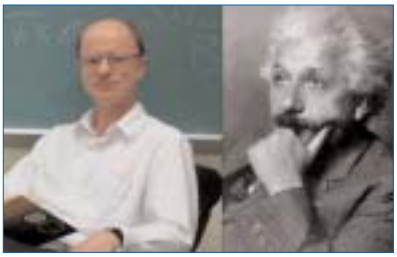
WAS EINSTEIN WRONG? SPACE STATION MAY FIND OUT

Why is it important?

Einstein's Theories of Relativity have withstood a wide range of tests in the more than 90 years since they were first offered. Although they are widely accepted as fact, significant aspects regarding gravity are unverified because testing is not possible deep within Earth's gravitational field. Further tests are needed because

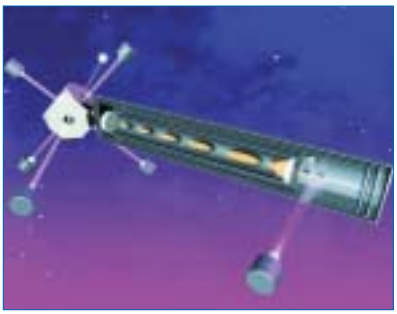
- gravity is one of the four known fundamental forces of nature and thus requires the best possible verification of our theories;
- the better we understand gravity and the implications of our observations regarding it, the more likely we will be to unify it with the other three forces; and
- any verifiable violation of the Theory of General Relativity is potentially fatal and would require developing a new theory of gravity.



Alan Kostelecky of Indiana University has analyzed the experiments testing Einstein's theories that can be performed on the ISS with high-resolution clocks.

What is NASA doing?

There are two initiatives in NASA to push the envelope of observations of gravity. The Office of Biological and Physical Research has supported laboratory-style investigations of general relativity for decades. The Office of Space Science, on the other hand, has recently formed a Fundamental Physics thrust that includes gravity and general relativity as prime subjects for exploration. This discipline supports gravity wave detection, investigation and modeling of high-density cosmological objects like black holes and neutron stars, and tests of general relativity like Gravity Probe B. Tests of the equivalence principle, such as the Satellite Test of the Equivalence Principle and Laser Lunar Ranging, are ongoing. Also, both ground-based laboratory and theory investigations of general relativity are supported. Now NASA is planning to place high-precision clocks on the ISS to improve the tests of gravity theories.



The Primary Atomic Reference Clock in Space experiment will test predictions of Einstein's theories of relativity regarding the fundamental nature of time and space. It will become the most accurate clock in the world, with performance disseminated worldwide through the Global Positioning System.

What are the benefits?

NASA provides investigators with a unique environment for testing this weakest of the natural forces. Test precision advances ranging to one part in one million aboard the ISS will give scientists considerable new knowledge of the properties of gravity. Entirely new ranges of test parameters can be explored in this "gravity-free" environment.

What is next?

NASA is planning to fly atomic clock experiments such as the Primary Atomic Reference Clock in Space (PARCS) on the ISS to test general relativity predictions. As well as supporting experiments requiring precise time standards, PARCS will open the way for experiments requiring the use of similar devices. In addition, Gravity Probe B is scheduled to test aspects of Einstein's theory of relativity in April 2003.

NASA contact: Dr. Mark Lee (202-358-0816)