E882-B – Search for Strangelets and Other Exotic Objects

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Physics Goals:	Search for Short-lived Exotic Composites
Beams:	Si and Au at $\sim$ 10 A GeV
Targets:	Pb

Experiment Description and Physics Summary

In this series of experiments, we search for production of various short-lived exotic objects in high energy heavy ion collisions.

1. Search for Abnormally Ultradense Nuclear Matter

A detector system consisting of 17 sheets of BP-1 phosphate glass and a 1.27-cm Pb target was exposed to 3.5×10^9 ions of ^{197}Au at 11.4 A GeV in 1992. This experiment was designed to search for the production of abnormally dense nuclei suggested by Lee and Wick and others. Exploiting one of the useful features of the BP-1 detector – that its sensitivity can be tuned by suitable choice of chemical etchants – we can set the detector to be sensitive only to $Z/\beta > 82$. In 10^9 interactions, we observed none of such composites emitted within an angle of 140 mrad to the beam direction, which led us to set an upper limit of $\sim$ 20 nb for the production cross section for abnormally dense nuclear matter.

2. Search for Strange Quark Matter

We have conducted an exploratory search for strangelets and other exotic composites using the beam of $\sim$ 10 A GeV ^{197}Au ions in 1993. Our setup consisted of a Pb target, 3 tracking chambers, each contained 25 sheets of CR-39 track-etch detectors, inside a magnet of 1.5 T at C5 beamline. The total fluence reached 10^9 Au ions in $\sim$ 20 hours of run. The purpose of the experiment was to search for negatively highly charged ($|Z| \geq 6$) and short-lived ($\tau \sim 10^{-9}$ sec) exotic fragments produced at mid-rapidities in 10 A GeV ^{197}Au + Pb collisions. The experiment will reach a sensitivity of 10^{-8}/interaction. The short lifetime to which this experiment is sensitive makes it complementary to other experiments at the AGS. The scanning and measurement are in progress.

2. Search for Dirac Magnetic Monopole Production

We will expose a detector module to $10^{11} - 10^{12}$ Au ions in 1994 run. The detector module will consist of 12 sheets of 10 cm $\times$ 10 cm $\times$ 0.1 cm BP-1 glass detectors and a 1.5 cm thick Pb target. With this setup, we will search for magnetic monopole production in high-energy nucleus-nucleus collisions. The production of Dirac magnetic monopole pairs in e^+e^-, pp, and AA collisions has been speculated about by many authors. Extensive searches for monopole pair production in e^+e^- and pp have been performed at various energies and upper limits to its production cross section have been placed. In all these collisions, the monopole pairs are expected to be produced via Drell-Yang mechanism. Moreover, in heavy-ion collisions the thermal production of monopole pairs has been predicted. We estimate that our detector is sensitive to a magnetic monopole with $n = 2$ and with various possible masses. This experiment will be the first search for monopole pair production in heavy ion collisions. Given a fluence of 10^{11} ions, a sensitivity of 10^{-35} cm^2 in its production cross section is expected. This sensitivity is well below the extrapolation of Drell-Yang cross section for pair production.

This setup will also allow us to search for ultradense nuclear composites with $Z/\beta > 82$ and $\tau \sim 10^{-10}$ sec in central collisions. Given a fluence of 10^{11} Au ions, we could reach a limit that is three orders of magnitude lower than previously achieved.

Selected Publications

"Sensitivity study of CR-39 plastic track detectors", Y. D. He and P. B. Price, Nucl. Tracks Radia. Meas. **20** (1992) 491–494.

"Search for abnormal nucleus production in heavy-ion collisions", Y. D. He and P. B. Price, Phys. Rev. C **48** (1993) 647–650.

Related Experiments

E793, E882-A