10 dimensions are better than four

MICHAEL R. LEGAULT

Organizers of a recent cosmology conference held at the University of Toronto saw fit to invite some non-cosmology types: String theorists. The presence of "string guys" (and gals) at a space conference is a sign that string theory – the conjecture that all matter and energy is composed of loops of tiny strings, each one billions of times smaller than the tiniest sub-atomic particle scientists can detect – has become an accepted, indeed essential, part of the scientific cannon.

Some scientists say the glamour of string theory, the relativity of its day, is pulling the best and brightest young scientists away from other research fields that have greater potential to solve more pragmatic, human-related problems. Moreover many "classical" physicists, a group that includes the three winners of this year's Nobel Prize in physics, cast a dubious eye on the whole enterprise of string theory, considering it pie-in-the sky speculation more akin to philosophy than true science.

One of the most vocal critics of string theory, Nobel laureate physicist Sheldon Glashow, has speculated it would take an atom smasher the size of our solar system to achieve the energies required to definitively prove or disprove the existence of strings.

Glashow, who helped develop the so-called standard model of particle physics, has earned his hard-boiled skepticism.

The standard model, which is derived from the far more established theory of quantum mechanics, asserts that all protons and neutrons are composed of more basic particles, quarks, and that all forces among matter are transmitted by particles called bosons. Starting with quantum theory, scientists first predicted the existence of these particles; and, in experiments using particle accelerators, subsequently found them. The remaining holdout of more than 20 odd particles comprising the standard model, the Higgs Boson, is expected to be found once the powerful Large Hadron Collider in Geneva starts up in 2006.

Expounding upon the issue in a *Nova* television series interview, Glashow drew sharp distinction between classical physicists and string theorists, noting "we don't listen to them and they don't listen to us."

Glashow could afford to keep his ears covered if not for one thing: The standard model accounts for only three of the four fundamental forces – the force of electro-magnetism, the force of radioactive decay and the force that holds the nucleus of an atom together. The fourth force, gravity, is, like itself, left up in the air by the model.

Thus the attraction of bright, young, ambitious scientists to string theory. Since when has science ever been content with a theory that explained three-quarters of something?

Michio Kaku, a theoretical physicist at City University of New York, claims string theory "is the only game in town" when it comes to the search for an elusive Grand Unified Theory that unites all known physical forces.

String theory not only incorporates the standard model, it "predicts" gravity as well. Gravity, it postulates, is a consequence of higher dimensional space – 10 dimensions, to be exact. We experience only four dimensions (three spatial and one time) because the extra six dimensions are compacted into an infinitesimally small space.

SOME SAY STRING THEORY IS MERELY PIE-IN-THE SKY SPECULATION

How infinitesimally small? If we were shrunk to fit into it, a single proton would appear the size of several million suns.

For those who find the idea of 10 dimensions empirically similar to ESP and palm reading, string theorists point out that science has a long history of confirming the counter-intuitive and non-obvious. The Earth is round, even though it feels like it is flat. Light behaves as if it is both a hard particle and an airy wave. Time begins to slow down for a person in a fast-moving space ship relative to a person on Earth.

Besides, string theorists argue, they aren't just pulling strings and extra dimensions out of the air. The mathematical architecture of their theory is so elegant that it resolves the incompatibility of the twin pillars of modern physics: quantum mechanics and general relativity.

But ultimately, string theory will have to be confirmed experimentally if it is to assume its place amidst the pantheon of established scientific truths.

Even the Large Hadron Collider, with energies about seven times greater than current particle accelerators, won't be able to detect strings. But it may be able to detect signs of "supersymmetry," an aspect of the sub-atomic realm predicted by string theory.

Joe Polchinski of the University of California at Santa Clara, one the string theorists invited to the recent U of T cosmology conference, speculates researchers might be able to measure gravitational waves of cosmic-scale superstrings with a new instrument called a laser interferometer gravitational wave observatory (LIGO), scheduled to be operational within a few years.

If validated, string theory would no doubt have intellectual, philosophical, practical and political consequences equal or exceeding those resulting from the discoveries of Newton and Einstein. As the late physicist David Bohm once put it, "fundamental notions like order and structure condition our thinking unconsciously, and new kinds of theories require new kinds of order."

And a new order, no doubt, will raise new questions.

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