The analyzing power $\overline{A_y} = 0.43 \pm 0.02$ at a velocity ratio cut of 0.92 measured with the lead–steel collimator was the same, within statistics, as that obtained without the collimator. This result is consistent, within statistics, with the prediction that depolarization by the shielding wall should be about 5%; therefore, the use of lead and steel for the shielding in the front wall will not hinder the measurement of G_E^n.

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FIRST COOLER TEST RUN FOR pp→pnπ^+ (CE03)

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On February 20-21, 1990, we made the first Cooler run for this experiment. At that time, an almost full set of CE03 detectors was available. The new, large aperture, 6° magnet (the central piece of equipment for the T-site experiment) was not installed and the gas jet target was not available, so the anticipated small-angle detection of protons and neutrons from the reaction pp → π was not possible at the T-site. However, thin window (127 micron stainless steel) exit ports for charged particles were available on both sides of the beam line covering scattering angles of 38° to 52° relative to the beam direction.

A correlated two-arm measurement involving ejectiles of realistic energies was accomplished by using the elastic reaction pp→pp for incident protons of 150 MeV as a source for simply correlated particles. A 2 mm thick polyethylene scraper target and a cyclical sweep of the cooled beam into the scraper generated an estimated luminosity of between 10^{26} and 10^{27} cm^{-2} sec^{-1} at a duty cycle of about 50%.

The "neutron" arm consisted of a 14 element position sensitive scintillator hodoscope (described elsewhere) of area 70 × 120 cm, with a set of four 3-mm ΔE detectors just in front of it. For the test run, these ΔE detectors were set to select charged particles. (In the final experiment they will veto them.) The center of the "neutron" hodoscope was located at an angle of $-45°$ and a distance of 300 cm from the target. The "proton" detector consisted of 2 wire chambers (measuring x and y), a 3-mm thick ΔE detector, a 7.6-cm thick E detector and a thin veto detector, mounted at a nominal angle of $+45°$ and a distance of 160 cm from the target. It had an active aperture of 22 cm by 40 cm. No shielding was required.

With this geometry, all protons intercepted by the wire chambers have their correlated particles intercepted by the hodoscope (but not vice versa). A "dimmer" reduced wire chamber voltages during beam injection and acceleration. No dimming action was required for the scintillators. Data were taken in the event by event mode with the Q data acquisition system in the 'may process' mode. Events for triggers corresponding to proton arm only, "neutron" arm only, and 2 arm coincidences were accumulated.

This test run of 2 day duration served several ends. A priori, background was a major concern, but all evidence indicates that for the geometry used and at luminosities of 10^{27}, particle and gamma background was not a problem serious enough to interfere with detector operation. It even seems possible (but not advantageous) to omit dimming the wire chambers during injection and acceleration. Similarly, pickup of electrical noise in the anticipated experimental site was well under control.

All detectors worked together under realistic conditions and the expected energy-angle correlations were seen. For the proton arm, the detected energies for pp$\rightarrow$pp varied by 25 MeV across its acceptance. Figure 1 is a plot of the missing mass for the undetected particle for events with a valid signal in both arms (i.e. the "neutron" arm was used only in the trigger). The width of 6 MeV is mostly due to multiple scattering in the vacuum foil and air. The level of background is quite small. Events from carbon are highly suppressed and the events with smaller missing mass can be explained by nuclear reactions in the stopping detector.

The angles detected for 2-arm events also show a strong position correlation suggesting the pp$\rightarrow$pp reaction. In Fig. 2, we show the angular correlation data compared to expectations from kinematics. From these data, we estimate the angular resolution of the neutron arm to be much better than 1 degree after the large contributions due to kinematic broadening and multiple scattering are subtracted.

As the initial operation of the full set of detectors with associated electronics and software in the Cooler environment, this run was very successful. However, there were a number of observations suggesting the need for further shake down runs and testing. We noted that our advance energy calibration of the scintillators with a UV laser was only partially successful. With 36 phototubes in the experiment, this will be important in the future. The wire chamber efficiency appears to be lower than expected. The wire chamber also showed electric pickup from the UV laser when it was triggered. Finally, it was difficult to measure detector resolutions precisely because of multiple scattering in the stainless steel exit foils.

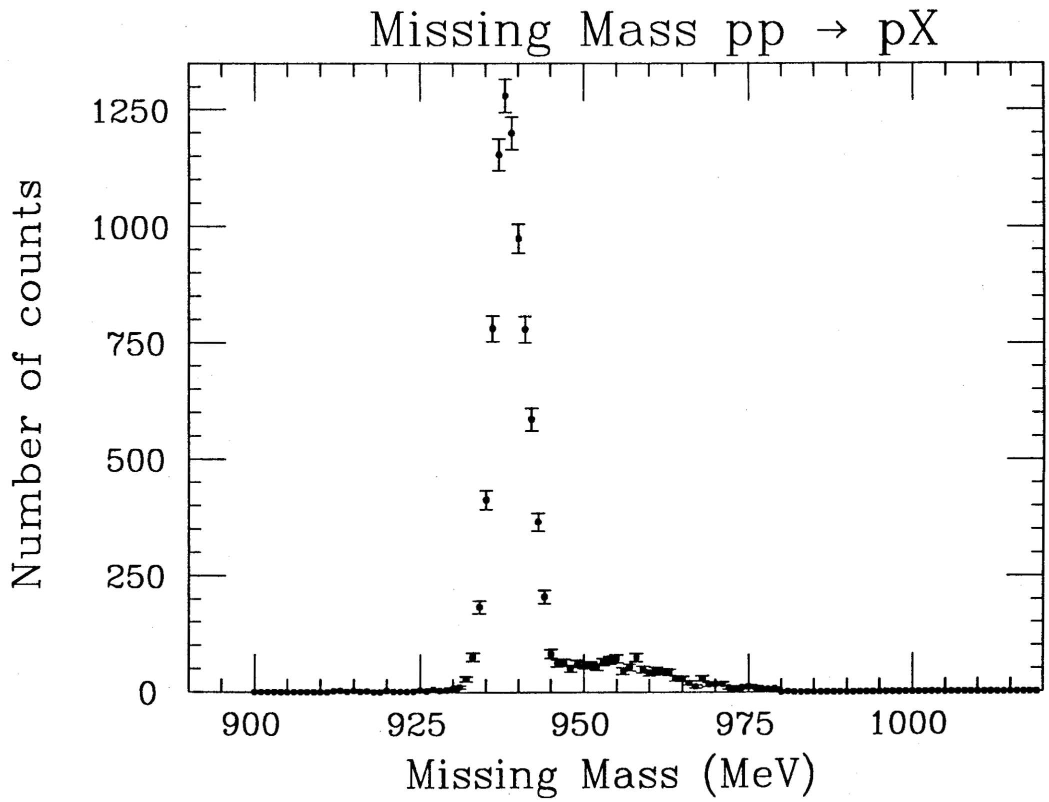

Figure 1. The missing mass computed for events firing detectors on both sides of the beam. Angle and energy data from the "proton" arm are used to calculate the mass of the particle on the other side of the beam.

Figure 2. Angular correlation data for coincidence events. No energy cuts were necessary. The errors of the data are about the same size as the points and the agreement is excellent.