measures of delinquency are critical omissions," say Emery and Marholin. "Although the techniques consistently demonstrate changes in behavior, the question of whether these changes are meaningful to the individual and society remains to be answered." □

X-raying special relativity

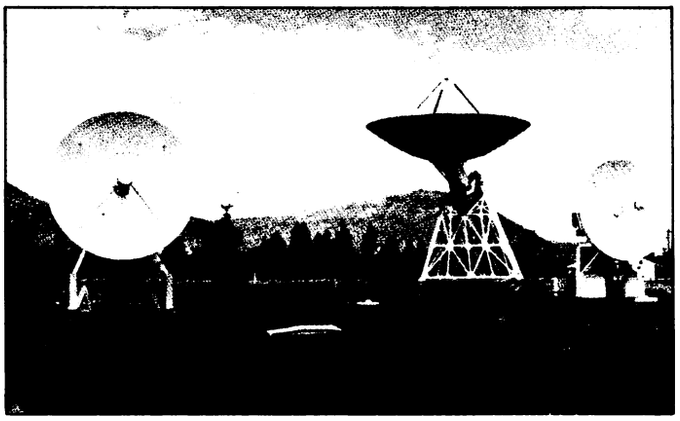
The special theory of relativity pervades all of contemporary physics. From the doings of subatomic particles to the astrophysics of peculiar stars, it is applied every day. The theory is based on two postulates. The first (called the principle of relativity) says that any law of physics that holds in one coordinate system holds in identical form in any other coordinate system moving at a constant velocity with respect to the first. The second is that the velocity of light is independent of the source.

There have been numerous laboratory proofs of the first principle, but, Kenneth Brecher of Massachusetts Institute of Technology writes in the Oct. 24 PHYSICAL REVIEW LETTERS, there have been few experimental proofs of the second, and some of those are ambiguous and not generally accepted. Brecher proposes a test involving binary X-ray sources that he says is more sensitive than those possible in laboratories.

The second postulate is responsible for much of the strange view of space and time that special relativity leads to. It makes light a special case in nature; anything else emitted by a moving object has a velocity with respect to an observer that depends on the velocity of the emitter. Proving the second postulate is not just an academic exercise because a self-consistent theory of electromagnetics can be derived, as W. Ritz showed in 1908, in which the velocity of light does depend on the velocity of the source.

To test the postulate one assumes that it does not hold. In that case the velocity of light reaching the earth from a celestial object would not be the familiar constant c (which is approximately 300,000 kilometers per second) but c plus the velocity of the source. This would make a difference in the observations of binary stars, because the orbital motions of such stars give them a constantly changing velocity with respect to the earth. The effect can't be tested with visual binaries, Brecher points out, because visible light is dispersed by the interstellar medium and comes to a velocity characteristic of the medium, which may not be moving with respect to the earth. X-rays are not so badly affected, and Brecher argues that the timing of a number of pulsing X-ray binaries can be used as a test. His survey indicates that the X-ray binaries support special relativity to an accuracy of 2 parts in a billion. The best laboratory tests are good only to about 1 part in 10,000. □

Listening for intelligent aliens



Univ. of Calif.

A special receiver to search for intelligent alien signals is attached to the middle telescope in this picture of the Hat Creek Observatory in California.

By their radio waves shall ye know them. Such might be called the general principle of scientists interested in the question whether there is intelligent life on other planets in the universe. The question has aroused a lot of interest but very little in the way of observation. The odds against finding anything in a reasonable time are so extremely long that managers of radio observatories are reluctant to devote time to such observations when there are many things needing to be done that will surely bring results, and current radioastronomical receivers are designed to discriminate against intelligent signals so as to filter out terrestrial broadcasts.

Special equipment has been proposed to look for intelligent signals, but some of it carries enormous price tags. One such proposal, called project CYCLOPS, could cost as much as $30 billion. A far less expensive system (one that has cost about $4,000 to date) has been put into operation by the University of California at its Hat Creek Observatory near Mt. Lassen. The system consists of a special receiver attached to Hat Creek's 85-foot radiotelescope, which will process all signals received by the telescope for evidence of intelligent signals.

The project, which is called SERENDIP (Search for Extraterrestrial Radio Emission from Nearby Developed Intelligent Populations), is under the direction of Stuart Bowyer. Working with him are Michael Lampton, Jack Welch, Jill Tarter, graduate student David Langley (who built most of the equipment) and Alvin Despain.

The search has to be of nearby objects since the telescope is much less sensitive (by a factor of hundreds or thousands) than the telescope array proposed for CYCLOPS, and that makes it something of a longer shot than CYCLOPS. However it will not cost observing time because it will piggyback on the observing program of the 85-foot telescope, which will be determined by astronomers' interests in the natural signals of the objects it is pointed toward. □

Dyes boost efficiency of solar concentrator

A transparent plastic seeded with dilute concentrations of dyes, such as rhodamine-6G, is able not only to concentrate sunlight falling on solar cells but also to extend the range of "usable" wavelengths (those able to transfer their energy to a silicon or other photovoltaic cell), according to Ahmed Zewail of the California Institute of Technology. (Photovoltaics transform light energy directly into electricity.) Zewail and colleagues Barry Schwartz and Terry Cole have seeded a plastic, polymethyl methacrylate with 0.0001 molar concentrations of each of three dyes. They found that certain dyes can convert energy entering the plastic at wavelengths around 4,000 to 5,000 angstroms —normally rather unusable wavelengths to silicon cells—to about 7,000 angstroms, a wavelength which silicon cells can convert to electricity with relatively good efficiency.

In this process, incident light absorbed by molecules of two "donor" dyes is transferred to molecules of a third, "acceptor" dye. The acceptor in turn re-emits light at "near the narrow wavelength band most efficiently used by silicon cells," about 7,500 angstroms, Zewail says. The smaller the mismatch between the wavelength emitted by acceptor molecules and the narrow wavelength band preferred by the silicon cells, the better the solar-cell conversion efficiency, Zewail told SCIENCE NEWS.

Implanting a dye in plastic is not new, although harnessing a combination of them in a single concentrator like this is, Zewail says. The Caltech team plan to add more dyes in an attempt to further extend the range of usable wavelengths to between 3,500 and 7,000 angstroms.

Because the refractive index of the plastic is so different from that of air, about 75 percent of the "usable" incident light gets trapped within the concentrator where it makes its way, by in-

ternal reflection, to the edge of the sheet. There it is reemitted, appearing as a bright glow. As a result, narrow strips of silicon only need to be placed below the edge of the collector, thereby greatly reducing the quantity of silicon-material needed and the cost of the solar collector.

Zewail says the concentrator enhances the efficiency of silicon cells by a factor of three and concentrates the flux of light at the edge of the concentrator, relative to that incident upon it, by a factor of 100.

This may offer a great advantage over the range of Fresnel and other lenses being developed for solar collectors. "Lenses are extremely expensive to manufacture, for each lens must be precisely ground," Zewail says. "By contrast, sheets of this plastic collector material could be mass produced for a fraction of the cost." And "while lenses focus usable light on solar cells, they also focus short-wavelength, high-energy light, which causes excessive heating of the silicon cell, greatly reducing its efficiency," he says. This concentrator eliminates overheating by dissipating heat over the concentrator's large surface area.

Because light from any angle is funneled to the plates's edge, a solar collector using this concentrator can be used even on cloudy days without need for costly equipment to follow or track the sun, Zewail says. There is still much engineering needed before the concentrator will be offered commercially, so Zewail is unwilling to speculate on the eventual cost or date at which it will be available. He said, however, that dyeing the plastic involves no special engineering problems and that the cost of materials involved in its production is "terribly cheap." Zewail and his colleagues in Caltech's chemistry department will soon begin working with engineers at the Jet Propulsion Laboratory. JPL will "investigate the practical aspects of the concentrator," he says and "do the engineering."

Among problems yet to be worked out are which dyes to use and at what concentrations to obtain optimum optical efficiency in conversion of light to electricity. In addition, Zewail says they plan to "play with the shape of the concentrator," to find the one that most efficiently enhances energy output. JPL plans to investigate ways of capturing dissipated heat to further increase collector efficiency.

In speculating on an eventual application, Zewail says it may be possible to use a window covered with the plastic concentrator to one day power small appliances such as a television. □

David's debut into the world

In 1971, a Houston couple gave birth to a child suspected of having combined immunodeficiency disease—that is, no immune protection whatsoever against infections. Immediately after birth the infant was put in a sterile environment at St. Luke's Hospital in Houston where physicians tested him for the disease. He had it, but the doctors could not give David, as the infant was called, the bone marrow transplant he needed to correct his disease, since he did not have a sibling whose marrow was immunologically compatible with his. Nonetheless, they hoped that marrow transplant registries would eventually identify the ideal marrow donor for him or that some other treatment for his condition might be devised. It was decided that until that time came David should live in a germ-free bubble at the Texas Children's Hospital in Houston, the clinical research center for Baylor College of Medicine.

By 1974, a solution to David's disease had not been found, but he was alive and well in spite of the accidental acquisition of some microorganisms that had leaked into his germ-free environment. What's more, he was not only normal but apparently psychologically advanced for his age (SN: 5/2/74, p. 335).

Now, at age six, David is still waiting for a cure for his disease, living six weeks in his bubble at Texas Children's Hospital and six weeks at home in a portable isolator. He has lived in a germ-free environment longer than any other person in history. However, he has experienced some changes in his immune system that might possibly indicate the natural development of some immune responses. He continues to develop exceptionally well psychologically, studying mathematics, reading, social studies, language skills, art and music. He excels in memorization, vocabulary and imagination. David is now making his debut into the world outside his isolator for the first time, courtesy of a germ-free suit unveiled to the press last week.

Texas Children's Hospital

Four years ago, scientists at the National Aeronautics and Space Administration's Johnson Space Center near Houston and at the Baylor College of Medicine began investigating the possibility of using space age technology to help David stay infection-free while participating in schoolwork, social interactions, physical education and group