The StarLight Space Interferometer

NASA's Jet Propulsion Laboratory, Pasadena, California

Two papers describe the StarLight space interferometer — a Michelson interferometer that would be implemented by two spacecraft flying in formation. The StarLight formation flying interferometer project has been testing and demonstrating engineering concepts for a new generation of space interferometers that would be employed in a search for extrasolar planets and in astrophysical investigations. As described in the papers, the original StarLight concept called for three spacecraft, and the main innovation embodied is a modification that makes it possible to reduce complexity by eliminating the third spacecraft. The main features of the modification are (1) introduction of an optical delay line on one spacecraft and (2) controlling the flying formation such that the two spacecraft are located at two points along a specified parabola so as to define the required baseline of specified length (which could be varied up to 125 m) perpendicular to the axis of the parabola. One of the papers presents a detailed description of the optical layout and discusses computational modeling of the performance; the other paper presents an overview of the requirements for operation and design, the overall architecture, and subsystems.

This work was done by William Folkner, Michael Shao, and Peter Gorham of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1)*
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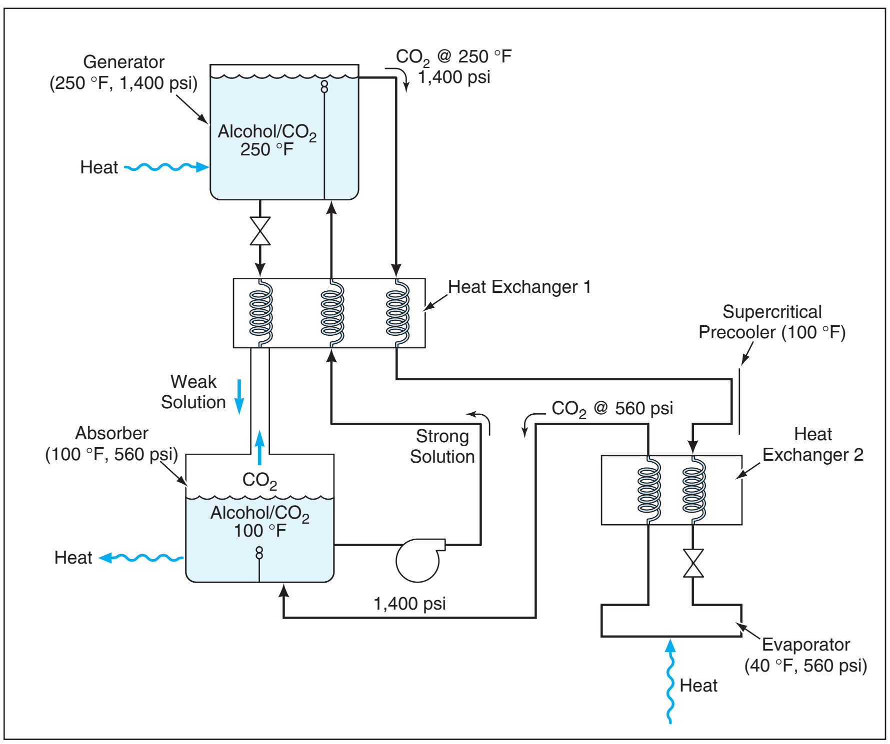
Champagne Heat Pump

Relatively safe and environmentally benign working fluids can be used.

NASA's Jet Propulsion Laboratory, Pasadena, California

The term "champagne heat pump" denotes a developmental heat pump that exploits a cycle of absorption and desorption of carbon dioxide in an alcohol or other organic liquid. Whereas most heat pumps in common use in the United States are energized by mechanical compression, the champagne heat pump is energized by heating.

The concept of heat pumps based on other absorption cycles energized by heat has been understood for years, but some of these heat pumps are outlawed in many areas because of the potential hazards posed by leakage of working fluids. For example, in the case of the water/ammonia cycle, there are potential hazards of toxicity and flammability.



Carbon Dioxide Is Absorbed and Desorbed in a thermodynamic cycle similar to that of a water/ammonia heat pump. The champagne heat pump is so named because the desorption part of its operating cycle is reminiscent of carbon dioxide effervescing out of alcohol-containing champagne.

The organic-liquid/carbon dioxide absorption/desorption cycle of the champagne heat pump is similar to the water/ammonia cycle, but carbon dioxide is nontoxic and environmentally benign, and one can choose an alcohol or other organic liquid that is also relatively nontoxic and environmentally benign. Two candidate nonalcohol organic liquids are isobutyl acetate and amyl acetate. Although alcohols and many other organic liquids are flammable, they present little or no flammability hazard in the champagne heat pump because only the nonflammable carbon dioxide component of the refrigerant mixture is circulated to the evaporator and condenser heat exchangers, which are the only components of the heat pump in direct contact with air in habitable spaces.

The champagne heat pump (see figure) includes a generator — essentially a heated pressure vessel — wherein a solution of carbon dioxide in the absorbent liquid is heated to generate pressurized carbon dioxide. In a typical application, the solution is heated to a temperature of 250 °F (121 °C), causing the carbon dioxide to be desorbed at a pressure of about 1.4 kpsi (9.7 MPa). The carbon dioxide is precooled, typically to about 100 °F (38 °C) while at this high pressure, then expanded to a pressure of about 560 psi (3.9 MPa); this expansion provides cooling to about 40 °F (4 °C). The carbon dioxide then passes back through a heat exchanger to an absorber, which is another pressure vessel wherein the carbon diox-