managing to lose his job.

Most of the Arecibo effort on extraterrestrial intelligence has been devoted to looking for signals rather than sending them. Drake and Sagan are looking at four frequencies: 1420 MHz (21-cm line of hydrogen), 1667 MHz (spectral line of the OH radical), 1652 MHz (where no observations have yet been made; the frequency is associated with the center of gravity of the H_2O molecule and is in the middle of the so-called "waterhole"), and 2380 MHz (which happens to be one of the antenna's radar frequencies). At all but the last frequency, the system noise is 100 K; at 2380 MHz, it is 42 K. A 1008-channel receiver was used. All frequencies have a bandwidth of 1 kHz—much less than that used in other searches, but still too wide, Drake believes. They observed with a 32-second integration time, making two independent samples and inspected the results immediately on an oscilloscope. If something looks interesting, the observers can look again promptly.

The observers looked for signals from nearby stars, such as Barnard's star, which they would have been able to detect with an effective isotropic radiative power greater than 10^{10} watts (10^{-3} Arecibos).

They also searched in four nearby galaxies, testing 10^{12} stars. These were Messier 33, Messier 49, Leo I and Leo II; the nearest is 1.5 million light years away. They are able to detect a power equivalent to 200 million Arecibos—something far beyond our technology. In the course of their observations, Drake and Sagan saw what appeared to be an intelligent signal coming from six different directions in Leo I. To their dismay, the signal turned out to be a terrestrial source intercepted by the sidelobes of the antenna.

The final speaker was Philip Morrison (MIT), who is chairman of a NASA advisory committee that is examining observational strategies. He noted that we should not be looking for a signal, but a high gradient in the signal. Morrison feels that we are still in the pioneering stage of the search. The second stage requires dedicated instruments: he would like to see a small, dedicated enterprise built now. —GBL

Group meets in USSR on Very Big Accelerator

This month, beginning on 17 May, an international study group will meet in Serpukhov in the Soviet Union, to discuss the prospects and possibilities of constructing a "Very Big Accelerator" by a world collaboration among many different countries. It would be a machine with much higher energy than any accelerator being planned by an individual nation.

In March 1975 a meeting was held in New Orleans, attended by about 25 high-energy physicists from the US, Western Europe, the Soviet Union and Japan to discuss various forms of international collaboration. The future development of high-energy physics was discussed, and many participants emphasized the desirability of extending the energy frontier beyond the limits presently available or recently proposed. any Many fundamental problems seem to require this extension for their solution, such as the question of the existence of a quantum of the weak interaction, the relation between the weak and electromagnetic interaction, and problems related to the quark hypothesis.

Many believe that national and regional authorities may no longer be willing to support projects that are considerably larger than those presently in existence or in the planning stage. Thus the Very Big Accelerator is being discussed.

At the meeting this month in Serpukhov, the American participants are expected to be J. D. Bjorken (SLAC), Robert E. Diebold (Argonne National Laboratory), Leon Lederman (Columbia University), Wolfgang K. H. Panofsky (SLAC), Victor Weisskopf (MIT) and Robert R. Wilson (Fermi National Accelerator Laboratory).

The international group will consider the possibility of building a proton accelerator of the order of 10 TeV (10^{13} eV) or an electron–positron colliding-beam device with each beam of about 100 GeV. Weisskopf emphasized to us that much of the discussion will probably focus on the best choice for an instrument and an energy range. To that end, the group is expected to consider the physics problems requiring higher energy and the numerous technical problems of achieving it.

"A world collaboration on the Very Big Accelerator," Weisskopf said, "would have important significance besides the mere scientific advantages, as a symbol of common human values beyond competition and strife, and as an example of intensive international collaboration across ideological frontiers." The former director of CERN said that the history of that laboratory has shown that high-energy physics is very conducive to such efforts because of its distance from commercial and military applications. There are many obvious political and social difficulties and problems in the way of such a project, Weisskopf notes, with little hope for an early realization. But, he feels, it is advisable to begin with this international study group.

Weisskopf urges that the vision of the Very Big Accelerator should not interfere in any way with further development of national or regional high-energy facilities. "Indeed," he says, "any international effort can be successful only if it is based upon well-developed national and regional research activities."

ERDA and the National Science Foundation are sponsoring the American participation. —GBL

Solar oscillations

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see at what frequencies there is significant power. Hill says that the Fourier transform is unaffected by the smearing effect of the terrestrial atmosphere.

The group, which consists of Hill, Robin Stebbins (National Center for Atmospheric Research) and Timothy Brown (High Altitude Observatory, NCAR), work at the Santa Catalina Laboratory for Experimental Relativity by Astrometry in Tucson. They made their initial announcement last June at the Fifth International Conference on Atomic Masses and Fundamental Constants, held in Paris. By now the group believes they have seen 20 modes in the 6–70-minute range. There is a broad peak at a period of 68.3 minutes, which the group feels may contain the fundamental acoustic mode. The longest period, Stebbins told us, that looks like it is clearly there is 109 minutes.

Hill says that the amplitudes of each period are all of the order of 5–10 arcmillisec out of a total solar diameter of 2000 arcsec. A naive interpretation of these results would mean that the sun was changing in size by 4–8 km during an oscillation. The Birmingham results for comparable oscillations imply size changes of the order of 0.4 km, Hill said; he explains the discrepancy by saying that the SCLERA group, unlike the Crimean and Birmingham observers, is not only seeing a deformation of the Sun itself, but also a change in the light-distribution curve. The whole sun is oscillating, he goes on, with waves reflecting in and out of the core. All one can see, however, is the outer 0.1%, and this outside portion acts like the end of a whip, moving with larger (but still relatively small) amplitude. Hill and his collaborators claim that the large amplitudes they see are primarily from brightness fluctuations caused by temperature variations. A small fraction of the amplitude, however, may be caused by an actual physical displacement, Stebbins says.

Most of the data were collected last October and November, when a typical run lasted 6–8 hours. The length of the data set determines the feasibility of observing longer periods. However, the SCLERA workers hope that they can string data sets from one day to the next by matching phases. If so, resolution of the period will be vastly improved. For example, the 68-minute period, which has an 8-minute uncertainty would, by linking three days, be defined to 0.75 minutes.

Stebbins outlined the group's arguments for believing that the pulsations observed are normal modes of the sun. He points out that other observers over the last 15 years have seen solar oscillations with periods of about five minutes, but Stebbins says that they were localized and lasted only a few cycles. More recently Franz-Ludwig Deubner (Fraun-