Brownian particles last longer

If a sphere were shot onto an unmanned pinball machine surface, it would seem to randomly zigzag between bumpers until it lost all of its momentum and was stilled. If a pinball wizard were at the controls of this same surface, pushes from the flippers would keep the sphere moving for a much longer period of time. Had Scottish physician Robert Brown been able to compare the motion of the microscopic grains in liquid he observed more than 150 years ago to that of a pinball sphere, he would have chosen the former scenario. For the past decade or so, however, calculations that describe particle movement, or Brownian motion, have suggested that the latter scenario is closer to the truth—that the velocity of Brownian particles does not decrease as rapidly as was once thought. And now, these calculations have been experimentally confirmed.

Yong W. Kim and colleagues at Lehigh University in Bethlehem, Penn., have observed droplets of mineral oil colliding with nitrogen molecules in a gas chamber. The oil droplets—one-tenth of a micron in diameter—were illuminated by the blue-green beam of an argon ion laser. Taking successive measurements of the speed and direction of these droplets, the researchers found that the initial velocity decreases not exponentially over time $[(e)^{-\text{time}/\text{relaxation time}}]$ as the classical view of Brownian motion would have it, but rather by the much slower function $(\text{time})^{-3/2}$.

That velocity decay function was first predicted in 1967 by Lawrence Livermore National Laboratory researchers Berni Alder and Thomas Wainwright, who developed computer simulations of molecules on the move. Later, various groups of physicists, including Robert Dorfman and colleagues of the University of Maryland at College Park, worked to explain the discrepancy between the classical and newer Brownian motion decay times.

These physicists theorized that while the classical view assumes that the particle always hits a "fresh" target, the newer view takes into account the possibility of binary collision, or the fact that the particle can collide again with any given target. When a repeat collision occurs, the physicists explained, the target "returns" some of the momentum the particle lost in the initial collision. In such a fashion, the particle continually is "reminded" of its initial velocity so that the decay of that quantity is not as rapid as an exponential decrease.

Kim's work—submitted for publication in PHYSICAL REVIEW LETTERS (preliminary results were published in the March 17, 1980, issue of that journal)—experimentally confirms this theory.

The "flurry of activity" in Brownian motion research, says Kim, has long-range implications for the effective use of future, high-tech analytical systems or energy sources that involve gases or liquids in motion. □

Cancer patterns in the chromosomes

All or most cancers involve a chromosome defect, and identifying the defect may provide valuable indications for a patient's treatment, suggests Jorge J. Yunis of the University of Minnesota Medical School. Speaking in Monterey, Calif., at the Arnold O. Beckman Conference on Genetic Disease, Yunis said that new methods of examining chromosomes and advances in working with solid tumor cells consistently have revealed defective chromosomes in patients with both hereditary and noninherited cancers. In some cases a type of cancer can be divided into subgroups by the specific defect, and thus the chromosome abnormality can predict the disease's course and its response to treatment.

When chromosomes from human cells are appropriately prepared and stained, they show a characteristic pattern of light and dark bands. In abnormalities, the banding pattern can reveal which pieces of a chromosome are absent, duplicated or moved to a new position. The earliest preparations showed about 300 bands per single (haploid) set of human chromosomes; later improvements raised the resolution to 900 bands. Yunis, who was introduced at the meeting as "the master of the high-resolution chromosome," reports that a new technique, which looks at stretched-out rather than condensed chromosomes, can reveal 2,000 bands, and recent preliminary work in his laboratory has extended that pattern to 5,000 bands. "We are getting closer to having just a few genes per band," he says. "We hope to reach 16,000 bands."

Two types of chromosomal defects can be involved in cancer. In the case of an inherited predisposition to cancer, from birth all cells in the body show the chromosomal abnormality. For example, Aniridia-Wilm's tumor and hereditary retinoblastoma each show a characteristic inherited deletion (SN: 5/9/81, p. 297).

In cases of nonhereditary cancers, only the tumor tissue has the chromosome defect, Yunis says. He works with newly diagnosed patients who have not yet had chemotherapy. For 15 types of acquired cancer, including six solid tumors, he finds one or more chromosome abnormalities consistently associated with the affected tissue. In some diseases, such as acute leukemias and some lymphomas, investigators had previously found that half the patients have chromosomal defects. Now, looking at the chromosomes' more detailed banding patterns, Yunis finds defects in some cells of *all* the patients. For example, in acute myelogenous leukemia, Yunis found defects in all of 32 consecutive patients. He observed seven specific defects and found some of the abnormalities associated with rapid disease progression, while patients with another abnormality had a better prognosis, surviving for several years.

Yunis suggests that the chromosomal deletions, additions and exchanges are the result of carcinogen attack. He postulates that specific genes, which he calls cancer genes, are required to keep a cell from becoming malignant. When a chromosomal change disrupts one of these genes, cancer results. Work is already in progress to more specifically identify these genes. Meanwhile, Yunis concludes, in the clinic it is essential to study patients' chromosomes for their prognostic significance. □

Pow-wow of the planet people

The biggest concern at the recent annual meeting of the American Astronomical Society's Division for Planetary Sciences in Pittsburgh was the possibility that budget cuts might cause the nation's entire program of planetary exploration to be scrapped. Heated comments on the issue were heard throughout the week-long gathering (SN: 10/24/81, p. 260), but the substance of the meeting was science: the latest results from hundreds of researchers engaged in the probing of other worlds.

With the Voyager 2 spacecraft's Saturn encounter less than two months past, one key topic was that planet's baffling rings. An early look at the spacecraft photos, for example, had surprised scientists by revealing no trace of the tiny "moonlets" whose gravitational effects were expected to account for the numerous gaps within the otherwise nearly continuous ring system. Since the flyby, researchers have had a chance to scan the images more closely, looking for still smaller moonlets, but so far, says Jeffrey Cuzzi of the NASA Ames Research Center, to no avail. "We've searched at least half the candidate gaps," according to Cuzzi, and found no moonlets even as small as 5 to 10 kilometers across.

Analysis of data gathered when Voyager's earthward radio beam passed through the ring plane confirmed that the rings contain particles of many different sizes, from dust to boulders, but it also indicated that the big and little chunks do not seem to be randomly mixed. The wide, main rings are composed of thousands of individual "ringlets," and in the C-ring, for example, notes G. Leonard Tyler of Stanford University, the centimeter-sized particles seem to be "segregated" along each