X-ray stars go, astronomers scattered over a large part of the Western Hemisphere are engaged in an effort to take simultaneous pictures of the one called Sco X-1 at wavelengths from the X-ray to the visible.

Sco X-1, in the constellation Scorpius, is one of the easiest to watch and longest known of the X-ray stars. It was first found by X-ray observers in 1962. A few years later, after the location had been determined precisely enough, it was identified with a faint bluish object that showed up on the plates of the 200-inch telescope at Mt. Palomar, but which no one had noticed.

Sco X-1 has been known to flare up to twice its normal brilliance from time to time. The astronomers would like to get a set of simultaneous pictures of such a flare at X-ray, visible, infrared and ultraviolet wavelengths.

To catch a flare in progress, Sco X-1 must be continually watched. Since it is seen best from the Southern Hemisphere, the monitoring has been underway since May 9 with the 60-inch telescope at Cerro Tololo Observatory in Chile. Dr. W. A. Hiltner of Yerkes Observatory is at Cerro Tololo supervising this work, and he calls the signals for the other participants.

When Dr. Hiltner sees a flare, he will notify astronomers in Hawaii, California and Wisconsin. From Hawaii a rocket will be sent up to get the X-ray signals. California astronomers will use the 200-inch telescope at Mt. Palomar for photographs in visible and infrared light. The Wisconsin group has equipment on the Orbiting Astronomical Observatory that is now circling the earth, and they will order it to take pictures in ultraviolet light.

Meanwhile cameras at Cerro Tololo will also take pictures in visible light.

Putting all the pictures together will give the astronomers a composite portrait of Sco X-1's activity over a wide range of the electromagnetic spectrum, and they hope that from this they can learn important new facts about the physical processes in the object.

Radiation in each section of the spectrum comes from different sorts of physical processes. X-rays often come from energy changes in the nuclei of atoms, for example, while visible light is often produced by changes of the electrons around the nucleus.

The wavelengths of radiation that appear and their relative brightness will give astrophysicists information about the physical processes that produced them. With a simultaneous picture over the widest possible spectral range they hope to get the most complete idea possible of all the physical processes going on at one time and thereby a comprehensive picture of the object.

ABM

Down to the wire

For some weeks, the controversy over the antiballistic missile system, with occasional eruptions, simmered on the back burner. Opponents reiterated their objections to the program and Administration spokesmen repeated their concern that the Soviet Union was preparing for a first strike. Newspapers carried stories of possible compromises in the wind, emphatically denied by both sides of the controversy in the next editions.

But last week the ABM war began to boil over as opponent Sen. Edward M. Kennedy (D-Mass.) released a book-length report, summarizing the arguments against the system. The report is likely to become the focus of the controversy as it makes its radioactive way toward a Senate vote by late May or June.

The sizzling tone of the battle was quickly set by Dr. John S. Foster Jr., director of defense research and engineering, who called it erroneous and inconsistent. He doubts, he said, whether it could meet "the standards of the scientific profession," given the short time taken to prepare it. He also said there was nothing in the report that hadn't been "analyzed in depth . . . over the past 10 years."

In fact, the report contributes very little that is new to the anti-ABM position. It reiterates the argument that President Nixon's Safeguard system is neither fish nor fowl, unable to protect U.S. cities against a Chinese attack or to guard retaliatory Minutemen missiles very effectively from a Russian first strike. It challenges the Administration claim that Russia may be preparing a first strike capability. It attacks the technical feasibility of the system and reprints an authoritative article by Nobelist Hans Bethe on the countermeasures that can be taken to fool the defense (SN: 3/23/68, p. 279). And it repeats the argument that deploying the weapons system would start a new spiral in the arms race, scuttle the possibility of arms limitations talks with the Soviet Union and lead to the failure of the Nuclear Non-proliferation Treaty by convincing non-nuclear nations that the big powers were not serious about disarmament.

"It is hard," say the report's editors, Dr. Jerome Wiesner, provost of the Massachusetts Institute of Technology, and Dr. Abram Chayes of Harvard University, "to understand why a system with so many such obvious defects . . . should command continuing support from military leaders, and in the last few years from political leaders as well."

One anti-ABM argument that has not been emphasized by opponents is the question of reliability of computer programs in complex systems, particularly in systems which have to be on the alert continually. Physicist Leonard S. Rodberg of the University of Maryland points out in the report that complicated, high-speed computer operations require so-called software, programmed instructions to the computer on how to analyze incoming data, that inevitably contains mistakes or bugs. Debugging computer programs is a long and tedious process, and is virtually impossible without repeated testing and operation. Opportunities for testing and trying out a full ABM system simply do not exist, argues Dr. Rodberg; hence the reliability of the system in emergency conditions is doubtful.

Another problem with such a large system is the need for constant readiness, Dr. Rodberg asserts. Pointing to other weapons systems which operated under similar conditions, such as the Ballistic Missile Early Warning System (BMEWS) and the Strategic Air Command Control System (SACCS), he argues that repeated experience has shown that continual readiness is an intolerable burden on a computer system. Such a load is not present, he points out, in the successful U.S. space programs, which operate on a fire-when-ready basis.

"To put SACCS-like software into an ABM system would be folly—potentially hideous folly," he says. "To put perfected software into an ABM system would be—and this is the consensus of experienced system programmers—impossible. There is no prospect for wholly perfecting any large software system in the next decade."

But it is just this kind of argument —that bugs can only be worked out by testing and operation—that is the backbone of the ABM-builders' insistence that now is the time to deploy. The systems engineers insist that, even if the present design won't work, it is necessary to start now so that, by the time the design is perfected, some of the bugs will also have been discovered and eliminated.

Although this point will probably not be emphasized in the weeks to come—it is not as politically forceful as a threat from Russia—it is the one that most propels the ABM proponents. And if Safeguard's defeat appears likely, the build-it-now argument will probably lead to compromise, on the grounds that any construction, no matter how restricted, will be better than none.