

RESEARCH FACILITIES AND PROGRAMS

Soviet 70-BeV synchrotron

While debate continues over authorization of a 200-BeV accelerator in the United States, Soviet scientists are continuing to build a 70-BeV proton synchrotron at Serpukhov, 100 kilometers southwest of Moscow. The Soviet scientists hope to obtain their first full-energy beams by the end of next year.

It will take three separate accelerators to produce the 70-BeV protons; a preinjector will make 700-keV protons, an injector will turn them into 100-MeV protons, and finally an alternating-gradient synchrotron (by dint of many, many turns) will produce 70-BeV protons.

In the preinjector the proton beam will be generated by a duoplasmatron ion source, then accelerated by a 700-keV pulsed high-voltage supply. The injector, a strong-focusing linear accelerator with three sections, will produce 100-MeV protons. The final stage, the synchrotron, will have a magnet ring 470 meters in diameter containing 120 magnet units. For injecting and extracting beams, the synchrotron will have long straight sections of 4.9 meters, medium straight sections of 2.6 meters, and short straight sections of 1.3 meters.

To produce the accelerating field, there will be 53 double resonators with ferrite rings. They will operate at the 30th harmonic of the revolution frequency and give a total voltage of about 350 kV. It will take 3.8 sec to accelerate to full energy, which will be available for up to 1.5 sec. The vacuum chamber will be 17 cm wide and 11.5 cm high, effectively.

Once the machine is finished its designers expect its maximum intensity, limited by space-charge effects, to be 10^{12} protons per pulse; repetition rate is 5 to 10 pulses per minute. Initially the designers expect only 10^{11} protons per pulse (there will probably be particle losses because of the relatively low magnetic field at injection).

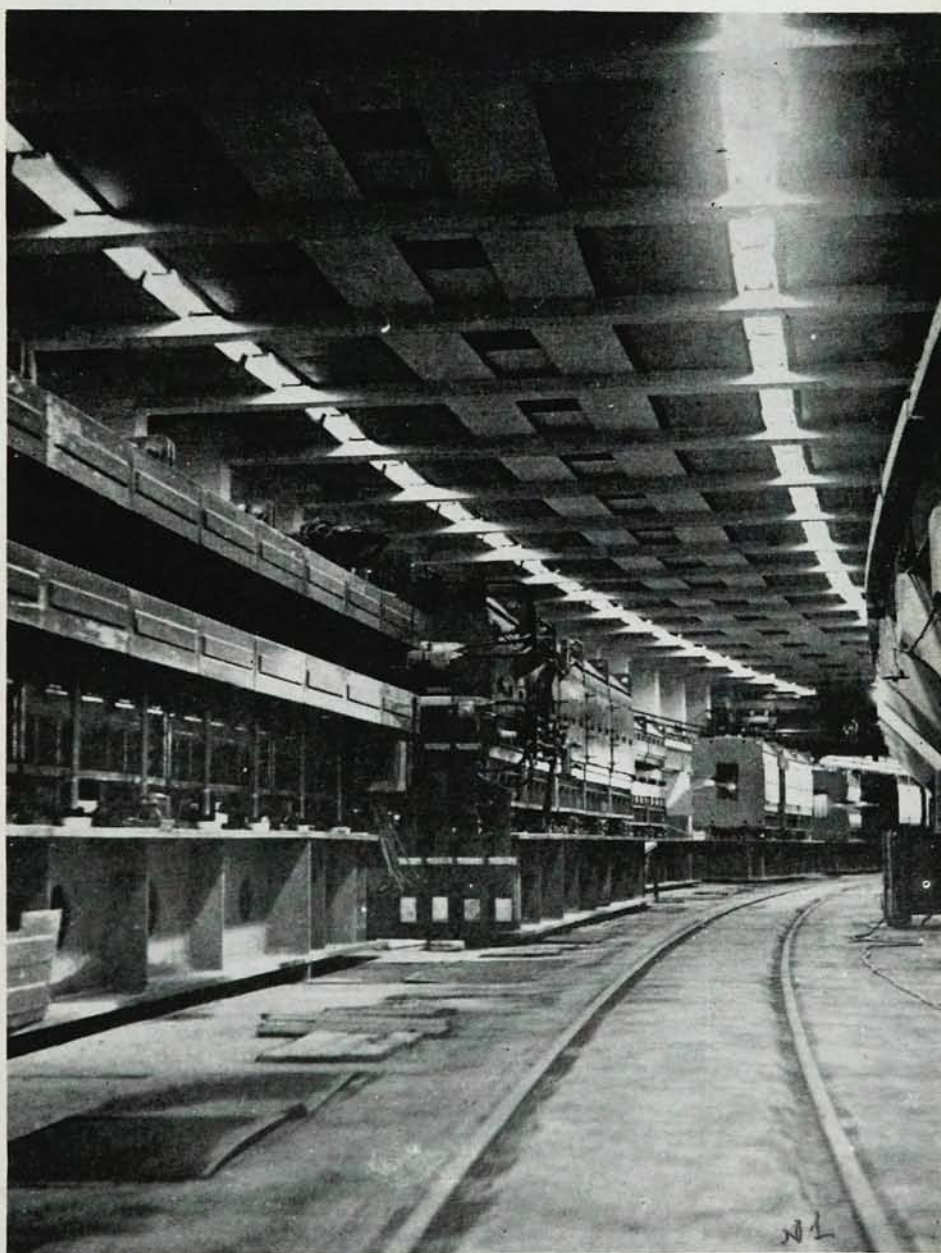
Recent visitors to Serpukhov noted

that the ring tunnel was finished and most of the magnets had been measured and placed in the tunnel. The magnets were being tested with an automated test bench and small on-line computer (whose punched cards looked just like western ones, except for the cyrillic characters on their faces). The copper rf liner of the linac's first section was being installed in its vacuum tank, and the preinjector was almost in operation. The building to house the linac was fin-

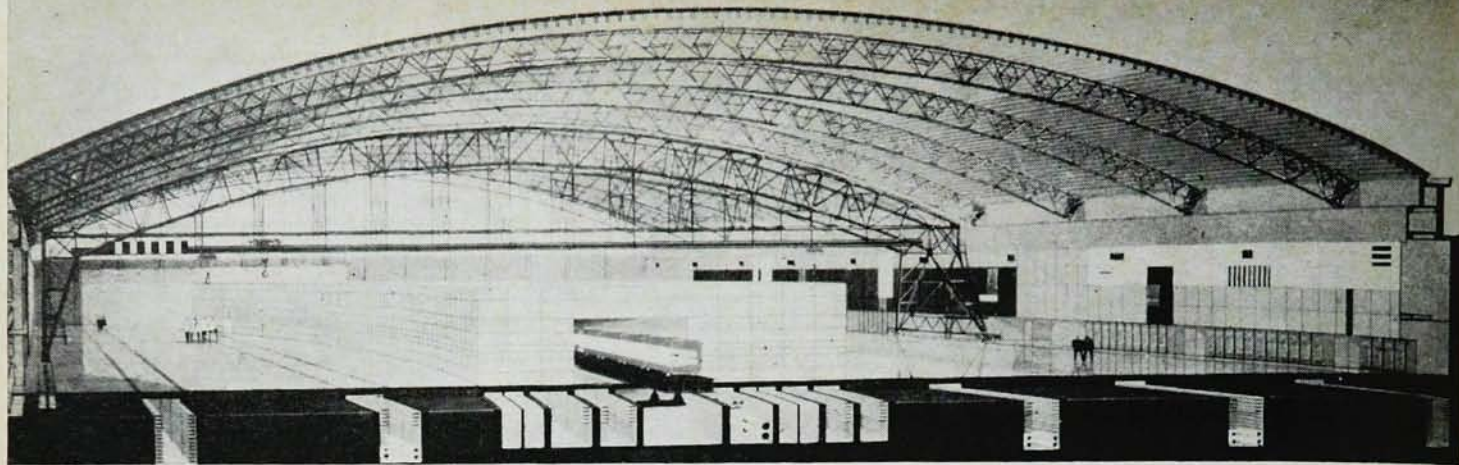
ished, as was a large experimental hall measuring 90 by 150 meters.

According to Yves Goldschmidt-Clermont of CERN, who recently visited the facility, designers are busy planning beam extraction; their job is complicated by the relatively short straight sections. By mid-1969, however, they expect to have a fast ejected beam for protons up to 40 BeV/c and a slow extracted beam up to 60 or 65 BeV/c.

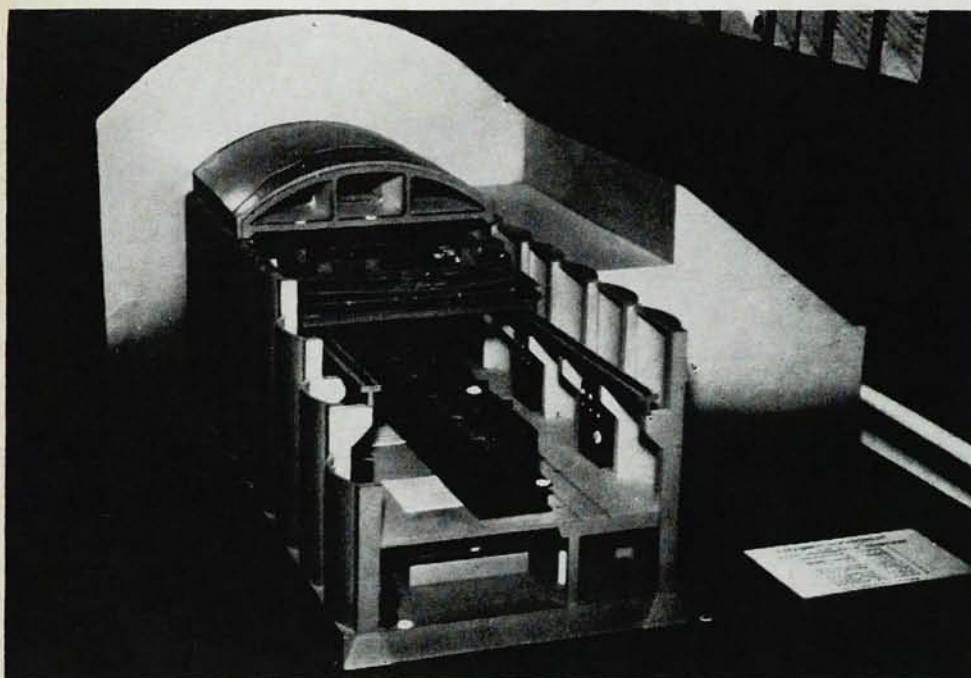
Other beams are being designed:



SERPUKHOV tunnel with magnets



SERPUKHOV experimental hall (artist's view)



MODEL of Serpukhov tunnel and magnets



VISITORS AND STAFF in front of the lab headquarters at Serpukhov: (l to r) B. Montague (CERN), A.A. Fillipov (Dubna), A. Rousset (Ecole Polytechnique

and CERN), A. A. Logunov (Serpukhov), M. Ferro-Luzzi (CERN), J. M. Perreau (CERN), Y. D. Prokoshkin (Serpukhov) and R. M. Sulaiev (Serpukhov).

- A high-energy unseparated negative beam (30 to 60 BeV/c) of π^- and p, produced by an internal target and aimed diagonally across the experimental hall.

- A high-energy unseparated positive beam (up to 40 or 50 BeV/c) from an internal target.

- Two electrostatically separated beams located towards the inside of the ring: one fully separated (up to 7 or 8 BeV/c), the other with one-stage partial separation and high flux (up to 15 BeV/c).

- An rf-separated beam that will probably be used with an external target and a bubble chamber.

Major detection equipment being built at Serpukhov includes a 4.5 by 1 by 1.5-meter heavy-liquid bubble chamber and a 6-meter magnetic spectrometer. It is also possible that a hydrogen chamber from Saclay and the 2-meter chamber being built at Dubna will be used at Serpukhov. Other detectors being developed are: total absorption spectrometer sandwiches for gamma-ray detection and digitized spark chambers.

Several experiments are already being prepared for 1968 and 1969. One experiment will measure total cross sections and elastic scattering with hodoscopes and an on-line computer. A neutrino experiment being planned will employ a 100-meter decay path, multiton spark chambers and the heavy-liquid bubble chamber.

Although the Serpukhov project started under the guidance of physicists from the Moscow Institute of Experimental and Theoretical Physics, it is now autonomous and known as the Serpukhov Institute for High-

10⁻¹⁸ AMPERES TO 1 MA BEAM DETECTION, ANALYSIS, AND MEASUREMENT

Energy Physics. Actual work on the site began in 1960.

Like all Soviet accelerators, the Serpukhov machine was designed in Leningrad, at the Research Institute for Electrophysical Equipment. Pieces of the accelerator are built by industry and then put together under the supervision of a large engineering firm. The minor modifications and repair usually needed during assembly are done at Serpukhov, where there are some limited workshop facilities.

A. A. Logunov is director of the laboratory, R. M. Sulaiev is vice-director and Y. D. Prokoshkin is director of research.

Argonne supermagnet

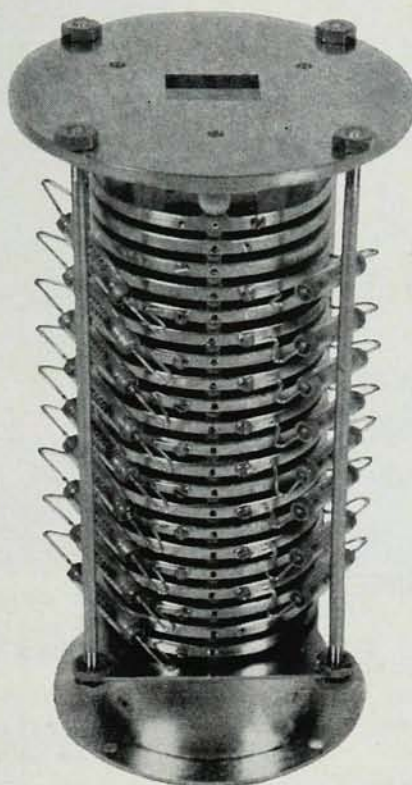
A superconducting magnet is being used for the first time in a high-energy experiment. Charles Laverick and Thomas H. Fields performed the magnet work at Argonne National Laboratory in collaboration with the staffs of Argonne and Carnegie Tech. The supermagnet provides the Argonne-Carnegie Tech 25-cm bubble chamber with a 44 000-gauss field for investigating hyperfragments that result from K⁻ capture by helium.

While development work is proceeding on a 100 000-gauss superconducting magnet for this chamber, tests are being conducted to determine the feasibility of using a supermagnet for a planned 3.6-meter bubble chamber. With their advantages of small size and economy, which results from very low power consumption, large supermagnets became feasible only after the development at Argonne of superconducting cables that could sustain the severe thermal and mechanical stresses to which they would be subjected.

Cosmic rays for high energy

The National Science Foundation has granted funds to investigate the feasibility of using cosmic rays to study particle interactions in the range between 100 and 1000 BeV. The project was proposed by Lawrence W. Jones of the University of Michigan and will be done under the auspices of the Midwest Universities Research Association. NSF gave \$279 800.

The idea of using cosmic rays was



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