logical investigation of space and planetary environments and their effect on human physiology, and proposed sending scientist-passengers into space along with trained astronauts on certain future missions.

Rf beam separator at Brookhaven

A new radio-frequency beam separator at Brookhaven National Laboratory has produced exposures of negative and positive K mesons at a momentum of 12.8 GeV/*c*, the largest momentum obtained to date with separated kaon beams. The separator, a joint project of the Brookhaven Accelerator Department and Yale University, was completed at the end of 1965. A similar instrument is in operation at CERN, producing kaon beams of 10 GeV/*c*. Before completion of the rf separator, Brookhaven used an electrostatic separator that produced kaon beams up to 5.5 GeV/*c*. The new facility will make possible studies of interactions of antiprotons, kaons, and pions at selected momenta between 7 and 18 GeV/*c*.

Both electrostatic and rf separators depend on the mass-dependent velocity differences among particles in a beam of well defined momentum. In an electrostatic separator, a static electric field is applied transversely to the flight of the beam. Particles of different velocities traverse the field in different times, and, in consequence, are deflected sideways by different amounts. An rf separator uses two short rf deflectors separated by a drift space. Here transit time determines the relative phase of the deflection, and the system has the advantage that the resultant deflection can be made twice the individual deflection for one type of particle at the same time as it is made to cancel for another. Furthermore, at high frequencies a small transit-time difference can correspond to a large phase difference.

In the Brookhaven separator, deflections are imparted to the particles by two iris-loaded waveguides, each 3 meters long, set 40 meters apart. The waveguides resemble electron linacs in their mechanical structure, but the power propagates as a hybrid backward wave. The travelling waves are synchronous with the particle and have a field configuration that provides aberration-free transverse deflections. The deflectors are powered from permanent-magnet focused klystrons capable of delivering 20 MW in pulses of 5 microseconds when triggered at the repetition rate of the alternating gradient synchrotron. The operating frequency of the rf source is 2.865 GHz, generated by a phase-locked source with quartz stability. For good particle separation, the amplitude and phase of the deflecting rf fields must be held constant to a high degree of accuracy, and to achieve this, many servo loops are incorporated in the equipment. Nevertheless, Brookhaven people say, the operation proved to be simple and reliable.

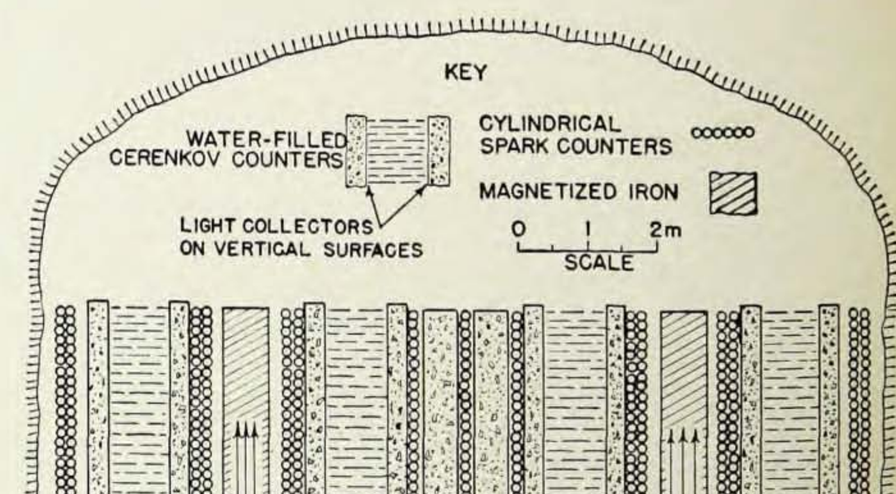
The separator was designed and developed by Harold Hahn and Henry Halama of the BNL Accelerator Department. The beam design was carried out by Horst Foelsche of BNL and Jack Sandweiss and Joseph Lach of Yale.

It's a spark, it's a pop, it's a neutrino

An underground cosmic-ray neutrinos detector is expected to start operation sometime this summer in a mine near the University of Utah. The installation, an array of counters $6 \times 12 \times 10$ meters, will actually count muons produced by interaction of neutrinos with the surrounding rock. The setup is biassed to favor muons coming from below the horizon so as to screen out muons from cosmic or other terrestrial sources. It will be used for investigations in neutrino astronomy.

At the heart of the device is a series of four water-filled Cerenkov counters with directional properties. These are $1 \times 6 \times 10$ meter tanks, two of whose vertical surfaces are lined with 113 light collectors each. The light collectors gather Cerenkov light produced by muons travelling transversely. The light collectors then trigger specially designed cylindrical spark counters.

The spark counters resemble giant Geiger tubes 15 cm in diameter and 10 meters long and have very thin (about 0.03 cm diameter) wires running along their axes. Fillings of 50 cm of argon and 25 cm of ethylene insure that the discharges, when the



NEUTRINO TELESCOPE arrangement at University of Utah