Leading physicists convene in Tucson for conference on gravity

More than three dozen leading physicists and astrophysicists will convene in Tucson for the conference, "Rethinking Gravity: from the Planck scale to the size of the Universe," Jan. 22 - 24, 2007.

Scientists will meet at the Tucson Marriott University Park, 880 E. Second St., to discuss their common goal -- to probe and test gravity at all scales, from the subatomic level to the entire universe. It's believed to be the first meeting on the topic to draw scientists from so many diverse research fields.

"Scientists have understood for several decades that Einstein's theory of gravity, which describes our universe at astronomical scales, is incompatible with quantum field theories, which describe phenomena at atomic scales," physicist Dimitrios Psaltis of The University of Arizona, a conference organizer, said. "Despite numerous efforts, scientists have yet to come up with a satisfactory quantum theory of gravity.

"But our quest has become intensely exciting for two reasons," Psaltis said.

"First, new ideas are challenging our previous notions of how the gravitational force works and pervades spacetime itself. And second, it is astonishing to realize that even though most of these ideas were unheard of a mere decade ago, they can be tested using present-day astronomical and cosmological observations," Psaltis said. "It is this exciting interplay of new theoretical ideas and new experimental tests that has ignited new interest in this field."

Perhaps the most exciting new concept about gravity to emerge in the past decade is that the universe contains extra dimensions that can be detected only by gravitational force, Psaltis said. Other new ideas aim to explain the single most unexpected result of modern cosmological observations: the existence of a mysterious energy field that permeates the entire universe and accounts for three-quarters of all its energy -- so-called "dark energy." Another new line of theory attempts to explain "one of the deep mysteries of physics," Psaltis said: "Namely, why the gravitational force is so much weaker than the other fundamental forces, including the electromagnetic force which holds atoms and molecules together, or the strong force which holds nuclei together."

Conference participants will discuss how modern technologies have opened the way to test the predictions of Einstein's theory in different contexts:

Astronomers are using the Hubble Space Telescope and powerful new ground-based telescopes to study supernovae in distant galaxies for a more accurate grasp of the "cosmological constant." Einstein added this term to his equations for general relativity, and scientists now believe that it describes the energy density of empty space. Nicholas Suntzeff of Texas A & M University will talk about dark energy with supernovae. The WMAP satellite (Wilkinson Microwave Anistropy Probe) has allowed astronomers to map the cosmic microwave background for stunning evidence that most of the universe is made up of mysterious dark energy. Eiichiro Komatsu of the University of Texas will talk about WMAP.

Modern ideas of gravity that go beyond general relativity predict deviations from Newtonian gravitational law at sub-millimeter distances. (A millimeter is 1/25 of an inch). Eric Adelberger of the University of Washington will present the latest findings from experiments on gravity at these miniscule distances.

Several current and planned NASA missions aim to test Einstein's theories in regimes that have never been

observed before. Stanford University's Francis Everitt will discuss what to expect when scientists get first results from Gravity Probe B in a few months. Craig Hogan of the University of Washington will brief participants on the status of LISA, a planned space mission that will detect gravitational waves from supermassive blackholes. Nicholas White, director of the Astrophysics Science Division at NASA's Goddard Space Flight Center, will discuss NASA's "Beyond Einstein" initiative for the next two decades. The program involves building and launching several space missions that will test Einstein's theory of gravity in different astrophysical settings.

Recent results from several high-precision experiments that are testing the most fundamental aspects of Einstein's theory. Alan Kostelecky of Indiana University and Tom Murphy of the University of California-San Diego will discuss current limits on violations of such axioms as the Lorenz symmetry and the Equivalence Principle.

Professor James Peebles of Princeton University will give a public talk for the UA Steward Observatory Evening Lecture Series at 7:30 p.m. Monday, Jan. 22. Peebles' talk, "The Expanding Universe," will be in the Steward Observatory lecture hall, room N210.

"We have convincing evidence that our universe is expanding from a much hotter, denser state," Peebles said. "I will describe what is meant by the expansion of the universe, how people arrived at the evidence that this expansion really is happening, and some of the open questions still to be solved, notably the natures of the dark matter and dark energy that dominate the mass of the universe."

Others to attend the conference include Clifford Will of Washington University, St. Louis, and Cliff Burgess of the Perimeter Institute, McMaster University. Will has led an international effort to test Einstein's theory of general relativity for the past three decades, and his book on the subject, "Theory and Experiments in Gravitational Physics," is the bible in the field. Burgess, one of the leading theorists studying the idea that the universe may contain extra dimensions that can be sensed only by gravity, is noted for his ability to explain the ideas in non-technical terms.

"The most important aspect of this conference is that it brings together, for the first time, all these researchers from many difference research fields," Psaltis said. "New ideas born from different branches of physics -- high energy physics and cosmology, for example -- and many new experiments that involve very different physical systems and techniques that include table-top experiments, laser ranging with the moon, and gravity wave and other cosmological observations provide an unprecedented opportunity to test and understand the fundamental aspects of Einstein's theory of gravity."

Source: University of Arizona