BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
Upton, New York

MASTER

ACCELERATOR DEPARTMENT
Informal Report

MEASUREMENT OF NUCLEON-NUCLEON TOTAL

CROSS SECTION RATIOS AT ISABELLE

K. Goulianos

December 10, 1971

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CRISP 71-56
ISABELLE PROJECT

INTERSECTING STORAGE ACCELERATOR NOTES

MEASUREMENT OF NUCLEON-NUCLEON TOTAL CROSS SECTION RATIOS

AT ISABELLE

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We propose to measure the total pp/nn/pn cross section ratios at c.m. energies up to 100 GeV per nucleon by using intersecting deuteron beams at ISABELLE and looking at spectator nucleon coincidences with scintillation counters. The spectators to, say, the n-n collisions will be protons of momentum $p \approx \frac{1}{2} p_d$ and transverse momentum $p_T \lesssim 100 \text{ MeV}/c$ and therefore they will be confined within an angle $\theta \lesssim 0.2/p_d \text{ (GeV}/c)$, which is 1 mrad for 200 GeV/c deuterons. A coincidence between two counters where these two spectator protons are expected would signify the occurrence of an n-n interaction. Similarly, a coincidence between two neutrons along the intersecting beam directions would be the signature for a p-p collision, while the p-n (n-p) collisions will be monitored by n-p (p-n) spectator coincidences.

Schematically, the location of the scintillation counters in the 20 mrad intersecting region is shown in the Figure. The spectator protons bend twice as much as the deuterons and they are counted with scintillation counters when they are safely outside the deuteron beam. The construction of an efficient neutron counter would not be a problem at these high energies.

The final state interaction of the spectators with the reaction products is important only for elastic events with transverse momentum $\sqrt{|t|} \lesssim 70 \text{ MeV}/c$ corresponding to $\sim 3 \times 10^{-13} \text{ cm}$ (deuteron diameter). In such cases the deuteron is not likely to split and therefore these events will not get counted. Thus our cross sections will be integrated over $|t| \gtrsim 0.005 (\text{GeV}/c)^2$. Within this region, the final state interaction effects will be small and they will be the same for all three cases: pp, nn, and pn. Therefore, a comparison of the cross sections measured in this way will be of significant value. We might point out that $|t| \lesssim 0.005$ contains the coulomb corrections and it may be as well that it is excluded in our measurements.