



A snapshot like this one contains data for restoring roughly 2 milliseconds of music.

following the path of the groove. A single 78 rpm record results in thousands of two-dimensional snapshots—100 to 1000 gigabytes of data. The snapshots are cleaned up to compensate for scratches, dirt, and warping, and then converted to a pure audio signal. The method draws on decades of experience in finding elementary particle tracks buried in large noisy data sets from high-energy experiments. “We thought these methods, which demand pattern recognition and noise suppression, could also analyze the grooved shapes in mechanical recordings,” says Haber.

The restoration technique works with vinyl, shellac, wax, acetate, and metal. “It also has the potential to digitally reassemble broken discs,” says Fadeyev. Examples of restored music are available at <http://www.cdf.lbl.gov/~av>.

Last year, Haber and Fadeyev contacted the Library of Congress and discovered that archivists were particularly concerned about how to save deteriorating and damaged phonographic wax or metal “Edison” cylinders—the earliest form of grooved recordings. The library asked Haber to develop a three-dimensional technique to save those recordings, a request that turned into a research grant. “The Library of Congress really took the initiative to engage with us on this,” says Haber.

Early this year, by processing images from a confocal scanning probe, the Berkeley-led team restored a 1910 Edison cylinder recording of George F. Root’s “Just Before the Battle, Mother.” According to Roosa, the library’s holdings include more than 2.5 million music and spoken-word recordings. “A substantial portion of these are grooved media, which could potentially benefit from this new

copying technology,” he says.

The current prototypes take 40 minutes to scan 1 second of recorded sound. Haber and Fadeyev say that with a customized scanning machine they could reduce the time taken to copy and process a 3-minute recording to between 8 and 20 minutes; 3D imaging of Edison cylinders takes longer. “What we have done so far are just small experiments

to prove that modern optical methods have sufficient precision and sensitivity to do that job and then show that image analysis methods can extract sound and improve the quality and reduce the clicks and pops,” says Haber. “It’s a good example of how basic research in the physical sciences can benefit other fields of science and culture.”

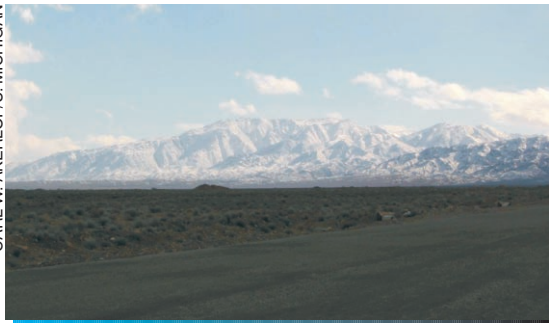
Paul Guinnessy

Iran Invests in Astronomy

The Iranian government has committed 150 billion rials (roughly \$17.5 million) for a telescope, an observatory, and a training program, all part of a plan to build up the country’s astronomy base. Iran wants to collaborate internationally and to become internationally competitive in astronomy, says the University of Michigan’s Carl Akerlof, an adviser to the Iranian project. “For a government that is usually characterized as wary of foreigners, that’s an important development.”

A 2-meter-class telescope will be the Iranian National Observatory’s first facility. “As far as I know, there has never been such a large purely scientific project in Iran,” says Sepehr Arbabi Bidgoli, the project’s assistant manager and an astrophysicist at the Institute for Studies in Theoretical Physics and Mathematics in Tehran. “The biggest telescope we have now is a 60-centimeter refractor. We can’t compete with the Hubble or Keck or the VLT [Very Large Telescope], but we can do real science with [a 2-meter] telescope.” Running a facility as a multi-university collaboration is also new for Iranians, Arbabi adds.

“Iran will have the only major telescope at that longitude,” says project adviser Edward Guinan, an astronomer at Villanova University in Pennsylvania. “With a first-class modern telescope at a great site, it



The Karkas mountains in central Iran is one of four candidate sites for the country’s new 2-meter-class telescope.

will be possible to swap time with other telescopes internationally.”

Measurements of light pollution, seismicity, wind, dust, and cloud cover have narrowed the site possibilities to four candidates. Testing for atmospheric turbulence, or seeing, at those sites begins this summer. A site is scheduled to be chosen within about four years, and the ready-made, robotically operable telescope could be installed and running in 2009.

Meanwhile, Iran’s astronomy community, which consists of about 30 professionals and as many students, wants to train about 50 people in observational astronomy over the next five or so years. Last fall, the first class in a new master’s program got under way. Students will learn theory and “get their first acquaintance with astronomical gadgetry on one of the few small observatories” in Iran, and then go abroad to gain experience on larger and newer instruments, says Yousef Sobouti of the Institute for Advanced Studies in Basic Sciences in Zanjan. “We do have enough friends and contacts in India, Europe, and elsewhere to give us a helping hand.”

“Fortunately, Iran has an immense pool of youth very much interested to make careers in all branches of science,” adds Sobouti, who spearheaded the telescope project. “This includes astronomy, though it may not seem to provide a lavish life for the individual.”

Toni Feder

Feds Set Priorities Based on “Quarks” Report

A federal government science group has issued recommendations based on the National Research Council’s 2002 report *Connecting Quarks With the Cosmos: Eleven Science Questions for the New Century*, and dark-energy research projects have

received the strongest endorsement. The recommendations come from the Interagency Working Group on the Physics of the Universe (IWG), which was organized by the National Science and Technology Council's Committee on Science to examine federal investments required by the NRC study (see PHYSICS TODAY, July 2002, page 22).

Although the recommendations don't have dollar figures attached to them, they are important because they define the priorities federal research agencies are placing on the NRC recommendations. The IWG included members from the US Department of Energy, NASA, NSF, the Office of Science and Technology Policy, and the Office of Management and Budget.

"The IWG recommends three highest priority investigations of Dark Energy by means of space- and ground-based astronomy, which should be enabled by coordinated activities of the [federal] agencies," the report says. Under the category "ready for immediate investment" are the following dark-energy recommendations:

► The NASA/DOE joint dark-energy mission. This mission would best serve the scientific community if

launched by the middle of the next decade, the IWG report says.

► The study of weak lensing produced by dark matter, currently the scientific goal of the ground-based Large-aperture Synoptic Survey Telescope. Significant technology investments to enable the proposed LSST are required, the IWG says.

► A coordinated NSF/NASA effort to use the number of clusters of galaxies observed by ground-based cosmic microwave background and space-based x-ray observations as a dark-energy probe.

To advance research on dark matter, neutrinos, and proton decay, the working group endorses the development by the end of 2004 of an NSF roadmap laying out the future of underground science. The group says that NSF and DOE "will work together to identify a core suite of physics experiments."

The IWG also endorses the upgrade of the Laser Interferometer Gravitational Wave Observatory (LIGO) and "execution of the *Laser Interferometer Space Antenna (LISA)* mission." NSF, NASA, and DOE efforts to "strengthen numerical relativity research" to simulate the

sources of gravitational waves are also supported.

The report endorses the development of roadmaps to determine future investments in programs related to the origin of heavy elements, the birth of the universe, and high-density and high-temperature physics. The report, *The Physics of the Universe: A 21st Century Frontier for Discovery*, is available at <http://www.ostp.gov/html/physicsoftheuniverse2.pdf>.

Jim Dawson

Alcock Tapped to Lead Center for Astrophysics

After more than 21 years, Irwin Shapiro has stepped down as head of the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Massachusetts. Filling his shoes is Charles Alcock, who moves from the University of Pennsylvania to begin a five-year term as director on 1 August.

Known for the breadth of its research and for operating NASA's *Chandra X-Ray Observatory*, the CfA has more than 300 scientists and an annual budget of \$110 million.



CeramTec
CeramTec North America Corporation

Advancing the Science of Technical Ceramics

Ceramic Substrates

Piezoceramics

Ceramaseal® Products

CeramTec North America
Technical Ceramic Products
Toll Free: (800) 845-9761
sales@CeramTec.com, www.CeramTec.com

ISO 9001:2000
Quality System Certified

ISO 9001:2000
Quality System Certified

CeramTec North America
Ceramaseal® Products
Toll Free: (800) 752-7325
sales@Ceramaseal.com, www.Ceramaseal.com