THE DELTA: THE FIRST PION NUCLEON RESONANCE

Its Discovery and Applications

—Darragh E. Nagle

I'd like to try to recapture with you some of the fun and excitement of the pion-scattering work that led to the discovery of what is now called the delta particle. How significant this discovery was became apparent only gradually, as I will try to summarize for you. That the delta is alive today and thriving at Los Alamos (as well as other places) I shall also try to persuade you.

Beginnings

The story begins for me back in 1940 at Columbia University where, as a shiny new graduate student, I thought I should pay a courtesy call on the illustrious Professor Enrico Fermi, whose presence at Columbia had been one reason for my coming. His office was listed as being on the seventh floor of Pupin Laboratory. So I took the elevator, got out at that floor, and looked around for the office. Suddenly a door burst open, and a dark-haired man ran past me at full tilt, disappearing through another door. He was wearing a lab coat and he was carrying a bit of something in a pair of chemical tongs. I stood there flat-footed wondering what to do, when the first door burst open again, and what appeared to be a younger version of the first gentleman, similarly attired and similarly burdened, dashed by me and also disappeared through the second door. Although the full significance of this minidrama was not completely clear to me then,* it seemed clear enough that this was not the day for a courtesy call on Professor Fermi. Only later did I find myself caught up in the races devised by Fermi and Herbert Anderson, at Chicago, then at Los Alamos, and then, in 1951, back at the University of Chicago again. The photo shows Anderson at the cyclotron in the 1950s.

*The bit of something that was being carried was in fact a thin foil of rhodium metal, which had been activated by neutrons. Because rhodium decays with a half-life of 42 seconds, it was necessary to be quick in carrying it from the lab where it was activated to a place where its activity could be measured.

Early Days at the Cyclotron

In 1951, the great Chicago cyclotron, constructed by Anderson following principles developed at Berkeley, was at the stage of final assembly and testing in the new building known as John Marshall's barn. The pictures, in order, show the cyclotron and the famous "trolley-car" target of Fermi, which ran along the periphery of the cyclotron magnet and in which the proton beam interacted to give pions, etc. A view from above shows the shield wall between the cyclotron and the experimental room. The slots in the steel were for several pion beams; they came at various "impact parameters" with respect to the cyclotron center, each slot corresponding to a different pion beam energy.

Because negative pions bend oppositely from the protons, the negative pions coming out were emitted in the forward direction. The positive pions were those emitted in the backward direction, and so the higher energy positive pion had lower intensity than the low-energy positive pion. In the initial operation, then, the positive pion energies were lower, a fact of some historical significance.