Cosmology project tops in Science Talent Search

Arvind N. Srivastava, a 16-year-old from Fort Collins, Colo., used advanced mathematics to examine the possibility that the universe is finite rather than infinite and won the $10,000 Westinghouse Science Talent Search scholarship this week. The award, one of ten, was presented at a dinner Monday night in Washington at the conclusion of the 32nd Annual Science Talent Institute for the 40 national winners (SN: 2/17/73, p. 110).

Srivastava showed that the shape of the universe might be analogous to the surface of an imagined doughnut extending beyond the three dimensions of ordinary experience. He began thinking about the problem two years ago when his father, a professor of mathematics and statistics, suggested he investigate the nature of universal space. Although a student at Poudre High School, he is on a full-time independent study program, taking sophomore and junior courses at Colorado State University. Srivastava was born in Lucknow, India.

The two $8,000 scholarship winners also had science projects in math and physics. Van J. Wedeen of Brooklyn, N.Y., and Joshua L. Rubin of Long Island City, N.Y., won second and third place in the competition.

Wedeen described the behavior of particles in a force field. He showed that the various properties of certain force fields are similar to the properties of a horizontal membrane, and that balls rolling on the membrane will behave like particles in the force field.

Rubin attempted to devise a new method for defining a mathematical concept orginally developed in the early 19th century. The purpose was to present a definition for derivatives of all real orders. While his final definition was equivalent to the classical one, he believes his methods were simpler.

Winners of the $6,000 scholarships were June A. Vayo, 17, of San Diego, Calif.; Robert J. Lipshutz, 18, of Freeport, N.Y.; and Laureen P. Miller, 18, of Jacksonville, Fla.

Vayo did a correlative study of mental retardation and eidetic imagery—the ability to produce visual images with photographic accuracy. She found mentally retarded people retain this ability beyond puberty, when most people lose it.

Lipshutz studied an advanced topic in mathematics called "leftist trees," developing his ideas through computer programming and computer graphics.

Miller conducted a study to determine the size and weight of saltwater catfish caught by prehistoric people more than 3,000 years ago at the Fig Island Shell Ring, an archaeological site in South Carolina.

Top winners Srivastava, Wedeen and Rubin: Emphasis is on original research.

Four students won scholarships of $4,000: Esther L. Zack, 17, of Los Angeles; Glenn J. Greene, 16, of San Diego; Donald P. Schneider, 17, of Heartwell, Neb.; and James V. Noto, 18, of Elmont, N.Y. Zack found a solution to a smoke pollution problem that occurs in the Willamette Valley in Oregon. Greene worked on a method to tame nuclear fusion. Schneider worked out a way to determine the ratio of the mass of Jupiter to the mass of earth. Noto "taught" a computer to play tic-tac-toe.

The Science Talent Search is sponsored each year jointly by the Westinghouse Educational Foundation and Science Service Inc. Westinghouse awards the $67,500 in scholarships and Science Service administers the talent search. Edward G. Sherburne Jr., director of Science Service, presided at the awards dinner, noting that the emphasis in the program is on original research rather than academic achievement, under the theory that the former is a better indicator of future success in science. Dorothy Schriver, assistant director of Science Service, who administers the STS, introduced the 40 winners to the banquet audience of 700 persons. The main speaker was H. Guyford Stever, director of the National Science Foundation, who spoke of research opportunities for young scientists in Antarctica. Also on the program were Glenn T. Seaborg, president of the Science Service board of trustees, and Harvey J. Brudner, president of the Westinghouse Learning Corp. □

Twisting the big bang down to (not quite) zero

Modern theories of cosmology all suffer from singularities. Singularity is a slightly euphemistic mathematical term for a point of zero dimensions and infinite density. Whether one is dealing with the gravitational collapse of a cloud of gas, or the converse process, the expansion of the universe from a big bang, singularities appear.

Mathematical and theoretical attempts to describe what happens when the universe has zero dimensions fail. Theorists are therefore much disturbed by singularities, and many would welcome attempts to remove them.

A prescription for such removal is suggested in the March 5 NATURE PHYSICAL SCIENCE by Andrzej Trautman of the Institute of Theoretical Physics of Warsaw University. It is done by including in the theory the spins of the objects that make up the cloud or the universe.

Trautman does a calculation for a collapsing universe of spinning dust. The gravitational forces involved in the collapse are seen as distortions of the curvature of the space in which the collapse is taking place according to Einsteinian theory. Including the spins in the calculation has the effect of adding a torsion to the space. Carrying the torsion through the calculation adds a repulsive factor to the gravitational attraction of the parts of the universe for each other. The repulsive factor becomes important when the radius of the collapsing universe reaches small numbers. Effectively the repulsive factor sets a minimum below which the radius of the universe cannot go; it reaches the minimum and bounces.

The idea of spin and torsion can be applied to the early stages of the actual universe, at a time when the universe was dominated by the class of heavy particles known as baryons, which includes neutrons, protons and a lot of others. Baryons all have intrinsic spin, and Trautman puts this into the equations, assuming that there is a cosmic magnetic field that lines up all their spins for maximum effect.

If there are as many as 10^{80} baryons involved—and this is the number often quoted for the number of baryons in the observable universe—then the minimum radius is on the order of one centimeter. Trautman admits that this is rather small for the universe, but he points out that it is much larger than the so-called Planck length (1.6×10^{-33} centimeters) at which Einstein's theory is supposed to break down. □