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The Gravity Probe B Science Instrument.[1]

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The Gravity Probe B (GP-B) experiment employs a unique state-of-the-art science instrument to measure the geodetic and frame-dragging precessions predicted by Einstein's theory of general relativity for gyroscopes orbiting a massive spinning body, in this case the Earth. The GP-B instrument comprises four electrostatically suspended gyroscopes, each of which is independently subject to both the geodetic and frame-dragging precessions, and a telescope that tracks the guide star, IM Pegasi. Each gyroscope is read out with a dc SQUID system utilizing the London magnetic moment of the spinning gyroscope. The two axes of the telescope are read out with an image divider assembly, solid-state photo detectors and JFET preamplifiers. The telescope and gyroscopes are mechanically and thermally linked by a fused quartz block, which forms the metrology bench for the experiment. The instrument is located in a probe/helium dewar system, which provides a low-temperature environment of about 2.7 K for the instrument, as well as the ultra-low magnetic field, the ultrahigh magnetic shielding of the on-orbit ambient magnetic field, and the ultrahigh vacuum environments. The instrument was designed to allow a measurement of the geodetic and frame-dragging precessions to an accuracy of better than 0.5 milli-arc second/year for one year of science data collection. The instrument also provides the signals needed for drag-free and attitude control of the space vehicle. This presentation will include a description of the instrument and its principal on-orbit performance characteristics. Many persons at various institutions contributed to the development of the instrument. Numerous contributed presentations in a poster session will provide more detail.

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