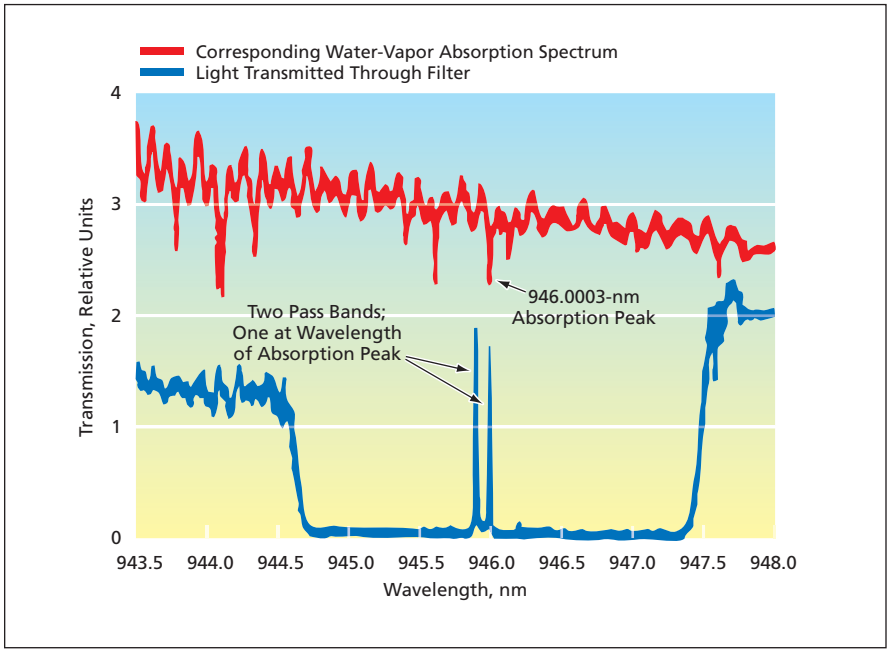

The **Transmission Spectrum** of a prototype filter was found to contain the desired two narrow pass bands within a stop band and was tension-tuned to match the 946-nm water vapor absorption line.

vapor absorption peak [which has 8.47 pm full width at half maximum (FWHM)], and

- Contains another pass band at the slightly shorter wavelength of 945.9 nm, where there is scattering of light from aerosol particles but no absorption by water molecules.

Whereas filters used heretofore in DIAL have had bandwidths of ≈300 pm, recent progress in the art of fiber-optic Bragg-grating filters has made it feasible to reduce bandwidths to ≤20 pm and thereby to reduce background noise. Another benefit of substituting fiber-optic Bragg-grating filters for those now in use would be significant reductions in the weights of DIAL instruments. Yet another advantage of fiber-optic Bragg-grating filters is that their transmission spectra can be shifted to longer wavelengths by heating or stretching: hence, it is envisioned that future DIAL instruments would contain devices for fine adjustment of transmission wavelengths through stretching or heating of fiber-optic Bragg-grating filters nominally designed and fabricated to have transmission wavelengths that, in the absence of stretching, would be slightly too short.

Prototype fiber-optic Bragg-grating filters were designed so that their grating structures were chirped and each filter included π-radian phase shifts at two locations along its length. In each filter, the chirp was characterized by 200 uniform-pitch fields concatenated along a total length of about 6 cm. The chirp rate was 0.3 nm/cm, with a pitch centered at 648.9 nm. The π-radian phase shifts were located at lengthwise positions of 29 and 31 cm, respectively. The particular combination of chirping parameters and phase-shift locations was chosen to yield the desired pass bands at wavelengths of 945.9 and 946.0003 nm in a stop band 2.66 nm wide upon stretching of the fiber at a tension equivalent to the terrestrial weight of a mass of 140 mg (see figure). The filters were fabricated in a multistep process, starting with electron-beam patterning of step-chirp corrugations into a mask. Hydrogen-loaded single-mode optical fibers were irradiated through the mask by light from an ultraviolet excimer laser, then the fibers were annealed by heating.

The prototype fiber-optic Bragg-grating filters were subjected to several tests that demonstrated their potential utility for DIAL water-vapor measurements. Measurements of the transmission spectra of the filters were found to be well approximated by theoretical calculations, which were made by use of a piecewise-matrix form of a coupled-mode equation. Tension tuning was also demonstrated.

This work was done by Leila B. Vann and Russell J. DeYoung of **Langley Research Center** *and Stephen J. Mihailov, Ping Lu, Dan Grobnic, and Robert Walker of the Communications Research Centre Canada. Further information is contained in a TSP (see page 1).* *LAR-17039-1*

Simulating Responses of Gravitational-Wave Instrumentation

NASA's Jet Propulsion Laboratory, Pasadena, California

Synthetic LISA is a computer program for simulating the responses of the instrumentation of the NASA/ESA Laser Interferometer Space Antenna (LISA) mission, the purpose of which is to detect and study gravitational waves. Synthetic LISA generates synthetic time series of the LISA fundamental noises, as filtered through all the time-delay-interferometry (TDI) observables. (TDI is a method of canceling phase noise in temporally varying unequal-arm interferometers.) Synthetic LISA provides a streamlined module to compute the TDI responses to gravitational waves, according to a full model of TDI (including the motion of the LISA array and the temporal and directional dependence of the arm lengths). Synthetic LISA is written in the C++ programming language as a modular package that accommodates the addition of code for specific gravitational wave sources or for new noise models. In addition, time series for waves and noises can be easily loaded from disk storage or electronic memory. The package includes a Python-language interface for easy, interactive steering and scripting. Through Python, Synthetic LISA can read and write data files in Flexible Image Transport System (FITS), which is a commonly used astronomical data format.

This program was written by John Armstrong, Jeffrey Edlund, and Michele Vallisneri 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-41001.