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The Gravity Probe B Relativity Mission

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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.