is director of the department of electrical engineering at Cornell, estimates that between one-fifth and one-quarter of the faculty members have expressed some interest in receiving SDI contracts. Those most likely to participate are concentrated in microwave and device physics and in particle-beam physics, Nation said.

At the University of Illinois, the petition had not made as much headway among engineers as at Cornell, but 53 out of 73 faculty in the physics department had signed as of end-September. Campus-wide, some 200 individuals had signed.

In addition to the Cornell–Illinois petition, the Union of Concerned Scientists has been circulating an "appeal by American scientists to ban space weapons," which has been signed by 59 US physicists, 20 of whom are Nobel prize winners. This appeal embraces antisatellite weapons as well as space-based missile defenses and says that both "would increase the risk of nuclear war and stimulate a dangerous competition in offensive nuclear arms." The appeal calls upon the US and USSR to "negotiate a total ban on the testing and deployment of weapons in space" and to "join in a moratorium on further tests of antisatellite weapons" to create a constructive environment for negotiations.

In Canada, petitions opposing space weapons also are circulating. A national petition signed by 750 science and engineering faculty members asserts that SDI escalates the arms race and violates the 1972 ABM Treaty. Individual petitions circulating at the University of Toronto and McMaster University have attracted 450 and 650 signatures, respectively.

A counter-petition drive? Despite the evident desire of petitioners to bring moral pressure on scientists who are contemplating SDI work, the launching of a counter-petition in support of SDI or the right of researchers to choose SDI work is not considered very probable among persons who have been involved in or affected by the petition drives. One reason, says Joseph M. Ballantyne, vice-president for research and advanced studies at Cornell, is that there is in his opinion no real threat to scientists who want to do SDI work. Ballantyne observes that some anti-SDI forces at Cornell originally wanted to ban SDI research from the campus but then backed off, he believes, because they concluded, on reflection, that making research decisions contingent on political and moral considerations would create an administrative nightmare and set a dangerous precedent.

Gronlund, coauthor (with David Wright) of the Cornell petition, has not detected any eagerness on the part of physicists at Cornell to rush to the defense of SDI. Kogut, the initiator (with Michael Weissman) of the Illinois petition, reports much the same experience. He could imagine a counter-petition drive, but does not anticipate one. The scientific arguments against SDI are so compelling, Kogut feels, that few physicists would be eager to publicly defend the general concept of space-based defenses, even if they were interested in working on projects supported by SDI.

One physicist who emphatically supports that assessment is Sheldon L. Glashow of Harvard University. "I would give Star Wars a 'D,' " Glashow told *The New York Times* in September, "because it is a danger to peace, a disinclination to arms control, deleterious to American science and it is destabilizing, dumb and damned expensive."

Glashow told PHYSICS TODAY that he hardly ever gives Ds, though he conceded that he has done so on occasion. Asked whether there is not a somewhat moralistic tone to the anti-SDI petitions, Glashow expressed the belief that physicists regard the idea of a foolproof missile-defense system as an insult more to their scientific judgment than their moral sensibilities.

Not every physicist agrees that the prospects for Star Wars are so hopeless or that the issue deserves a substantial investment of political capital by scientists and engineers. But it remains to be seen whether or not there will be any kind of direct challenge from physicists to the petition drives.

—WILLIAM SWEET

US test of ASAT dims prospects for comprehensive treaty

The test on 13 September of a US antisatellite weapon against a target in space was a setback and disappointment for the scientists who have been trying for the last three years to persuade the government to negotiate a comprehensive treaty with the Soviet regime to ban ASATs (PHYSICS TODAY, November 1984, page 99).

In 1983 and 1984, science lobbyists helped persuade Congress to limit the President's authority to order ASAT tests. The USSR had tested missile-launched ASATs, but the US was developing a more versatile weapon. Now that this weapon has been tested, there may not be much prospect of negotiating a treaty that would ban ASATs capable of knocking out satellites in low orbits.

The ASAT restrictions enacted by Congress last year limited the number of tests to three in fiscal year 1985. The legislation required the President to make a certification to Congress, no less than 15 days before a test of an ASAT against a target in space, that the test was in the national interest and that the government was attempting in good faith to negotiate the strictest possible ASAT limits.

Early this year, the US government tested an ASAT against a point in space, but planned tests against a target were repeatedly delayed, reportedly because of problems with both the proposed target—a balloon-like satellite with instruments—and the ASAT system itself.

On 20 August, shortly after Congress recessed for the summer, the Reagan Administration announced its intention of conducting a second ASAT test, this time against a target in space. The certification that the Administration sent to Congress said that the Administration was trying in good faith to negotiate "the strictest possible limitations on antisatellite weapons consistent with the national security interests of the United States," and then went on to say, in effect, that no ASAT limits would be in the national interest.

"The United States must develop its own ASAT capability in order to deter Soviet threats to US and Allied space systems," the certification said. "A number of serious problems, including definitional and monitoring difficulties, plus the need to counter existing Soviet targeting satellites, contribute to the conclusion that a comprehensive ban on development, testing, deployment and use of all means of countering satellites is not verifiable or in our national security interests."

The test orginally was scheduled for 4 September, the day Congress reconvened, but then was cancelled at the last minute, the official explanation being that the Air Force counted to 15 incorrectly and failed to realize that only 14 days had elapsed since the Presidential certification.

By this time it was known that the target for the test was to be an old satellite, not a special test target, which enabled John Pike at the Federation of American Scientists to predict by a process of elimination that the test would take place on 13 September.

In a last-ditch effort to block the test, the Union of Concerned Scientists and Representatives George E. Brown Jr, Joe Moakley, Matthew F. McHugh and John F. Seiberling brought a Federal suit claiming that the Administration's

certification failed to meet Congressional requirements. On 12 September, District Judge Norma Johnson rejected the motion on the grounds that the issue was mainly a "political question," that the plaintiffs lacked adequate legal standing and that she found little evidence the test would do "irreparable harm."

The test took place the following day, as Pike predicted, though he was off by a few hours. A week later it was disclosed that the target was a working satellite that was producing scientific data until the moment it was destroyed (see box).

The science lobbyists and members of Congress who worked hardest for adoption of ASAT restrictions remain determined to carry on with the battle, and some cling to the belief that the latest episode has strengthened their position. As a member of Representative Brown's staff saw it in early October, the Presidential certification proved that nothing less than absolutely restrictive legislation will inhibit ASAT testing and promote negotiation of a treaty. Pike agreed, and he thought there definitely was a chance that the House would attach an ASAT moratorium to the fiscal 1986 budget legislation, "though whatever passes will get a rough handling in conference," he noted.

The dominant view among Congress watchers at the beginning of this fall was that everything would depend on the Geneva summit. In the estimation of a Democratic staffer for the Senate Foreign Relations Committee, the President had a kind of honeymoon until the summit, partly because his Administration "has been pretty good at portraying itself as serious about negotiations." If the President manages to maintain that image at Geneva, most observers believe, there is little chance that Congress will place tighter restrictions on ASAT testing.

A month before the summit, the Reagan Administration was sending very mixed signals on whether space weaponry would be negotiable, and at that time nobody was known to be privy to the President's innermost thoughts.

Asked about the mixed signals, a State Department official who works on arms control at a high level said at the end of September, "It doesn't look any different on the inside than it looks on the outside." The situation reminded him, he said, of the series Doonesbury cartoonist Gary Trudeau did some time back, in which a television news reporter conducted a tour of Reagan's brain cells. Everybody wished they could read the President's mind, the official implied, but nobody could.

—William Sweet

Interceptor destroyed working satellite

The Air Force satellite that was destroyed in the ASAT test on 13 September was launched in 1979 with an anticipated maximum lifetime of three years. In announcing the test, a top Air Force officer said that the satellite had "outlived its usefulness," but a week later it was disclosed that the satellite was providing data on solar activity until the moment it was hit.

The P78–1 satellite was launched in 1979, and its most highly publicized discovery, perhaps, was the solar-grazing comet—comets that pass very close to the Sun or actually hit it. The satellite carried instruments for the Air Force and the Naval Research Laboratory, the two most important of which were a gamma-ray spectrometer, operated by DARPA, and the Solwind coronagraph, operated by NRL. According to an Air Force spokesman, the satellite was still transmitting data from these instruments when it was hit, but returns from the other experiments on board were marginal, partly because of battery problems that developed in 1980.

According to Robert M. MacQueen, director of the High Altitude Observatory at the National Center for Atmospheric Research in Colorado, the Solwind coronagraph was producing data of continuing importance to the study of solar mass ejections, phenomena first discovered in the early 1970s by the OSO–7 and Skylab spacecraft. Such ejections are now known to occur on an average of every 20–40 hours and consist of large quantities of coronal material that are projected out into interplanetary space.

The main sources of data on the ejections, MacQueen says, have been interplanetary spacecraft equipped to study particles and fields, especially the European Space Agency's Helios; a ground-based k–coronameter, operated on Mauna Loa by the High-Altitude Observatory, that can collect data from the Sun's innermost corona; Solwind, the satellite just destroyed; and the Solar Maximum satellite, launched in 1980.

Solar Max carries an instrument that is both a coronagraph and a polarimeter. It observes the Sun at roughly 1.6 solar radii from the Sun's center out to six solar radii. The Solwind coronagraph observed the region from about three to ten radii. Thus, the two satellites could be considered complementary.

"The beauty of the two instruments together," MacQueen says, "is that as the solar ejections propagate out through the corona they both evolve in their own characteristics and they influence the corona in different ways depending on what the particular magnetic configuration is near and further away from the Sun. The two instruments permit a very complete picture as the propagation occurs and as the corona responds—a picture that encompasses a broad domain of variables. For example, the coronal electron density drops by almost four orders of magnitude from the inner corona out to ten solar radii; the coronal magnetic field drops by about two orders of magnitude over this distance. Therefore, when you see what might be a magnetic disturbance—a coronal mass ejection—propagating through the corona, you have a wide range of physical variables over which to test hypotheses about how such magnetic ensembles should respond."

Solar Max failed six months after its launch in 1980 and did not resume transmitting data until nearly four years later, when it was repaired by a Shuttle crew. Fortunately, Solwind worked well beyond its planned lifetime. Together the two satellites produced correlative data for six to nine months during 1980 and from April 1984 to 13 September 1985, when Solwind was destroyed by an ASAT interceptor launched from an F-15 fighter.

Naturally, opinions differ drastically between the Air Force, on the one hand, and the High Altitude Observatory and NRL, on the other, about the value of the data lost. NRL officials are said to be bitter because they made a rather perfunctory recommendation this year that the satellite be retained in service, not realizing it was in jeopardy. Then, when the Air Force warned them that Solwind would be terminated sometime after 1 August, the name of the satellite was classified, making it impossible for NRL to seek outside opinion or solicit the kind of peer review that NASA ordinarily orders when it is considering shutting off a satellite.

MacQueen feels it is a shame to lose any instrument in space at a time when NASA is accused of skimping on space science generally and solar science in particular. "Right now, given the state of the space science program at NASA, I just hated to see a functioning satellite that was giving useful and, I think, important data shot down," MacQueen said. If Solar Max were to fail again, MacQueen notes, "we would be completely blind in observing the outer solar corona."

An Air Force spokesman points out that scientists were lucky to have gotten data from Solwind so much longer than planned or expected. The Air Force considered data from Solwind relatively unimportant because, after all, Solar Max is working very well now. The Air Force spokesman said it was his impression that Solwind data from the last three years has never been processed. As for concerns among NRL scientists about knocking out a satellite that was still sending back signals, "We needed some telemetry to let us know whether we had accomplished what we were setting out to do," the spokesman said.

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in brief

McGraw-Hill Publications Company has started a quarterly magazine, *Commercial Space*, which is to report on business developments relating to space. The magazine is produced by the editors of *Aviation Week & Space Technology*. □