sented, and the ideas by Brian Webber and Giuseppi Marchesini seem to be as successful as the Lund model in accounting for some of the experimental results. It is based on perturbative calculations with some extra restrictions to take into account among other things quantum interference effects.

Several speakers stressed the importance of more detailed experimental tests of these hadronization models. In particular, it will be necessary to perform precise studies of production of strange particles, baryons, vector mesons, etc. Here, one should mention the quantitatively and qualitatively imposing data which are now coming in from the electron-positron machines at DESY, Hamburg, and Stanford. Another important branch of particle physics where precise hadronization studies are being performed is 'soft' hadronic reactions producing particles of low transverse momentum.

The next Symposium is to be held in Israel in June 1985.

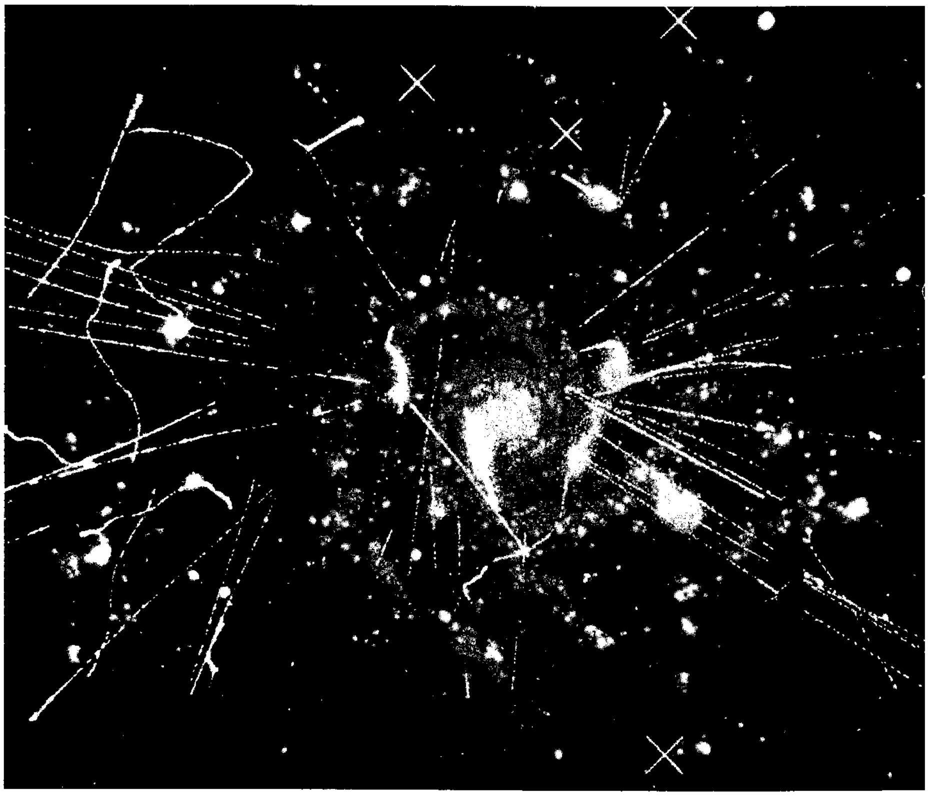
(From Bengt Svensson)

WORKSHOP
Inner space - outer space

During the first week of May, the Fermilab theoretical astrophysics group hosted an international conference on science at the interface of particle physics and cosmology/astrophysics. The conference (Inner Space-Outer Space) was attended by a very diverse group of more than 200 physical scientists, including astronomers, astrophysicists, cosmologists, low-temperature physicists, and elementary particle theorists and experimentalists. The common interest which brought this diverse group together is the connection between physics on the smallest scale probed by man — the realm of elementary particle physics — and physics on the largest scale imaginable (the entire Universe) — the realm of cosmology.

The Fermilab conference was designed to be a comprehensive review of the status of the field. Inflation, galaxy formation, proton decay, the microwave background, nucleosynthesis baryogenesis, strings, monopoles, Kaluza-Klein models, supersymmetry, free quarks, and neutrino oscillations were discussed at the conference. All of these topics were of common interest to both astrophysicists and particle physicists.

In its infancy the Universe was probably a hot soup of quarks and leptons, closely resembling the conditions created in very high energy particle collisions. One of the intriguing connections between particle physics and cosmology is the possibility that most of the mass in the Universe resides in a yet-to-be-detected sea of elementary particles which are relics of the earliest moments of the Universe. Marc Davis (Berkeley) gave an observer's view of the large scale structure in the Universe, and Jay Gallagher (Kitt Peak National Observatory) presented the evidence that there are more to galaxies than meet the eye: perhaps most of the mass in a galaxy is not in the form of stars. If so, it probably exists in a dark spherical halo, possibly comprised of exotic relics. Simon White (Arizona) summarized the results of numerical simulations of the formation of structure (galaxies, clusters, etc.) in model universes with different types of elementary particles as the 'dark matter'. Based upon comparison of the simulations and the observations which were discussed by Davis, the preliminary



'Inner Space-Outer Space' was the theme of a recent workshop hosted by the Fermilab theoretical astrophysics group. Symbolizing this merger of the two frontiers of physics is this superposition of photographs of a galaxy and of particle tracks from a bubble chamber.

People and things

conclusion is that the dark matter is probably not massive neutrinos, but might be more exotic particles such as axions or one of the particles from the 'supersymmetric zoo'. On the final day of the conference, J.D. Bjorken (Fermilab) discussed the prospects for actually producing, at present or future accelerators, some of the more exotic (not yet known to exist) particles which have been suggested as candidates for the dark matter.

In the 15th century, Copernicus suggested that the earth is not at the centre of the solar system. Bruno in the 16th century took the Copernican idea one step further when he wrote that there are '... innumerable suns, and an infinite number of earths revolve around those suns...' In the 20th century, it was discovered that our solar system is not at the centre of our own galaxy, and that our galaxy is but one of billions in the Universe. At the Fermilab conference, equally heretical theories were put forward in which the Universe we observe might well be only one among many, that there may be more than three spatial dimensions, and that the matter of which we are made (neutrons, protons, electrons) may not be the dominant form of matter in the Universe. It is just possible that one of these ultimate extensions of the Copernican principle will be confirmed by high energy experiments at Fermilab or elsewhere. We all hope that the intrepid physicists and astronomers working in this field fare better than Bruno (who was burned at the stake in 1600)!

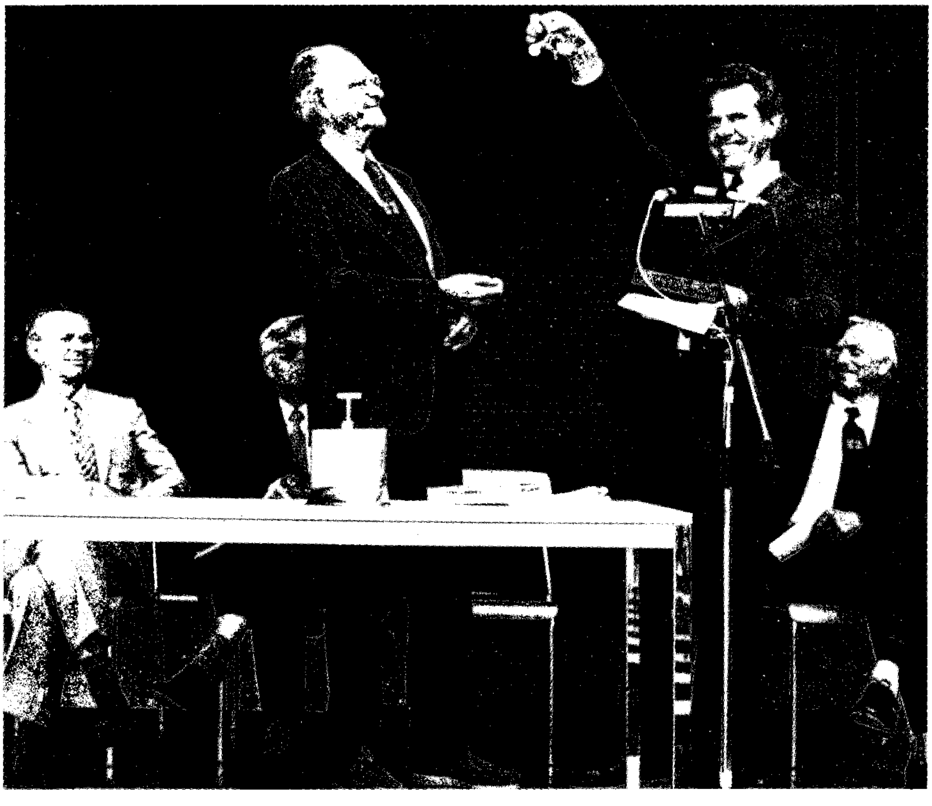
The return of the key

The symbolic act of the return of the ISR key culminated the closure ceremony for the CERN Intersecting Storage Rings on 26 June. The key had passed from Werner Heisenberg (a theorist) to Edoardo Amaldi (an experimentalist) when the ISR was inaugurated in 1971. It returned from Giorgio Bellettini (the last Chairman of the ISR Experiments Committee) to Viki Weisskopf (doyen of theorists) who as Director General of CERN in the early 60s did much to promote the construction of the ISR.

In his speech, Weisskopf claimed that the ISR, by virtue of tremendous technical success, had 'changed the landscape of high energy physics'. As a consequence, all future projects for achieving higher energies involve colliding beams. He quoted Rabi on the jump in energies that the ISR made possible... 'The ISR does not just ask questions of Nature, it grabs Nature by the throat and forces her to speak.'

Kjell Johnsen, who led construction of the machine, reviewed its record-studded history of technical achievements. From the first ideas of Donald Kearst and Gerry O'Neill in the USA in 1957, it was a spectacular journey to the world record luminosity of 1.4×10^{32} per cm^2 per s, to 57 A in a single beam, to loss-rates of only one particle in a million per minute, to 60 hour continuous runs, to stochastic cooling...

Herwig Schopper thanked all who had contributed to these successes and Weisskopf concluded with an exhortation to cherish CERN's double role — a place of scientific excellence and a symbol of the United States of Europe.



On the platform at the closure ceremony for the CERN Intersecting Storage Rings on 26 June, left to right: Herwig Schopper, Kjell Johnsen, Viki Weisskopf, Giorgio Bellettini and Gunther Plass.