Technion, he nominated—during the days of the Israel-Lebanon war—Menachem Begin, Israel's then prime minister, for the Nobel Prize in Physics. As justification, Asher said Begin deserved the physics prize as much as the peace prize, which he had shared with Egyptian President Anwar al-Sadat in 1978. The prime minister's office did not appreciate the humor, and the Technion president felt it necessary to apologize to the Swedish Academy. The academy responded that it feared the Technion president may have lost some of the spirit of good Jewish humor.

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