Astronomers get physical for future plans

Geoff Brumfiel, Albuquerque

A satellite to study the radiation left over by the Big Bang and a laboratory deep underground are among the projects endorsed by a US survey of the interface between astronomy and physics.

Researchers working at this interface are hoping that the survey, released at a joint meeting between the American Physical Society and the American Astronomical Society on 21 April, will help to build support for their work.

The recommendations follow a two-year study undertaken at the request of Dan Goldin, then the director of NASA, after he identified astrophysics as a key area for collaboration between NASA and other agencies (see *Nature* **399,** 509; 1999). The report also endorses Goldin's vision of stronger links between NASA and Earth-bound science agencies, to help get some of the projects off the ground.

Each of three instruments newly endorsed by the National Academy of Sciences' report is designed to probe a different question in cosmology. One of them, a 2-metre diameter wide-field space telescope, would probe the 'dark energy' that seems to be play a role in the expansion of the Universe. A second satellite would look for polarization in the cosmic microwave background left over from the Big Bang. Researchers believe that this might help to explain how gravity waves influenced the rapid inflation of the early Universe.

Experiments conducted in the underground laboratory would include a search for the decay of protons — an extremely rare event that high-energy physicists have predicted but never observed — as well as probing the neutrino, a hard to detect particle whose recently discovered mass poses a challenge to the standard model of physics.

This year, construction of the underground laboratory has become an issue in a tight Senate election race in South Dakota, home of the disused Homestake goldmine where the facility would probably be built (see *Nature* **415,** 105; 2002).

The report also adds its support to three projects already endorsed in the National Academy of Sciences' 2001 decadal review of astronomy: the Laser Interferometer Space Antenna, which would detect gravity waves; Constellation-X, a group of four satellites to probe the edges of black holes; and the Large-aperture Synoptic Survey Telescope, which would search for so-far undetected dark matter in deep space.

All of these programmes, the authors suggest, should be run through a new inter-agency initiative between NASA, the Department of Energy and the National Science Foundation. The report does not say how much such an initiative would cost, but Michael Turner, an astrophysicist at the University of Chicago, who chaired the panel that wrote the report, says that it might spend "something like a billion dollars" over 10 years.

Michael Lubell, director of public affairs at the American Physical Society, says he is optimistic that the report will help to raise awareness of the physical sciences both among the general public and in the US Congress, which will ultimately decide which of the projects will proceed. ■

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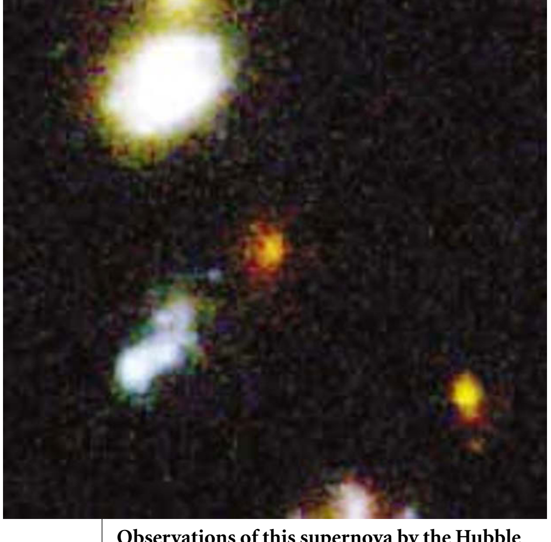

Observations of this supernova by the Hubble Space Telescope hint at the role of dark energy.

Laser gears up for star role

Natasha McDowell, London

Astrophysicists will soon be able to deploy a range of lab experiments to test the predictions of some of their theories.

The upgraded Vulcan laser, which was inaugurated this month at the Rutherford Appleton Laboratory near Oxford, will offer researchers the most intense laser pulses in the world. When trained on a target, these pulses will create temperatures and pressures comparable to those found inside stars.

"Vulcan will provide us with the experimental data to check the theoretical calculations that have come from observations," says Steven Rose, an astrophysicist at the University of Oxford.

Vulcan's upgrade will see it emit near-infrared pulses containing a relatively modest 500 joules of energy. But their ultrashort life — the pulses last just 500 femtoseconds (5×10^{-15} seconds) — means that they offer a peak power of one petawatt (10^{15} watts). This exceeds the power produced by typical high-energy machines such as the OMEGA laser at the University of Rochester, New York, which emits longer pulses containing 40,000 joules.

"The increased intensity of Vulcan will drive research into new territories," says Chris Edwards, manager of the Vulcan upgrade. "It is sure to produce new surprises." Initial tests at the facility are scheduled to begin next month, and it should open to users in November.

Vulcan's beam will be focused onto a spot just 10 micrometres across, producing what its operators say will be one of the most intense laser beams ever generated in a laboratory. It will be used for a range of experiments — Rose, for example, plans to use it to study iron, a constituent of the Sun that plays an important role in conducting energy outwards from the fusion reactions at the star's core. It will also be involved in research into a 'fast ignition' approach to nuclear fusion energy, which uses the intense pulse to initiate fusion reactions.

Vulcan will be used primarily by British and European researchers, but access has also been arranged for scientists in the United States. Similar high-intensity lasers are under development in Japan and Germany, and researchers are seeking funding for a facility in France. ■

S. KILL/RAL

Getting a grip: the Vulcan laser will help astrophysicists to test their theories.