Einstein's General Relativity: It's a Drag

Let's do the twist! According to Einstein, everything does.

Astronomers announced last week that they may have found the first evidence that spinning bodies drag or twist space and time along with them. An inescapable consequence of Einstein's Theory of General Relativity, this seemingly bizarre concept was described nearly 80 years ago, but until now, researchers lacked the equipment to test it.

Two teams of astronomers base their conclusion on periodic variations in the intensity of X rays emitted by the gas that circles neutron stars and suspected black holes in our galaxy. Gas pulled toward these superdense objects forms a disk around them, and as material in the disk gets compressed and heated, it emits X rays.

If the gaseous disk happens to orbit at an angle to the plane in which the neutron star or black hole is spinning, the dragging of space-time predicted by relativity theory will have a specific effect: It will cause the disk to wobble like a top.

The wobble, in turn, will induce periodic oscillations in the intensity of the radiation emitted by the gas. Such oscillations, occurring as rapidly as 300 times per second, are precisely what astronomers saw when they analyzed X-ray data recorded by the Rossi X Ray Timing Explorer. Launched 2 years ago, the craft was designed to measure rapid variations in high-energy radiation.

Wei Cui of the Massachusetts Institute of Technology and his colleagues examined X rays from the vicinity of five candidate black holes. In accordance with relativity, they found faster oscillations—evidence of greater dragging—in X rays emitted by the gas surrounding the more rapidly spinning holes.

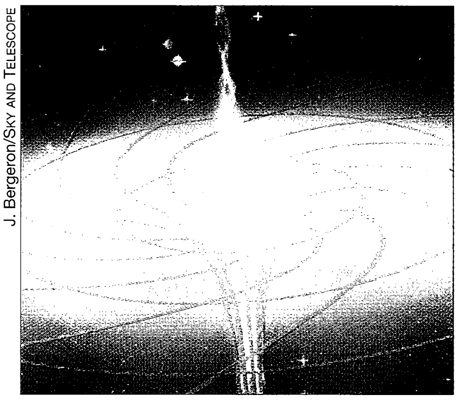
Another team, led by Luigi Stella of the Astronomical Observatory of Rome and Mario Vietri of the University of Rome, found telltale oscillations in the intensity of X rays from several rapidly spinning neutron stars. The teams reported their findings at a meeting of the American Astronomical Society's High Energy Astrophysics Division in Estes Park, Colo.

Detection of the oscillations, notes theorist Cole Miller of the University of Chicago, only hints that scientists have glimpsed the effect of relativistic drag. He says that even if gas in the disk initially orbited at an angle, several forces are likely to compel the gas to align itself with the plane in which a black hole or neutron star spins. In such a case, the disk would not wobble, and the variations in X-ray emissions could not arise from drag.

"Right now, what we have is a suggestion, which is very exciting precisely because it is possibly a signature of a dramatic strong gravity–general relativity effect that we otherwise have no evidence for," says Miller. "It would be great if it were true, but we have to be cautious because the physical mechanisms by which this would be produced are not evident at the moment."

Miller and other researchers note that the drag effect is a direct outcome of relativity theory. Einstein replaced the traditional concept of gravity as a mysterious force that acts at a distance with the notion that matter and space profoundly influence each other. The geometry of space acts on mass and energy, telling them how to move. Similarly, mass and energy act on space, telling it how to curve.

If space is likened to a rubber sheet, then concentrations of mass create dimples in it. As a result, particles traveling along the sheet follow curved paths rather than straight lines. If the mass rotates, it will impart a twist to the surrounding space.



J. Bergeron/Sky and Telescope

Schematic of a rotating black hole dragging space-time along with it.

Any spinning body, regardless of its mass, should produce this effect. In 2 years, NASA plans to launch Gravity Probe-B, a suite of four gyroscopes that will attempt to measure the drag generated by Earth (SN: 6/10/95, p. 367). —*R. Cowen*

Wheat's DNA points to first farms

Wheat today is synonymous with bread, but before it became the stuff of the staff of life, people grew an ancient form known as einkorn. The cultivation of einkorn, perhaps for eating as gruel, is thought to mark the origin of agriculture in the Old World.

"If you know where [einkorn] wheat was domesticated, you know where agriculture originated," says wheat geneticist Jan Dvořák of the University of California, Davis.

A new study aims to find those whereabouts. Sifting through and winnowing DNA fragments from wild and cultivated einkorn, a group of European researchers has traced the first sprouts of cultivated einkorn to a stretch of mountains in southeastern Turkey. The group, including Manfred Heun of the Agricultural University of Norway in As and Francesco Salamini of the Max Planck Institute for Research on Plant Breeding in Cologne, Germany, reports the finding in the Nov. 14 SCIENCE.

Stretching between present-day Turkey and Iran, the Fertile Crescent is well known from archaeological evidence as the home of the first farmers, about 10,000 years ago. Wild einkorn grows abundantly in the crescent and elsewhere. The grain "was a logical choice for neolithic people," says Dvořák.

Heun and his colleagues analyzed the DNA from 270 lines of the wild einkorn, as well as 68 lines of the larger, cultivated grain, which differs genetically only slightly from the wild forms. In the DNA fragments they examined, the cultivated einkorn most closely resembles 11 lines of wild einkorn that grow in the Karacadağ Mountains.

"They show that all the cultivated einkorn is related to one specific population in Turkey," says Dvořák. It's an important finding, he adds, and bears repeating with a different genetic technique.

Hard on the seed of cultivated wheat came barley and lentils, then other crops, including another form of wheat that led eventually to the familiar bread wheat. Likewise, sheep, goats, and pigs were domesticated in the Fertile Crescent, along with dogs (SN: 6/28/97, p. 400).

The result, writes Jared Diamond of the University of California, Los Angeles School of Medicine in an accompanying commentary, was a "valuable package" of domesticated plants and animals that quickly spread along the same latitudes, spurring Eurasia's large settlements. In contrast, agriculture in the Americas (SN: 5/24/97, p. 322) expanded more slowly but with more variety, he says, as crops had to be adapted to northern and southern conditions. —*C. Mlot*