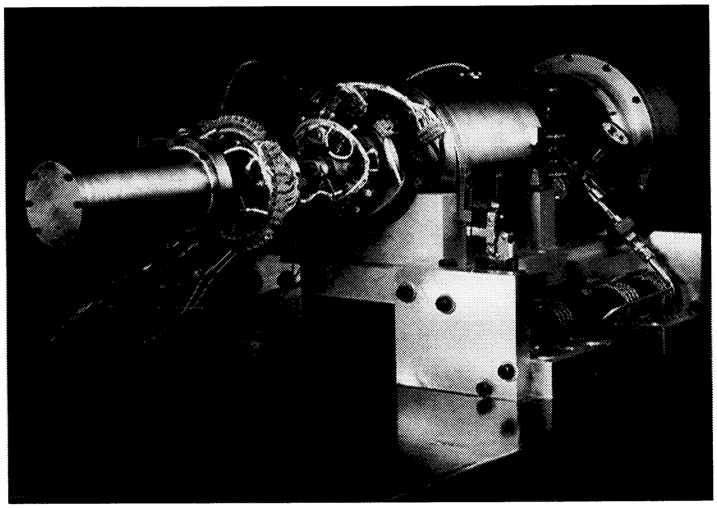

Satellite-based scientific instruments that observe in certain non-visible portions of the electromagnetic spectrum—such as infrared, x-ray and gamma ray detectors—must be kept at supercold temperatures to pick up the faint levels of energy emanating from distant bodies in space. This has been accomplished so far by use of cryogenic gases that cool the instruments to temperatures 300 degrees or more below zero Fahrenheit. But there is a problem with this approach—the cryogenic gases boil off gradually, thus limiting the satellite's data gathering lifetime to about a year. An alternative approach investigated by NASA is the closed-loop cooling system, in which the same gases are used over and over. This technique could lengthen satellite life, but it poses new problems: wear of the system's mechanical components due to friction and possible contamination of the coolant by organic materials and lubricants. For planned orbital observatories that will be operating in the 1990s and beyond, NASA is looking for a superior refrigeration system that will cool instruments for five years or more without generating adverse effects on other components of the observatory.

Goddard Space Flight Center (GSFC) believes it has the solution: a novel refrigeration system whose components work without seals, lubricants or conventional bearings and do not wear down from friction. Developed with GSFC guidance by Philips Laboratories, Briarcliff Manor, New York, a division of North American Philips Corporation, the system offers an extraordinary range of potential spinoffs—in industrial applications, medical research, computers, food processing and robotic machinery—because of its long-life, friction-free, non-contaminating characteristics.

Called the Stirling Cycle Cryogenic Cooler, the NASA/Philips closed-loop system is designed to produce five watts of supercooling to 65 degrees Kelvin, which corresponds to minus 343 degrees Fahrenheit. Friction is eliminated by use of electronically controlled linear magnetic bearings—rather than conventional sliding or ball bearings—so that the refrigerator's components remain levitated while working, centered in magnetic fields and moving without touching the sides of their housing. The design minimizes the chance of mechanical failure through employment of a direct linear drive motor that drives a piston and displacer, eliminating the mechanical linkages and shaft required by rotary motors. Contamination of the system's helium working fluid is eliminated by metal and ceramic construction and by the fact that no lubricants are needed.

The initial model, called the Proof of Principle Model, has successfully completed more than two years of operation without degradation of performance and it has demonstrated its ability to cool to 65 degrees Kelvin. Philips Laboratories is fabricating a second generation cooler, known as the Technology Demonstration Model, that has design refinements for survival of Shuttle launch and operations in space; it is scheduled for completion in the late spring of 1987.

Philips Laboratories, which seeks to identify and develop technologies that will be important to the parent company's business five to 10 years in the future, sees a variety of Earth-use possibilities for the cooler technology. It could, for example, be adapted to development of pumps, motors, compressors and other mechanical devices featuring longer, wearproof lives. ▲