Vibration Isolation and Zero-G Simulation System for the SIM System Test Bed 3 (STB3) at the NASA Jet Propulsion Laboratory

NASA/JPL needed a dynamic test bed for the Space Interferometry Mission (SIM) to demonstrate spacecraft vibration-induced errors of a few nanometers. They selected a Minus K 0.4 Hz vibration isolation system for Zero-G simulation and to mitigate floor-induced vibrations into the System Test Bed 3 (STB3), which helped to achieve this important goal.

Minus K Technology was selected to provide the vibration isolation and Zero-G suspension system for the SIM System Test Bed 3 (STB3) at the NASA Jet Propulsion Laboratory (JPL). The purpose of the Minus K suspension was to mitigate floor vibrations into the test bed and to simulate zero gravity so that stringent dynamic stability goals for SIM could be demonstrated. Testing with STB3 during the past several years succeeded in this demonstration, thereby helping to achieved one of eight critical technology milestones: Demonstration of the ability of SIM to stabilize fringes of faint science stars on the science interferometer of STB-3 (http://planetquest.jpl.nasa.gov/SIM/sim_milestones.html).

The SIM flight vehicle will be a surveying instrument that will use optical interferometry to measure the distances between objects in deep space to unprecedented precision (www.jpl.nasa.gov/missions/future/sim.html). The SIM instrument will have vibration-induced error allocations at levels of a few nano-meters and milli-arc-seconds. A dual stage passive isolation approach has been proposed to isolate the vibration-inducing reaction wheels of the space vehicle from an active optics system that will be part of the SIM instrument.

The STB3 is a 10 m 2000 kg test bed that was built to verify that the vibration isolation system and active optics would work together to achieve the dynamic stability goals. The Minus K STB3 suspension system was integrated into the test bed and consists of three custom SM-1 vibration isolators that provide 0.4 Hz natural frequencies, vertical and horizontal. The isolators also have the auto-adjust feature, an optical-mechanical servo system that keeps the vertical position within a +/- 0.010-inch deadband. The 0.4 Hz behavior of the 6-DOF Minus K system was sufficiently removed from the lowest mode frequencies of the STB3 structure, approximately 10 Hz, so that zero gravity could be successfully simulated.

A more complete description of the SIM vibration isolation system and the Minus K STB3 suspension sytem is given in: Allen J. Bronowicki, et al, “Dual stage passive vibration isolation for optical interferometer missions,” Proc. SPIE Vol. 4852, p. 753-763, Interferometry in Space; Michael Shao; Ed., Feb 2003.

An artist rendering of STB3 is shown in Fig. 1. A picture of one of the isolators is shown in Fig. 2.

Figure 1

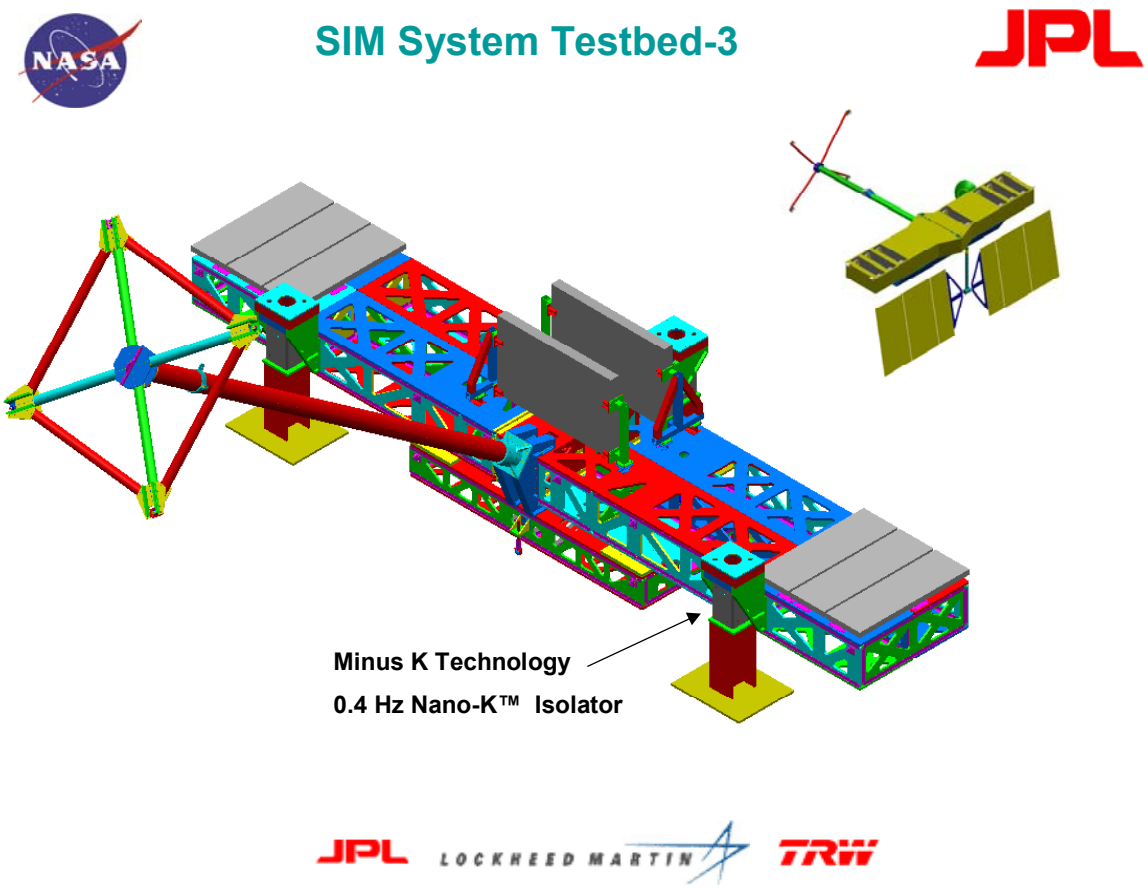

Figure 2