well as broken cores, and it also acts as a core retention device. The cores are broken at the bottom of the sample tube with a clean cut. The invention uses a core bending principle and does not induce additional axial load on the drill / robotic arm.

This invention is potentially applicable to sample return and *in situ* missions to planets such as Mars and Venus, moons such as Titan and Europa, and comets. It is also applicable to terrestrial applications like forensic sampling and geological sampling in the field.

This work was done by Mircea Badescu, Stewart Sherrit, Yoseph Bar-Cohen, Xiaoqi Bao, and Randel A. Lindemann of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47356

Scoring Dawg Core Breakoff and Retention Mechanism

NASA's Jet Propulsion Laboratory, Pasadena, California

This novel core break-off and retention mechanism consists of a scoring dawg controlled by a set of two tubes (a drill tube and an inner tube). The drill tube and the inner tube have longitudinal concentric holes. The solution can be implemented in an eccentric tube configuration as well where the tubes have eccentric longitudinal holes. The inner tube presents at the bottom two control surfaces for controlling the orientation of the scoring dawg. The drill tube presents a sunk-in profile on the inside of the wall for housing the scoring dawg. The inner tube rotation relative to the drill tube actively controls the orientation of the scoring dawg and hence its penetration and retrieval from the core. The scoring dawg presents a shaft, two axially spaced arms, and a tooth. The two arms slide on the control surfaces of the inner tube. The tooth, when rotated, can penetrate or be extracted from the core.

During drilling, the two tubes move together maintaining the scoring dawg completely outside the core. After the desired drilling depth has been reached the inner tube is rotated relative to the drill tube such that the tooth of the scoring dawg moves toward the central axis. By rotating the drill tube, the scoring dawg can score the core and so reduce its cross sectional area. The scoring dawg can also act as a stress concentrator for breaking the core in torsion or tension. After breaking the core, the scoring dawg can act as a core retention mechanism.

For scoring, it requires the core to be attached to the rock. If the core is broken, the dawg can be used as a retention mechanism. The scoring dawg requires a hard-tip insert like tungsten carbide for scoring hard rocks. The relative rotation of the two tubes can be controlled manually or by an additional actuator. In the implemented design solution the bit rotation for scoring was in the same direction as the drilling. The device was tested for limestone cores and basalt cores. The torque required for breaking the 10-mm diameter limestone cores was 5 to 5.8 lb-in. (0.56 to 0.66 N-m).

This work was done by Mircea Badescu, Stewart Sherrit, Yoseph Bar-Cohen, Xiaoqi Bao, and Paul G. Backes of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47355

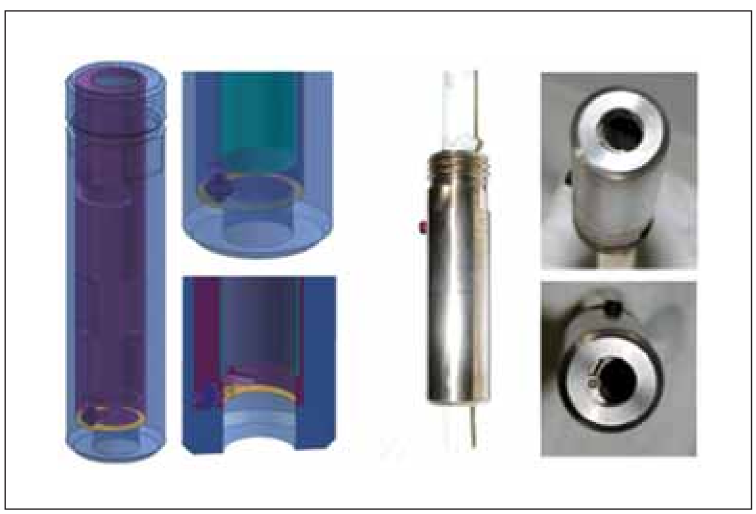
Rolling-Tooth Core Breakoff and Retention Mechanism

The mechanism has applications in analytical tests of geological materials.

NASA's Jet Propulsion Laboratory, Pasadena, California

Sampling cores requires the controlled breakoff of the core at a known location with respect to the drill end. An additional problem is designing a mechanism that can be implemented at a small scale that is robust and versatile enough to be used for a variety of core samples. This design consists of a set of tubes (a drill tube and an inner tube) and a rolling element (rolling tooth). An additional tube can be used as a sample tube. The drill tube and the inner tube have longitudinal holes with the axes offset from the axis of each tube. The two eccentricities are equal. The inner tube fits inside the drill tube, and the sample tube fits inside the inner tube.

While drilling, the two tubes are positioned relative to each other such that the sample tube is aligned with the drill tube axis and core. The drill tube includes teeth and flutes for cuttings removal. The inner tube includes, at the base, the rolling element implemented as a wheel on a shaft in an eccentric slot. An additional slot in the inner tube and a pin in the drill tube limit



The **Rolling-Tooth Design** of the core breakoff and retention mechanism (left), and the assembled parts (right).

the relative motion of the two tubes. While drilling, the drill assembly rotates relative to the core and forces the rolling tooth to stay hidden in the slot along the inner tube wall. When the drilling depth has been reached, the drill bit assembly is rotated in the opposite direction, and the rolling tooth is engaged and penetrates into the core. Depending on the strength of the created core, the rolling tooth can score, lock the inner tube relative to the core, start the eccentric motion of the inner tube, and break the core. The tooth and the relative position of the two tubes can act as a core catcher or core-retention mechanism as well. The design was made to fit the core and hole parameters produced by an existing bit; the parts were fabricated and a series of demonstration tests were performed.

This invention is potentially applicable to sample return and *in situ* missions to planets such as Mars and Venus, to moons such as Titan and Europa, and to comets. It is also applicable to terrestrial applications like forensic sampling and geological sampling in the field.

This work was done by Mircea Badescu, Donald B. Bickler, Stewart Sherrit, Yoseph Bar-Cohen, Xiaoqi Bao, and Nicolas H. Hudson of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47354

Vibration Isolation and Stabilization System for Spacecraft Exercise Treadmill Devices

Lyndon B. Johnson Space Center, Houston, Texas

A novel, passive system has been developed for isolating an exercise treadmill device from a spacecraft in a zero-G environment. The Treadmill 2 Vibration Isolation and Stabilization System (T2-VIS) mechanically isolates the exercise treadmill from the spacecraft/space station, thereby eliminating the detrimental effect that high impact loads generated during walking/running would have on the spacecraft structure and sensitive microgravity science experiments. This design uses a second-stage spring, in series with the first stage, to achieve an order of magnitude higher exercise-frequency isolation than conventional systems have done, while maintaining desirable low-frequency stability performance. This novel isolator design, in conjunction with appropriately configured treadmill platform inertia properties, has been shown (by on-orbit zero-G testing onboard the International Space Station) to deliver exceedingly high levels of isolation/stability performance.

This work was done by Ian Fialho, Craig Tyer, Bryan Murphy, Paul Cotter, and Sreekumar Thampi of The Boeing Company for Johnson Space Center. For further information contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-24847-1