



# LITU

THE CENTER FOR THE STUDY OF LIFE IN THE UNIVERSE:  
ON THE FRONTIER OF DISCOVERY

Scientists in the SETI Institute's Center for the Study of Life in the Universe (LITU) conduct exciting, varied research projects in the burgeoning field of astrobiology, the scientific discipline that seeks to understand the origins of life and the extent to which it may be present beyond Earth. One such research area is the study of terrestrial analogs for Mars.

Dr. Nathalie Cabrol, a Principal Investigator at the SETI Institute, and

her husband and Co-Principal Investigator, Dr. Edmond Grin, traveled to Lake Licancabur—one of the highest alpine lakes on Earth at 19,523 feet—to research the prospects for life in the paleolakes of Mars. The extreme temperature, altitude, and high ultraviolet radiation of this volcanic region, which is located on the border of Chile and Bolivia, provided our team with a unique research environment that is possibly analogous to early lakes on

Mars. Cabrol and Grin also serve on the Mars Exploration Rover (MER) team, where they were the primary advocates for the Gusev Crater landing site for the rover *Spirit*, which found its way to Mars on January 4, 2004 and continues to offer extraordinary scientific discoveries.

Astrobiology is a field that breaks down the traditional boundaries separating disciplines, creating opportunities for conversations to take place between biologists, planetary scientists, astronomers, geologists, chemists, and paleontologists. For example, SETI Institute geochemist Janice Bishop recently found her ongoing research, which examines the spectra of iron oxide compounds, taking on an exciting new dimension. While attending a presentation by NASA biologist Dr. Lynn Rothschild, Dr. Bishop observed spectrographs of a highly UV-resistant microbe. Realizing that these spectra “looked like upside-down versions” of her iron oxide spectra, Bishop initiated a collaboration with Rothschild to study the potential role of iron oxide as a sunscreen for primitive life on the early Earth.

Recently, LITU scientist Peter Jenniskens completed his fourth mission chasing the tail of a comet. The dusty debris trail of comet 55P/Tempel-Tuttle is responsible for the annual Leonid meteor shower, which appears each November with varying intensity. Periodically, these fiery displays are active enough to qualify

as “storms.” Between 1998 and 2002, when the Leonid meteor storms were particularly intense, Jenniskens organized a series of missions that brought a large, international group of researchers to the best place in the world to watch the Leonid meteors — the sky. Observing from specially equipped, high-altitude aircraft, Jenniskens and his colleagues had a superb vantage point above the clouds, collecting an unprecedented volume of data on comets which may have implications related to the origins of life on this planet, and perhaps throughout the universe.

Interstellar space might seem to be an unlikely nursery for organic chemistry, yet Max Bernstein’s laboratory simulations of the ice that forms in the void between stars reveal startling clues to life’s origins. Building upon earlier experiments of irradiated ice that yielded amino acids, Bernstein’s team has embarked upon an investigation of the surface of Europa. Biological material that might find its way to the Jovian moon’s frozen surface would receive a heady dose of decomposing radiation. In Bernstein’s lab, simulations of this process will help characterize the distinctive signatures of such irradiated biological materials. The resulting organic compounds will help researchers identify genuine “biomarkers” from the background organic compounds that may form abiotically.

< Left: 3-D image captured by the MER *Spirit* on Mars. Courtesy: JPL/NASA

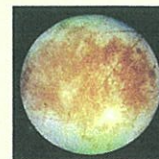
**“The most exciting thing about our endeavor is finding ourselves on the verge of answers to some of the most profound questions human beings have been asking for millennia. We now have the means to determine—in this decade—exactly how common Earth-like planets really are.”**

DR. CHRISTOPHER CHYBA  
*Carl Sagan Chair for the Study of Life in the Universe*

#### SETI Institute Selected for Membership in NASA Astrobiology Institute

In 2003, the SETI Institute received special recognition from the National Aeronautics and Space Administration (NASA) with the Institute’s selection as a lead team in the NASA Astrobiology Institute (NAI), an international research consortium coordinated by NAI’s offices at the NASA Ames Research Center. NAI, a virtual institute, comprises 16 educational and research institutions in the United States and five international partners. Our five-year, institute-wide NAI award is funded at just under one million dollars per year and will support eleven interrelated LITU, SETI, and Education and Public Outreach projects.

Dr. Christopher Chyba, who holds the Carl Sagan Chair at the SETI Institute, leads the NAI team as Principal Investigator. An expert on Europa, one of Jupiter’s moons, he is conducting research to investigate the liquid water ocean that is thought to exist beneath its frozen surface to determine its life-supporting potential. Among other significant interests, Dr. Chyba also chairs a National Research Council committee that focuses on issues of planetary protection, specifically with respect to the forward contamination of Mars.



Above: Europa. Courtesy: JPL/NASA

**Asteroid 4859**, identified in 1992, was christened “Asteroid Fraknoi” in recognition of Andrew Fraknoi, a member of the Board of Trustees of the SETI Institute.

# SETI

CENTER FOR SETI RESEARCH:  
SEEKING EVIDENCE OF  
TECHNOLOGICALLY ADVANCED  
CIVILIZATIONS IN THE UNIVERSE

will be able to conduct early studies suitable to the first phase of the instrument. And it will conduct this research two years earlier than originally planned. When the 350-dish array is completed later in the decade, the ATA will be among the world's largest and fastest observing instruments. Though the 73,000-square-meter Arecibo dish in Puerto Rico — the largest radio telescope in the world — has a collecting area seven times larger than the planned ATA 350, it does not have as extensive an observing window as the ATA. At any one time, the ATA will be able to look at a portion of the sky 2,500 times larger than that observed by the Arecibo dish, over a frequency range that is five times as broad, allowing more time to be dedicated to large surveys than is possible at Arecibo.

## ALLEN TELESCOPE ARRAY

After more than three years of design, development, and testing of a radically new kind of radio telescope, astronomers at the SETI Institute and the University of California, Berkeley, began to construct the first 32 dishes of the Allen Telescope Array (ATA) in late 2003. This array will evolve into at least 350 complex radio dishes dedicated to galactic and extragalactic astronomy and the search for intelligent signals from space. The array will be built at Hat Creek, the UC Berkeley radio observatory site 290 miles northeast of San Francisco. Because the telescope design is scalable, the ATA-32

## PROJECT PHOENIX: LIFTING OUR VISION TO THE STARS

Project Phoenix, the Institute's privately funded SETI search project, came on line in early February 1995, when the 64-

meter Parkes radio telescope in Australia pointed at the star *Nu Phoenixis*. Later, the 26-meter antenna at Mopra joined the search. Since that time, Institute scientists have searched for signals from more than 750 stars in our interstellar neighborhood over a wide spectrum of frequency bands. This was made possible by significant contributions from committed donors and the combined support of many individual members of TeamSETI.

After six months in Australia, Institute researchers took Project Phoenix to the National Radio Astronomy Observatory in West Virginia and the Woodbury telescope in Georgia, and, over the last several years, we've encamped at the Arecibo Radio Observatory in Puerto Rico and the Lovell telescope at Jodrell Bank Observatory in the UK. During that time, our scientists have searched a small, but important sampling of stars, all within 200 light years of our home planet. Our galaxy contains more than a hundred billion stars, and we've only just begun to explore our own neighborhood; the rest of the Milky Way is waiting.

## OPTICAL SETI: A FLASH OF BRILLIANCE

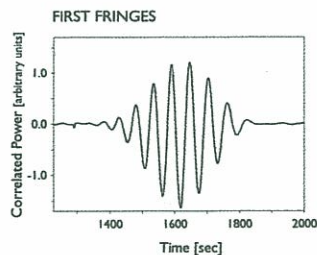
SETI Institute Trustee Charles Townes, considered the "Father of Optical SETI," has long championed the idea that a remotely located, technologically advanced civilization might have the capability to deliberately transmit a detectable optical laser signal. In the late 1990s, as part of a long-range planning effort of the Institute, it became apparent that affordable technologies were currently available to search for short laser pulses emanating from elsewhere in the galaxy. In 2001, our scientists joined forces with Lick Observatory at the University of California, Santa Cruz, to begin an optical SETI experiment that continues today. These observations merge the power of the observatory's 40-inch Nickel Telescope with a pulse-detection system that is capable of finding laser beacons, should they exist, from civilizations located up to 1,000 light-years from Earth.



Lick Observatory,  
University of California  
at Santa Cruz

### First Fringes

Constructing a large number of individual small antennas to serve as the segments of a much larger radio "mirror" is not difficult, but connecting them together is a major signal handling and data processing challenge. Doing that affordably is an even bigger challenge. In early 2003, the first milestone was accomplished when the first "fringes" were observed by the ATA team. The first three ATA antennas were aimed at a small radio source in the sky and the outputs from the individual antennas were multiplied together pair-wise to produce the fringes. These fringes are caused by the slight difference in the arrival times of the signal received by the individual



antennas. Depending on what fraction of a wavelength the signal travels during the small time difference, the antenna outputs will be more or less in phase, and the antenna products will be greater or smaller. Over time, as the radio source moves across the sky, the varying amplitudes of the fringes are produced. (Image courtesy of ATA staff.)

### Townes Receives Frank Drake Award

The SETI Institute named Dr. Charles H. Townes, Nobel Laureate and Emeritus Professor of Physics at the University of California at Berkeley, the 2002 winner of the Frank Drake Award for Innovation in SETI and Life in the Universe Research. Dr. Townes is best known as the co-inventor of the laser, and has been a visionary champion of optical SETI for over thirty years. Dr. Townes joined the Board of Trustees of the SETI Institute in 2003.



Charles Townes

< Left: A composite image of Helix Nebula. Courtesy: NASA, NOAO, ESA, The Hubble Helix Team, M. Meixner (STScI), and T.A. Rector (NRAO)

**"I am eager to begin observing on the Allen Telescope Array. Conducting observations 24/7 is a dream come true for any astronomer, and it is particularly exciting for the Institute's researchers, who have been constrained by limited time on other large centimeter wavelength telescopes. Finally, our tools are becoming commensurate with the size of our task."**

DR. JILL TARTER

Director, Center for SETI  
Research, Bernard M. Oliver  
Chair for SETI

**"The ATA's ability to make high resolution radio images over large swaths of sky, to make measurements over a uniquely large range of radio wavelengths, and to do several kinds of observations at once, provides a power and flexibility that will allow astronomers to address entire areas of astronomy that are currently inaccessible. Because of the telescope's unique capabilities, I expect that we'll discover things out there we can't even anticipate."**

DR. LEO BLITZ

Professor of Astronomy  
Director, Radio Astronomy  
Laboratory, UC Berkeley



# EDUCATION

EDUCATION AND PUBLIC OUTREACH:  
THE HUMAN CONNECTION

## “VOYAGES THROUGH TIME”

The SETI Institute has been a significant leader in the fields of Education and Public Outreach (EPO), communicating science to all ages since its inception. Both in the classroom and in the public arena, Institute scientists deliver scores of open lectures annually to eager audiences. The Institute has made a major commitment to bringing the excitement of astrobiology and SETI research to classrooms, homes, and museums throughout our

nation and around the world. Inspiring the next generation of research scientists is vital to sustaining the country's international leadership in mathematics and science. To that end, the Institute's educational leaders collaborated with scientists, teachers, and students to publish an interdisciplinary ninth-grade science curriculum called *Voyages Through Time (VTT)*, in 2003. This product weaves the themes of evolution and life beyond earth into an engaging integrated science curriculum based on national science education standards. You can learn more about this innovation in science education by accessing the *VTT* website at: <http://www.voyagesthroughtime.org>

## SOFIA TAKES OFF

The SETI Institute is collaborating with the Astronomical Society of the Pacific to implement the ambitious Education and Public Outreach program for NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA). SOFIA's 2.5-meter telescope is mounted in a Boeing 747 jet and the project will provide the opportunity to pair educators with astronomers on high-altitude, overnight observation missions, enabling teachers to experience the research environment first-hand. SOFIA will provide scientists and educators with a closer look at the formation of stars and planets, the chemical compositions and ecosystems of galaxies, the nature of the interstellar medium, and the opportunity to observe protoplanetary disks around stars. It will also enable a closer scrutiny of the center of our galaxy than ever before possible.



*SOFIA mirror*  
Courtesy: NASA/USRA

## THE KEPLER MISSION: THE COUNTDOWN BEGINS

The SETI Institute is collaborating with numerous organizations including the NASA Ames Research Center, Ball Aerospace Technologies Corporation, and the Jet Propulsion Laboratory, on a NASA Discovery Mission known as *Kepler*. Scheduled for launch in 2007, *Kepler* will seek evidence of Earth-sized worlds in orbit around distant stars. The spacecraft will watch for the slight dimming that occurs when a planet transits across the face of its sun. The *Kepler* Mission will aim to conclusively prove whether other Earth-like planets exist within the habitable zone of distant suns. Institute scientists Dr. Jon Jenkins and Dr. Douglas Caldwell are developing data processing programs that will identify planets, while Edna DeVore and her EPO team are creating the education and outreach program for *Kepler*, in cooperation with the University of California, Berkeley's Lawrence Hall of Science.



*Kepler*  
Courtesy: NASA

< *Left to right: Jupiter's moon, Io, and Neptune.*  
Courtesy: JPL/NASA

**"People of all ages are intrigued by the profound questions asked by scientists at the SETI Institute, such as 'What is the history of life on Earth?' 'How can we explore Mars?' 'Is there life beyond Earth?' We delight in sharing our scientific research, exploration, and discovery with students, teachers, and the public. It's a great way to engage people at the frontier of modern science."**

EDNA DeVORE  
*Director of Education and Public Outreach*

### Coming to a Radio Near You: Stay Tuned for "Are We Alone?"

We invite you to keep up with the work of the SETI Institute by reading the scientist profiles on the Institute homepage and by viewing the video clips in the "Voices" section of our Web site. Our scientists are currently conducting research on more than forty astrobiology topics. You can stay current on many issues related to the search for life on and off Earth by tuning in to our weekly radio program, "Are We Alone?" with Dr. Seth Shostak, SETI Institute's Senior Astronomer. Visit [www.seti.org](http://www.seti.org), and click on the events calendar and then select "SETI Radio Network" for the radio broadcast schedule.

**Phone calls from Burma,  
a contest of imagination  
and a wardrobe for Ms. Midler**

**UP AND COMING IN  
BEVERLY HILLS**

If you've seen Touchstone Films' hit movie, *Down and Out in Beverly Hills*, then you're aware of the heroine's passion for our Beverly Hills store. As played by Bette Midler, Barbara Whiteman actually had some help with her spring fashion shopping. Albert Wolsky, the movie's costume designer called on the Neiman-Marcus Beverly Hills studio services department to provide many of Midler's wardrobe needs.

Vikoria Kaye, NM's director of studio services, stresses that all costume credit must go to the costumer or designer of the many projects she works on (around 200 films, TV pilots, series and commercials a year), but that the following have been some of the store's most recent feature film involvements.

*Made in Heaven*, Made in Heaven Productions, April Ferry, designer; starring Kelly McGillis and Timothy Hutton. *Legal Eagles*, Universal Productions, Albert Wolsky and Birney Pollack, designers; starring Robert Redford and Debra Winger. *Back to School*, Back to School Productions, starring Rodney Dangerfield and Sally Kellerman. *Just Between Friends*, MTM Productions, Cynthia Bales, designer; starring Mary Tyler Moore and Ted Danson. *Big Trouble in Little China*,

Photo courtesy of Touchstone Productions



Bette Midler with co-star Richard Dreyfuss.

20th Century Fox Productions, April Ferry, designer; starring Kurt Russell.

Studio services also did personal shopping at the time of movie release for three of the *The Color Purple* producers, Steven Spielberg, Kathleen Kennedy and Frank Marshall, and for director Sydney Pollack when *Out of Africa* had its premiere.



Seven days of fitness at The Greenhouse.

**GREAT WEEKS AT  
THE GREENHOUSE**

A second Mother/Daughter Week featuring a mystery celebrity and her mother is planned at The Greenhouse Spa, Sunday, July 13 through Sunday, July 20. The first such week has Debbie Reynolds and her mother, Maxene, participating May 11 through 18.

The famous all-women spa features special Mother/Daughter Weeks twice a year. But any season, a maximum of 39 guests receive all the attention of a full staff of 125 during a seven-day sabbatical of fitness, nutrition and beauty. Fashion shows and a shopping trip by limousine to the Neiman-Marcus downtown Dallas store are part of the fun. Enrollment is limited for the Mother/Daughter event; the fee for one week at The Greenhouse, with private room and bath and all meals is 2,625.00.

For the executive woman showing vital signs of burnout, there is a choice of two dates for an Executive Renewal Week at the spa: Sunday, August 17 through Sunday, August 24, or Sunday, August 24 through Sunday, August 31. The week includes seminars in stress management and balance in work and play to promote harmonious, happy living. Call (817) 640-4000 for reservations or write The Greenhouse Spa, P. O. Box 1144, Arlington, Texas 76010.