



## Books & Reports

### Telescope Formation at L2 for Observing Earth's Atmosphere

Two documents describe a proposed Earth-atmosphere observatory to orbit the Sun at the Sun-Earth L2 Lagrange point — a point of unstable equilibrium in the shadow of the Earth, about 1.5 million km from the Earth along an outward projection of the Earth-Sun axis. The observatory would comprise two spacecraft flying in precision formation: (1) a primary-aperture spacecraft, from which would be deployed a 25-m diameter membrane primary mirror aimed at the Earth, and (2) a secondary-telescope spacecraft at the focal plane of the primary mirror, 125-m distant along the axis towards the Earth. The secondary telescope would be aimed at the primary mirror and slowly rotated to scan the focused annular image of the visible illuminated portion of the Earth's atmosphere during continuous occultation of the Sun.

The purpose of the observations is to gather spectroscopic data of chemical signatures from ultraviolet to near-infrared that could contribute to major advances in understanding atmospheric dynamics and development of models for prediction of climate change. The documents present an overview of the scientific mission, the rationale for the choice of L2, and numerous engineering issues, including the overall architecture of the telescope formation, delivery to L2, design of the telescope and associated metrology instrumentation, formation maneuvering to follow a unique powered solar occultation orbit in the vicinity of L2, and strategies for observatory initial-ization and mission operations.

*This work was done by Edward Mettler, Beçet Açıkmeşe, William Breckenridge, Steven Macenka, Randall Hein, and Eldred Tubbs of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).  
NPO-40973*

### Ultraviolet-Resistant Bacterial Spores

A document summarizes a study in which it was found that spores of the SAFR-032 strain of *Bacillus pumilus* can survive doses of ultraviolet (UV) radiation,  $\gamma$  radiation, and hydrogen perox-

ide in proportions much greater than those of other bacteria. The study was part of a continuing effort to understand the survivability of bacteria under harsh conditions and develop means of sterilizing spacecraft to prevent biocontamination of Mars that could interfere with the search for life there.

A major conclusion stated in the document is that standard UV treatments that are effective against spores of other bacteria may not be sufficient to inactivate spores of SAFR-032 and, hence, may not be sufficient to inactivate all bacterial spores. Noting that heretofore, spores of *B. subtilis* have been used as a biodosimetry model for the UV inactivation of spores, the document presents the further conclusion that *B. subtilis* should now be considered unreliable as such a model. It is further suggested that because of its greater resistance to sterilization processes, SAFR-032 should be substituted for other biological indicators that have been used in hospitals and government facilities as indicators for quality control of sterilization.

*This work was done by Kasthuri Venkateswaran, David Neucombe, Myron T. La Duc, and Shariff R. Osman of Caltech for NASA's Jet Propulsion Laboratory.*

*In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:*

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*Refer to NPO-40953, volume and number of this NASA Tech Briefs issue, and the page number.*

### Launching Payloads Into Orbit at Relatively Low Cost

A report proposes the development of a system for launching payloads into orbit at about one-fifth the cost per unit payload weight of current systems. The system would be based on the formerly secret PILOT microsatellite-launching system developed in response to the Soviet launch of Sputnik-1. The PILOT sys-

tem was a solid-fuel, aerodynamically spun and spin-stabilized, five-stage rocket with onboard controls including little more than an optoelectronic horizon sensor and a timer for triggering the second and fifth stages, respectively. The proposal calls for four improvements over the PILOT system to enable control of orbital parameters:

- (1) the aerodynamic tipover of the rocket at the top of the atmosphere could be modeled as a nonuniform gyroscopic precession and could be controlled by selection of the initial rocket configuration and launch conditions;
- (2) the attitude of the rocket at the top of the first-stage trajectory could be measured by use of radar tracking or differential Global Positioning System receivers to determine when to trigger the second stage;
- (3) the final-stage engines could be configured around the payload to enhance spin stabilization during a half-orbit coast up to apoapsis where the final stage would be triggered; and
- (4) the final payload stage could be equipped with a "beltline" of small thrusters for correcting small errors in the trajectory as measured by an off-board tracking subsystem.

*This work was done by Brian Wilcox of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

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*Refer to NPO-20908, volume and number of this NASA Tech Briefs issue, and the page number.*

### Effects of Bone Morphogenic Proteins on Engineered Cartilage

A report describes experiments on the effects of bone morphogenic proteins (BMPs) on engineered cartilage grown

*in vitro*. In the experiments, bovine calf articular chondrocytes were seeded onto biodegradable polyglycolic acid scaffolds and cultured in, variously, a control medium or a medium supplemented with BMP-2, BMP-12, or BMP-13 in various concentrations. Under all conditions investigated, cell-polymer constructs cultivated for 4 weeks macroscopically and histologically resembled native cartilage. At a concentration of 100 ng/mL, BMP-2, BMP-12, or BMP-13 caused (1) total masses of the constructs to exceed those of the controls by 121, 80, or 62 percent, respectively; (2) weight percentages of gly-

cosaminoglycans in the constructs to increase by 27, 18, or 15, respectively; and (3) total collagen contents of the constructs to decrease to 63, 89, or 83 percent of the control values, respectively. BMP-2, but not BMP-12 or BMP-13, promoted chondrocyte hypertrophy.

These observations were interpreted as suggesting that the three BMPs increase the growth rates and modulate the compositions of engineered cartilage. It was also concluded that *in vitro* engineered cartilage is a suitable system for studying effects of BMPs on chondrogenesis in a well-defined environment.

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