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Particles, Resonances, and New Data Analysis Devices Make News at CERN High Energy Physics Conferences

Advances on several frontiers of high-energy physics were reported by LRL scientists at two international conferences held at the European Organization for Nuclear Research (CERN) during July. Nineteen LRL scientists, representing several research groups, participated in the meetings, the CERN High Energy Physics Conference and the 1962 International Conference for Instrumentation in High Energy Physics (See MAGNET, July).

Highlighting the CERN proceedings were a number of reports on elementary particles and resonances, plus encouraging progress reports on two data-reduction devices (the Flying Spot Digitizer and the Scanning-Measuring Projector) currently under development at the Berkeley Laboratory.

"Better Than Expected"

Referring to the reports on new particles and resonances presented at the conferences, Victor S. Weisskopf, Director General of CERN, remarked, "The experimental situation now is very much better than any of us had a right to expect a few years ago."

Since 1960, scientists have discovered about 29 new particles and resonances (very short-lived particle states), bringing the total number now known to 75. Twenty-one of the recent discoveries were made by LRL Berkeley scientists, and four more by a UCLA group using Berkeley experimental apparatus. Resonance work at Berkeley has chiefly been carried out in the Alvarez group.

As a result of the recent work, the news from CERN revealed, high energy physicists appear to be surrendering the distinction they once made between elementary particles and resonances. The strong trend of opinion now suggests that the "elementary" particles are no more elementary than the resonances. The concept of a table of 75 particles without the former distinction is meeting with growing acceptance.

Commenting on the CERN discussions, Berkeley Theoretical Group Leader Dave Judd expressed hope that "it may be possible soon to develop a systematic understanding of the complexities . . . in high energy particle phenomena."

Flying Spot Digitizer

Other significant news coming out of the CERN conferences centered on two data-reduction systems currently nearing completion at LRL Berkeley. The two systems are the Flying Spot Digitizer (FSD) and the Scanning-Measuring Projector (SMP), two independent approaches to the problem of high-speed measurement and analysis of bubble-chamber film data.

Howard White, formerly of the Powell-Birge Group and now leader of Berkeley's new Data Handling Group, reported up-to-the-minute developments in the FSD, due to begin full-scale operation on the Hill within the next few months.

Flying Spot Digitizer development is a joint effort of LRL Berkeley, CERN, and Brookhaven National Laboratory. Core of the FSD system is the "Hough-Powell Device," originally proposed in 1960 by P. V. Hough of Brookhaven and B. W. Powell of CERN. The device consists of a mechanically-generated "flying spot" which performs a television-like scan of bubble chamber films. The "flying spot" is generated by projecting light from a mercury vapor arc lamp through an aperture formed at the intersection of two crossed slits, one fixed and one mounted upon a rotating disc. As the spot sweeps across a frame of bubble chamber film, its image is simultaneously focused on a precision grating. By measuring the position of the spot on the grating at the time the companion spot is centered upon a track, the position of the track being "read" can be determined to a high degree of accuracy.

A series of informal meetings at Berkeley and at Brookhaven during

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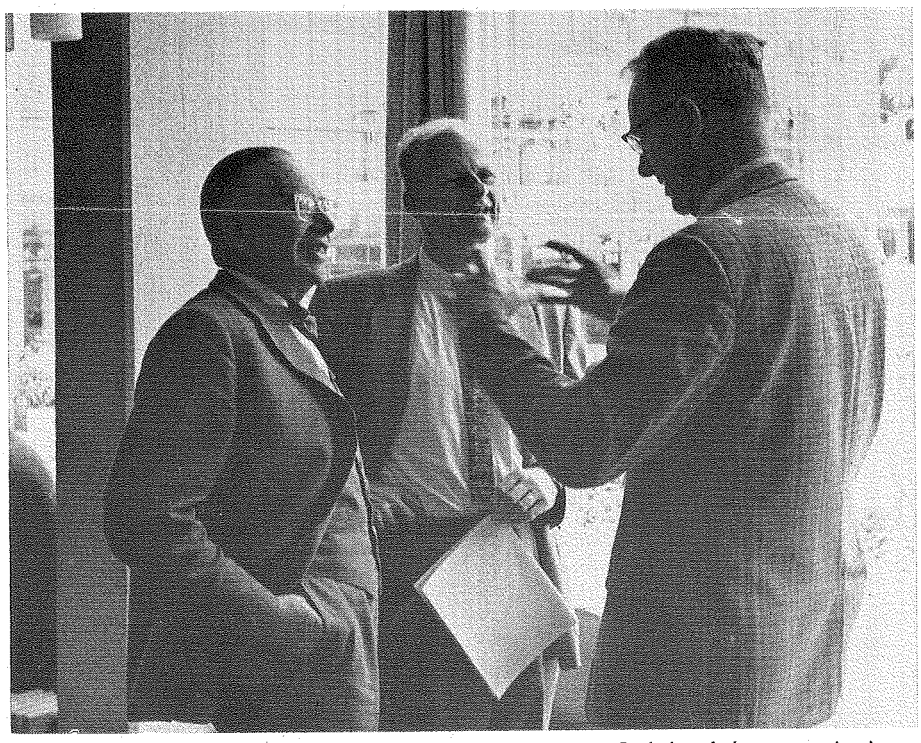

THE FACES ARE FAMILIAR—but the setting is Geneva, not Berkeley. Laboratory scientists Emilio Segrè (l.) and Luis Alvarez (r.) were snapped by a CERN *Courier* photographer as they greeted old friend and associate Hans Bethe in the entrance hall of the CERN Administration Building during High Energy Physics Conference.

New Data Analysis Devices . . .

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White's report at the July CERN conference, should considerably reduce bubble chamber data analysis time at the Laboratory. Under the system currently in use here (see MAGNET, April 1961) scanning (by manual procedures), measuring (by the Franckenstein measuring device), and data analysis (by the 7090 computer) are three separate operations, requiring an estimated total of 15 minutes per event measured. Under the FSD system, scanning should require about four minutes per event, and measurement and analysis will be combined into a single, 25-second operation. It is expected that future developments in the FSD will bring the scanning operation within the scope of the automatic system as well.

LRL personnel who have made important contributions to the FSD development program include, besides Howard White, the following scientists, engineers, technicians, and programmers:

Toby Aronstein, Alex Babin, Art Barnes, Gene Binnall, Jim Braley, Paul Broadhead, Lou Flores, Ed Fong, Jack Franck, David Gumz, Ray Kenyon, Worley Low, Charles MacDonald, Frank Neu, Carol Osborne, Nels Peterson, Franz Plunder, Matt Renkas, Sig Rogers, Jerry Rosenthal, Bob Rozzano, Robbie Smits, Tom Taussig, Fred Toby, Mike Torrano, Marcel Vanderbeck, Ray Weber, Lauren Yazolino.

Scanning-Measuring Projector

Another approach to bubble-chamber film analysis was presented at the CERN conference by LRL scientists Luis Alvarez and Robert Hulsizer. This is the Scanning-Measuring Projector (SMP), which seeks to combine all three steps of data reduction (scanning, measuring, and data analysis) into one semi-automatic operation. The SMP was conceived by Luis Alvarez in 1960, and developmental work has taken place largely within the Alvarez Group at LRL Berkeley.

Heart of the SMP system is a specially-designed scanning-measuring table which utilizes the concept of the "bench mark" (borrowed from surveying) to fix the exact coordinates of tracks. Expanding on the surveying analogy, Alvarez explains the idea this way: "If a homeowner wishes to know the coordinates (i.e., the location) of his home relative to

FLYING SPOT DIGITIZER: Above, LRLers Jack Franck (l.) and Howard White demonstrate the Laboratory's first operational FSD model, in Room 2167, Building 50A.

an appropriate fiducial mark which is just outside the White House in Washington . . . he makes use of an extensive grid of bench marks which was set down by the Coast and Geodetic Survey many years ago.

Differential Coordinates

"He measures the distance from his home to the closest bench mark, using relatively inaccurate surveying methods as contrasted with the highly precise surveying techniques employed by the C & GS. He adds his 'differential coordinates' to those engraved on the bench mark, and thereby learns his absolute coordinates with a much higher overall percentage accuracy than would be expected from the relatively crude measurement techniques used in the differential measurement."

The SMP system consists of the special scanning table and an IBM 709 computer. In the scanning table, the "bench marks" are tiny scratches located about one centimeter apart on an otherwise polished plate of lucite underneath the glass surface of the table. The table top is masked by a contrivance rather like a window shade on rollers. Cut into the shade is a small hole, or "window," one centimeter square. By moving the shade on its rollers, the "window" can be positioned anywhere on the surface of the table. When light from a projected image (e.g., a bubble chamber film) penetrates the window and hits one of the "bench marks," it is deflected and then conducted, by internal reflections, to a light-sensitive cell. Since the location of each of the "bench marks" has previously been precisely determined, to find the coordinates of any point of light falling on the plate one need only roughly calculate the distance between the point of light and the nearest bench mark.

Data Input

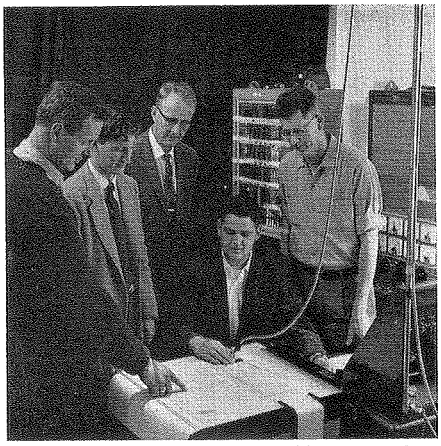
Coordinate data from the SMP unit is fed directly into the 709 computer by means of its direct data channel. Descriptive information (roll number, etc.) is fed into the computer via an on-line typewriter which serves as an "interpreter" between the computer and the scanner. The typewriter types out questions, the scanner types the answers alongside. Once the computer has determined (by referring to its program) which events shown in the frame are "interesting" ones, it instructs the scanner to measure these events. To make the measurement, the scanner simply positions the "window" and moves it along the track, simultaneously pressing a "record" button.

Operational Models

Three operational models of the SMP are now being built in the Alvarez Group's data reduction center in Building 46. They will be ready to go to work analyzing bubble chamber films in a few months.

LRL personnel involved in the SMP development program include, besides Dr. Alvarez, the following scientists, engineers, technicians and programmers:

Ben Abington, Richard Blumberg, Phil Carnahan, Peter Davey, Robert Hulsizer, William Humphrey, Ralph Jones, Jim Lindsey, John Munson, Bart Nyman, Ron Ross, Arnold "Pete" Schwemin, John Shafer, Robbie Smits, John Weir, and Ron Zane. University of Illinois staff members who contributed to the project were Uli Kruse, John Lathrop, and James Snyder.



EARLY MODEL of Scanning-Measuring Projector (SMP) is shown with designers (l. to r.) Robert Hulsizer, Peter Davey, Luis Alvarez, Ron Zane, Pete Schwemin.