The cylindrical/conical shell enclosing the cavity is machined from copper, which is chosen for its high thermal conductivity. In use, the shell is oriented vertically, open end facing up, and inserted in a Dewar flask filled with isopropyl alcohol/dry-ice slush. A flange at the open end of the shell is supported by a thermally insulating ring on the lip of the Dewar flask. The slush cools the shell (and thus the blackbody cavity) to the desired temperature. Typically, the slush starts at a temperature of about 194 K. The slush is stirred and warmed by bubbling dry air or nitrogen through it, thereby gradually increasing the temperature through the aforementioned calibration range during an interval of several hours. The temperature of the slush is monitored by use of a precise thermocouple probe. A comparison with an independently calibrated commercial radiometer with a thermocouple demonstrated less than a 1 K difference between a thermocouple in the slush and the radiometer's output. The flow of dry air also acts as a purge to prevent airborne water vapor from frosting the conical and cylindrical cavity surfaces.

This work was done by Dane Howell, Robert Ryan, Jim Ryan, Dane Howell, Doug Henderson, and Larry Clayton of Stennis Space Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Intellectual Property Manager, Stennis Space Center, (228) 688-1929. Refer to SSC-00193.

KML Super Overlay to WMS Translator

NASA's Jet Propulsion Laboratory, Pasadena, California

This translator is a server-based application that automatically generates KML super overlay configuration files required by Google Earth for map data access via the Open Geospatial Consortium WMS (Web Map Service) standard. The translator uses a set of URL parameters that mirror the WMS parameters as much as possible, and it also can generate a super overlay subdivision of any given area that is only loaded when needed, enabling very large areas of coverage at very high resolutions. It can make almost any dataset available as a WMS service visible and usable in any KML application, without the need to reformat the data.

With the proper configuration, very large datasets that exist in WMS can become layers in a KML-enabled client. For example, Google Earth natively uses KML for data access and is both popular and available. This KML to WMS translator makes Google Earth act as a WMS client and can be used to make NASA remote sensing data more accessible, thus enabling exploration, collaboration, and education efforts. Simulated or modeled data available in WMS can become available in KML. This tool can be used for remote imagery of other planets, the Moon, and Earth.

This program was written by Lucian Plesea of Caltech for NASA's Jet Propulsion Laboratory.

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-44684.

High-Performance Tiled WMS and KML Web Server

NASA's Jet Propulsion Laboratory, Pasadena, California

This software is an Apache 2.0 module implementing a high-performance map server to support interactive map viewers and virtual planet client software. It can be used in applications that require access to very-high-resolution geolocated images, such as GIS, virtual planet applications, and flight simulators. It serves Web Map Service (WMS) requests that comply with a given request grid from an existing tile dataset. It also generates the KML super-overlay configuration files required to access the WMS image tiles. This server can sustain extremely high request rates with very short request latencies in both WMS and KML protocols. It does not require significant computer resources and can operate from read-only media.

This server makes it possible to support very demanding interactive or immersive applications that require geographically located data. It has direct applications for making NASA data such as remote sensing and modeled or simulated data available to applications like WorldWind or Google Earth.

This program was written by Lucian Plesea of Caltech for NASA's Jet Propulsion Laboratory.

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO- 44685.

Modeling of Radiative Transfer in Protostellar Disks

NASA's Jet Propulsion Laboratory, Pasadena, California

This program implements a spectral line, radiative transfer tool for interpreting Spitzer Space Telescope observations by matching them with models of protostellar disks for improved understanding of planet and star formation. The Spitzer Space Telescope detects gas-phase molecules in the infrared spectra of protostellar disks, with spectral lines carrying information on the chemical composition of the material from which planets form. Input to the software includes chemical models developed at JPL. The products are synthetic images and spectra for comparison with Spitzer measurements.

Radiative transfer in a protostellar disk is primarily affected by absorption and emission processes in the dust and in molecular gases such as H_2, CO, and HCO. The magnitude of the optical absorption and emission is determined by the population of the electronic, vibrational, and rotational energy levels. The population of the molecular level is in turn determined by the intensity of the radiation field. Therefore, the intensity of the radiation field and the population of the molecular levels are inter-dependent quantities.

To meet the computational challenges of solving for the coupled radiation field and electronic level populations in disks having wide ranges of optical depths and spatial scales, the tool runs in parallel on the JPL Dell Cluster supercomputer with C++ and Fortran compiler with a Message Passing Interface. Because this software has been developed on a distributed computing platform, the modeling of systems previously beyond the reach of available computational resources is possible.

This program was written by Paul Von Allmen and Neal Turner of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-44467.

Composite Pulse Tube

Axial leakage of heat is reduced.

Lyndon B. Johnson Space Center, Houston, Texas

A modification of the design of the pulse tube in a pulse-tube cryocooler reduces axial thermal conductance while preserving radial thermal conductance. It is desirable to minimize axial thermal conductance in the pulse-tube wall to minimize leakage of heat between the warm and cold ends of the pulse tube. At the same time, it is desirable to maximize radial thermal conductance at the cold end of the pulse tube to ensure adequate thermal contact between (1) a heat exchanger in the form of a stack of copper screens inside the pulse tube at the cold end and (2) the remainder of the cold tip, which is the object to which the heat load is applied and from which heat must be removed. The modified design yields a low-heat-leak pulse tube that can be easily integrated with a cold tip.

A typical pulse tube of prior design is either a thin-walled metal tube or a metal tube with a nonmetallic lining. It is desirable that the outer surface of a pulse tube be cylindrical (in contradistinction to tapered) to simplify the design of a regenerator that is also part of the cryocooler. Under some conditions, it is desirable to taper the inner surface of the pulse tube to reduce acoustic streaming. The combination of a cylindrical outer surface and a tapered inner surface can lead to unacceptably large axial conduction if the pulse tube is made entirely of metal. Making the pulse-tube wall of a nonmetallic, low-thermal-conductivity material would not solve the problem because the wall would not afford the needed thermal contact for the stack of screens in the cold end.

The modified design calls for fabricating the pulse tube in two parts: a longer, nonmetallic part that is tapered on the inside and cylindrical on the outside and a shorter, metallic part that is cylindrical on both the inside and the outside. The nonmetallic part can be made from G-10 fiberglass-reinforced epoxy or other low-thermal-conductivity, cryogenically compatible material. The metallic part must have high thermal conductivity in the cryogenic temperature range and would typically be made of pure copper to satisfy this requirement. The metallic part is bonded to the nonmetallic part with epoxy. Copper screens are inserted in the metallic part to form the cold-end heat exchanger, then the assembled pulse tube is inserted in the cold tip.

This work was done by Jerry L. Martin and Jason H. Cloyd of Mesoscopic Devices, LLC for Johnson Space Center. For further information, contact:

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Refer to MSC-23522

Photometric Calibration of Consumer Video Cameras

In imaging of point sources, dynamic ranges can be extended beyond saturation levels.

Marshall Space Flight Center, Alabama

Equipment and techniques have been developed to implement a method of photometric calibration of consumer video cameras for imaging of objects that are sufficiently narrow or sufficiently distant to be optically equivalent to point or line sources. Heretofore, it has been difficult to calibrate consumer video cameras, especially in cases of image saturation, because they exhibit nonlinear responses with dynamic ranges much smaller than those of scientific-grade video cameras. The present method not only takes this difficulty in stride but also makes it possible to extend effective dynamic ranges to several powers of ten beyond saturation levels. The method will likely be primarily useful in astronomical photometry. There are also potential commercial applications in medical and industrial imaging of point or line sources in the presence of saturation.

This development was prompted by the need to measure brightnesses of de-