RADIO ASTRONOMY

East-West baseline

Soviet and U.S. astronomers cooperate on small sources

by Dietrick E. Thomsen

Long-baseline interferometry makes the world its radiotelescope.

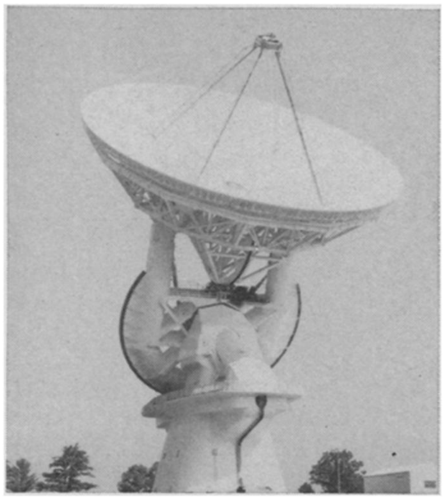
Combining signals from two observatories spaced far apart, astronomers can distinguish small objects as well as they could with a single telescope as big as the distance between the two (SN: 10/13/67, p. 370).

To take full advantage of the technique, the telescopes should be as far apart as possible. This requirement even overrides political differences and is providing one of the smoothest examples of Soviet-American cooperation, with joint observations by the National Radio Astronomy Observatory at Green Bank, W. Va., and the Crimean Astrophysical Observatory at Simferopol in the U.S.S.R. The project, which involves reciprocal visits by personnel and use of American equipment in the Crimea, was planned by scientists who knew each other and were able to get the approval of their respective governments.

Radio astronomers have practiced interferometry for years, but until recently telescopes used for the purpose had to be connected by a cable or microwave link. This limited distances between telescopes to a few tens of miles at most.

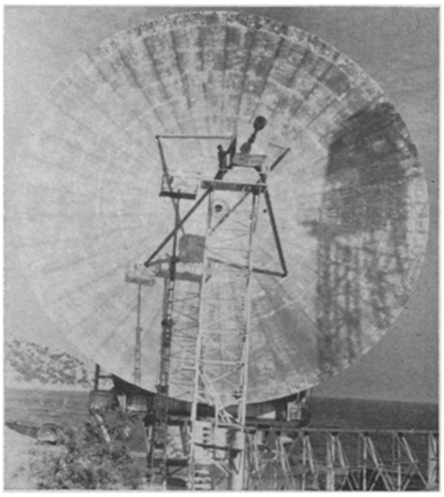
In the last few years improvements in highly accurate atomic clocks have made it possible to combine recorded signals by computer after the fact rather than having to combine live signals at the time of observation. With this technique the distance between telescopes—the interferometry baseline —can be the diameter of the earth. That is the longest distance (until there are radio telescopes on the moon) between two telescopes that can see the same object at the same time.

The United States and the Soviet Union are on opposite sides of the world, and the Green Bank-Crimea cooperation is the longest baseline interferometric observation yet attempted, a distance of about 6,000 miles.



NRAO

Green Bank is one end of the line . . .



Novosti

. . . Crimean Observatory is the other.

Green Bank has done intercontinental interferometry in the past with an observatory in Sweden, nearly the same distance away. This time, says Dr. William Howard, assistant to the director of NRAO, "It was necessary to use the Crimean because no one else in that part of the world has a big enough telescope for three-centimeter waves."

The point is that for a given baseline, the shorter the wavelength of observation the better the resolution will be. The resolution criterion is the number of waves that could fit in the distance between the telescopes. Using three-centimeter waves will give the Green Bank-Crimea observations a resolution of 0.0003 to 0.0005 second. Before long baselines, one second was the best resolution in radio astronomy.

This experiment is looking for structure in the smallest radio sources there are, especially quasars and Seyfert galaxies. These may be a first look at young sources. "Radio sources are apparently born small and increase in size as they age," says Dr. Howard.

"The purpose of our study," says Dr. Marshall Cohen of California Institute of Technology, one of the participants, "is to learn something about the mechanics of the explosions that seem to be associated with such objects as quasars and to find out something about their structure."

One of the results of measuring the diameters of quasars, says Dr. Howard, will be an independent check on their distances, one of the hottest arguments in astrophysics at the moment (SN: 11/1, p. 406).

By current cosmological theory the farther away an object is, the more will its light be shifted toward the red end of the spectrum. Some quasars have bigger red shifts than any objects ever seen, and this leads some observers to place them at the edge of the observable universe and to consider them important to such questions as the history of the universe and the curvature of space.

Other observers object that quasars are apparently very dense bodies with strong gravitational fields, and that some of the red shift should be attributed to the effect of gravity on the emitted light. On this argument the quasars would not be near the edge of the universe at all.

To check the distance, observers start with the variations in a quasar's emission. If a quasar's radiation varies with a period of, say, four days, then the radius of the quasar can be no greater than four light-days. If it were greater, coherent variation on a four-day scale would be impossible.

Knowing the maximum possible actual size of the object, observers can use its apparent size to determine a maximum possible distance. This can then be compared with the distance calculated from red shift.

American participants in the observations are Dr. Cohen, Drs. Kenneth Kellerman and Barry G. Clark of NRAO, and David Jauncey of Cornell University. Russian participants are Drs. Leonid Matveyenko, Nikolai Kardashev, Viktor Vitkevitch and Ivan Moiseev. Drs. Clark and Kellerman are now in the Crimea. They took with them a rubidium vapor frequency standard to time the observations and an interferometric receiver to be plugged into the Russian telescope. Drs. Matveyenko and Kardashev are expected to arrive at Green Bank later on Nov. 3.

Preliminary observations were done at six-centimeter wavelength between Oct. 15 and 21. It was run, says Dr. Howard, "even though it's not the best resolution. It will give information but will not be as good." The six-centimeter data showed interference fringes, which means that the interferometry is successful. Three-centimeter observations started Oct. 24 and ended mid-day of Nov. 1. Results are expected about the middle of November. □