high performance air-supported turntable. The cavity resonance frequencies are continuously monitored using monolithic Nd:YAG lasers and analyzed for periodic modulations indicating violations of Lorentz-invariance. Compared to pervious experiments using cryogenic optical resonators (COREs), but relying solely on Earth's rotation, this new version is expected to lead to orders of magnitude improvement in sensitivity to Lorentz-Invariance violation. We present the initial results of this experimental effort at the $\Delta c(\theta)/c \sim 10^{-16}$ level for an direction dependent variation of the speed of light and discuss the potential for future improvements.

14:42

C2 3 Laboratory Tests of Newtonian Gravity.

BLAYNE HECKEL, *University of Washington*

Torsion balances provide a table-top experimental tool to test the equivalence principle and inverse square law of gravity, properties of gravity that have recently been called into question. Modern theories of quantum gravity predict new spatial dimensions that may lead to an observable violation of the inverse square law and new scalar interactions that violate both the equivalence principle and inverse square law. The dark energy that pervades the universe may lead to similar violations of these laws. Our group at the University of Washington has developed torsion balances to test these laws. We have experimental results that set new limits on the violation of the equivalence principle at length scales larger than one meter and that probe the inverse square law at distances as small as 50 microns. The latest results from our group will be presented.

15:18

C2 4 The Gravity Probe B Relativity Mission.

G. M. KEISER, *Hansen Experimental Physics Laboratory, Stanford University, Stanford, CA*

The Gravity Probe B satellite was launched from Vandenberg Airforce Base on April 20, 2004. The satellite and its payload were designed to perform a high precision experimental test of the general theory of relativity. Measurements are now being made of the precession rates of the four cryogenic, electrostatically-supported, mechanical gyroscopes relative to the guide star, IM Pegasi. Simultaneously, using Very Long Baseline Interferometry, the proper motion of this guide star is being measured relative to extragalactic reference sources by a group at the Harvard-Simithsonian Center for Astrophysics. Combining these two measurements, the precession rate of the gyroscopes relative to the extragalactic reference sources may be determined, and this precession rate may be compared with the geodetic and frame-dragging precession rates as predicted by the general theory of relativity. The geodetic effect is due to the gravitational interaction of the spinning gyroscope with its orbital motion, while the frame-dragging effect is due to the gravitational interaction of the spinning gyroscopes with the Earth's angular momentum. In the 640 km circular, polar orbit, general relativity predicts that these precession rates will respectively be 6.6 arc seconds/year in the plane of the orbit and 41 milli-arc-seconds/year perpendicular to the plane of the orbit. The goal of the mission is to measure the precession rates of each of the four gyroscopes to an accuracy significantly better than 0.5 milli-arc-seconds/year. This talk will describe the payload and satellite hardware and discuss the method of measuring the orientation of the gyroscope spin axis relative to the guide star as well as measurements designed to place tight limits on potential systematic errors.

[redacted]

Contributed Papers

13:30

C3 1 Spectra of Stick Molecules* REINHOLD BLUMEL, *Wesleyan University* Imagine an electron roaming freely on a ball-and-stick molecule made out of very thin wire. The result is a "quantum network," or a "quantum graph." It is shown that no matter how complex the stick molecule, its quantum spectrum can be computed explicitly and analytically using exact periodic-orbit expansion techniques.

*Funded by NSF, grant number PHY-9984075

13:42

C3 2 Near-threshold photodetachment in parallel electric and magnetic fields CHRISTIAN BRACHER, JOHN DELOS, *College of William & Mary* We predict photodetachment cross sections and spatial photoelectron distributions in parallel electric and magnetic fields. Near-threshold photodetachment cross-sections of negative ions in strong external electric fields show oscillations related to interference of outgoing with returning electron waves. The interference pattern can also be imaged on a position-sensitive detector, and these observed interference patterns permit the determination of electron affinities with unprecedented accuracy. If a magnetic field is added parallel to the electric field, the spiraling motion of the electron produces trajectories with interesting caustic structures. Multiple paths connect the source to any point on the detector, so a complex interference pattern is found. Using semiclassical methods, we predict the structure of this interference pattern, and we show how it evolves as the electron energy and the field strengths change.