The Gravity Probe B EXPERIMENT

LOCKHEED MARTIN

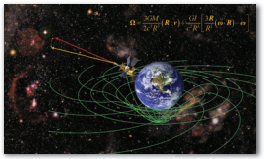
The Enigma of Gravity

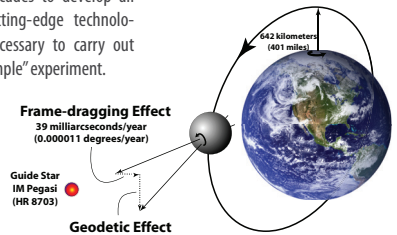
Sir Isaac Newton
Space and time are absolute or fixed entities. Gravity is a *force* that acts instantaneously between objects at a distance, causing them to attract one another.

Albert Einstein
Space and time are relative entities, interwoven into a *spacetime fabric* whose curvature we call gravity. Spacetime tells matter how to move, and matter tells spacetime how to curve.

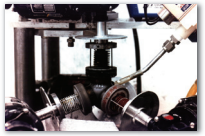
A "Simple" Experiment

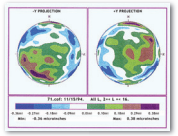
GP-B Co-Founder, Bill Fairbank, once remarked: "No mission could be simpler than GP-B; it's just a star, a telescope and a spinning sphere." However, it took over four decades to develop all the cutting-edge technologies necessary to carry out this "simple" experiment.





Ultra-Precise Gyroscopes

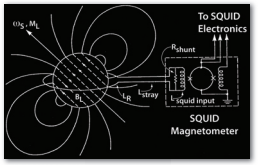


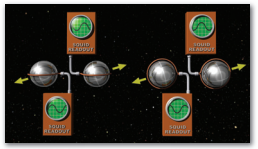


To measure the minuscule angles predicted by Einstein's theory, it was necessary to build near-perfect gyroscopes 10 million times more precise than the best navigational gyroscopes. The GP-B gyro rotors are listed in the Guinness Database of World Records as the most spherical man-made objects.

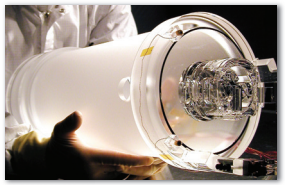
SQUID Magnetometers

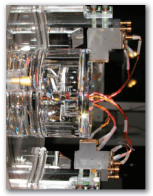
How can one monitor the spin-axis orientation of a near-perfect spherical gyroscope without any physical marker showing the location of the spin axis on the gyro rotor? The answer lies in *superconductivity*.
Predicted by physicist Fritz London in 1948, and most fortunate for GP-B, a spinning superconductor develops a magnetic moment exactly aligned with its spin axis.



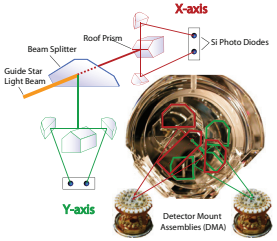


Pointing Telescope

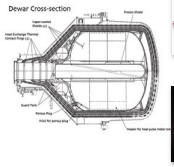




A telescope mounted along the central axis of the dewar and spacecraft provided the experiment's pointing reference to a "guide star." The telescope's image divider precisely split the star's beam into x-axis and y-axis components whose brightness could be compared.



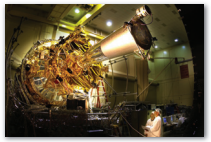
Dewar & Probe

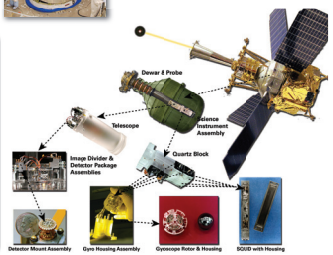


GP-B's 650-gallon dewar kept the science instrument inside the probe at a cryogenic temperature (2.3K) for 17.3 months and also provided the thruster propellant for precision attitude and translation control.

Integrated Payload & Spacecraft

Built around the dewar, the GP-B spacecraft was a total-integrated system, comprising both the space vehicle and payload, dedicated as a single entity to experimentally testing predictions of Einstein's theory.





A Collaborative Effort

The success of GP-B required extraordinary collaboration between the Physics and Aero-Astro departments at Stanford and between Stanford, NASA, and Lockheed Martin. In 2005, NASA gave a Group Achievement Award to the entire GP-B team.