Gauging planetary escapes and asteroid ages

When the fragments of Comet Shoemaker-Levy 9 started plunging into Jupiter, the times and locations of the impacts came as no surprise to astronomers. Accurate measurements of the fragments' positions at various times over the last year had enabled them to calculate the orbits of these objects with extraordinary precision.

Such certainty, however, has proved elusive for planetary and asteroid orbits calculated millions of years into the future. A number of computer simulations based on equations describing the motion of bodies in the solar system indicate it's generally impossible to make precise predictions of the long-term future of planets and asteroids (SN: 2/22/92, p.120). In many cases, these motions display the extreme sensitivity to initial conditions typical of chaotic dynamics.

Now, Jacques Laskar of the Bureau des Longitudes in Paris has extended these orbital calculations, using a simplified set of equations, to cover up to 15 billion years. By looking at the effect of making slight changes in the initial orbital characteristics of the planets from one computation to another, Laskar showed that Mercury can drift into an orbit so elongated that a close encounter with Venus could cause a cataclysmic collision or send Mercury careering out of the solar system.

Laskar describes his results in the July ASTRONOMY AND ASTROPHYSICS.

According to Laskar's calculations, the motion of Jupiter and the other large planets remains very regular. In contrast, the inner planets all show varying degrees of chaotic behavior, with Mars and Mercury potentially experiencing much larger excursions from their normal orbits than Earth and Venus.

"The difference in behavior between the large planets and the inner planets is very striking," Laskar says. "One reason . . . is probably that the large-planets system is not perturbed much by the inner planets."

Moreover, "if the outer planets were less regular, then the inner planets' motion would be so chaotic that . . . Earth would suffer changes too large in its orbit to ensure climatic stability on its surface," he adds.

Asteroid orbits can experience large changes over even smaller time scales. The occurrence of such chaotic fluctuations may provide a way to estimate when families of asteroids formed, say Andrea Milani and Paolo Farinella of the University of Pisa in Italy.

An asteroid family is a group of objects created when a large asteroid breaks up into smaller pieces as the result of a collision. Although the fragments spread out rapidly in space, their orbits tend to retain certain characteristics that make them distinguishable as a group from other asteroids.

However, the orbital parameters of an individual fragment may occasionally change enough to put it outside its family. By determining the likelihood of such an escape for a given family member, researchers can obtain a rough estimate of the family's age. Astronomers have identified more than 20 asteroid families.

Milani and Farinella applied their technique to the Veritas asteroid family, a particularly dense cluster close to Jupiter's orbit. They calculated how the orbital characteristics of two family members (including the largest, 490 Veritas) would change over millions of years.

Reported in the July 7 NATURE, the calculations show that these two members would wander outside the family borders within approximately 50 million years. The results suggest that the Veritas asteroid family can be no more than 50 million years old, the researchers conclude. *— I. Peterson*

New risks for meat eaters

In the last decade, researchers have debated the role dietary fat plays in the incidence of breast cancer. Earlier case studies correlating fat consumption with breast cancer (SN: 2/18/89, p.102) failed to be confirmed by later studies, such as the Nurses' Health Study, which looked at 89,494 women over an 8-year period (SN: 10/24/92, p.276).

Now, a report published in the July EPIDEMIOLOGY suggests that, though fat intake hasn't proved a relevant factor, consumption of red meat might.

Paolo Toniolo of the New York University Medical Center and his colleagues examined the dietary habits of 14,291 women from New York City between 1985 and 1991, focusing on their consumption of meat, animal products, fat, and protein. Women who reported eating red meat every day—including beef, veal, lamb, pork, and luncheon meats—had nearly twice the risk of developing the cancer as did women who ate primarily fish, poultry, and dairy products.

"It seems that frequent meat consumers are at more of a risk for breast cancer," Toniolo says. "I don't know if it's fat or other elements of one's diet. But I know it's diet."

"We're getting more and more evidence that fat isn't related to risk," adds Geoffrey Howe of the University of Toronto. "This particular study is providing an interesting lead for other research" looking at specific foods like red meat. *—G. Marino*

Disk information on lower-back pain?

In the United States, back pain constitutes the leading cause of work-related disability and the second leading cause of visits to the doctor. Indeed, some 80 percent of the U.S. population eventually experiences lower-back (lumbar) pain, with an estimated 30 million hobbled by the condition at any given time.

While noninvasive technologies permit detailed examination of the spine, such imaging may prove not only a waste of money, but also counterproductive to diagnosing the source of pain, a new study suggests.

Maureen C. Jensen of Hoag Memorial Hospital in Newport Beach, Calif., and her coworkers asked experienced neuroradiologists to read scans created by magnetic resonance imaging (MRI) of the spine. MRI uses a magnetic field to induce transitory changes in the alignment of hydrogen nuclei; these enable physicians to discriminate between types of tissue and their biochemical environment.

Elastic pads of cartilage, called disks, separate and cushion each pair of vertebrae. Though none of the 98 participants in this study currently suffered pain or had a history of serious lumbar pain, disk abnormalities showed up in lumbar scans of all but 36 percent, Jensen's team reports in the July 14 NEW ENGLAND JOURNAL OF MEDICINE.

More than half had a bulge in at least one disk. Twenty-seven percent possessed at least one herniation—a disk splaying out beyond the vertebrae. One volunteer had an even more serious herniation: Called an extrusion, this disk exuded a localized cylindrical blob—like toothpaste—beyond the vertebrae.

Increasingly, physicians have begun scanning the spines of back pain patients with MRI and other imaging technologies. But the high rate of disk problems seen in symptomfree individuals suggests that whatever pain develops may be coincident to the disk problems, not the result of them, Jensen's group says.

In an accompanying editorial, Richard A. Deyo of the University of Washington in Seattle agrees, and concludes that MRI and other advanced imaging should be reserved for back pain sufferers who either exhibit other signs of underlying disease (such as cancer) or become candidates for surgery after 4 to 6 weeks of conventional, exercise-based therapy bring no relief.

In fact, he argues, "Physicians who use early imaging studies to practice 'defensive medicine' may actually be exposing their patients and themselves to greater risk because of the potential for such studies to set in motion a series of ill-advised medical interventions"—including surgery. *—J. Raloff*