THE TRIUMF PARITY VIOLATION EXPERIMENT IN p-p SCATTERING AT 221 MeV

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Using the weak interaction to probe hadronic structure is a present motivation for the parity violation experiments in nucleon-nucleon collisions at low and medium energies. Parity violating proton-proton scattering below 300 MeV provides a unique window on hadronic structure at internucleon distances of about 0.5-1.0 fm i.e. the confinement range. The direct quark-quark contact interaction model [1] and the one-meson exchange model predictions [2,3] for the parity violating analyzing power $A_z = (\sigma^+ - \sigma^-)/(\sigma^+ + \sigma^-)$ are quite different at 220 MeV energy, as seen in figure 1. In this context, the TRIUMF parity violation experiment, presently underway at 221 MeV, is an important test, provided that the accuracy goal of $\delta A_z = \pm 0.2 \times 10^{-7}$ can be achieved.

A transmission technique is used at TRIUMF, where an optically-pumped polarized H^- ion source (OPPIS) and H^- ion cyclotron with multiturn stripping extraction deliver a longitudinally polarized beam to a 40 cm liquid hydrogen target. Descriptions of the experimental apparatus and polarized beam development have been presented elsewhere [4,5,6]. Polarized source, detectors, target and dedicated beamline development took a period from 1988 to February 1997, when the first high precision data set was obtained and analyzed [6]. A preliminary result of that run is $A_z = (+0.6 \pm 0.6) \times 10^{-7}$, for about 120 hrs of real data taking. Most of the 5 week run was spent in beam studies, calibrations and checking of systematic error contributions. Systematic error contributions for current, position, size and residual transverse polarization components are less than 0.2×10^{-7}, and the systematic error is dominated by

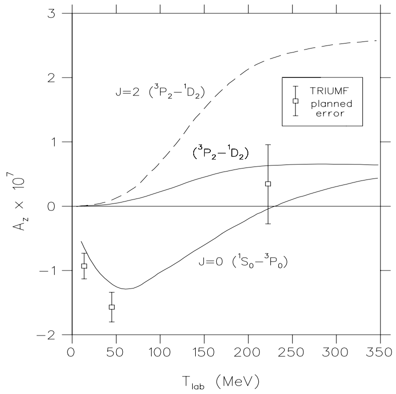

Figure 1: A_z energy dependence: solid line - one meson exchange model[2,3], dashed line - contact quark model[1] 13.6 MeV - Bonn experiment, 45 MeV - SIN experiment, and 221 MeV preliminary TRIUMF results[6].

its statistical uncertainty. The only significant corrections, on average about 1.5×10^{-7}, were due to polarization moments.

Due to the limited scanning polarimeter accuracy, the correction to A_z for the polarization moments contributions had a quite large error. Most of the polarization moments are produced by the polarization distribution across the stripping foil in the cyclotron. The moments can be reduced by a cyclotron tune producing symmetrical beam profiles and by stripping only the central part of the distribution by appropriate "shadowing" of the extraction foil. Moments, as a product of polarization and beam size must scale with the beam size and by proper choice of the beam convergence can be reduced at the target.

The results of the most recent July-August 1998 run are presented in Figure 2 and Table 1. The experimental asymmetries $\varepsilon_\pm$ are defined as: $\varepsilon = \pm(A_z \pm \delta A_z)$ for positive and negative beamline helicity tunes; a total of approximately 250 data hours were acquired, roughly equally shared between states of opposite beamline helicity tune. The beamline helicity tune reversal allows some systematic error contributions such as beam energy modulation to be cancelled by averaging the data. The transverse polarization moments were significantly reduced as compared with February 1997, and their contributions to the new data set are of order 1×10^{-7}. When the analysis of all existing data is completed, a total uncertainty of $\pm 0.4 \times 10^{-7}$ is expected. The next data taking run is scheduled for summer 1999.

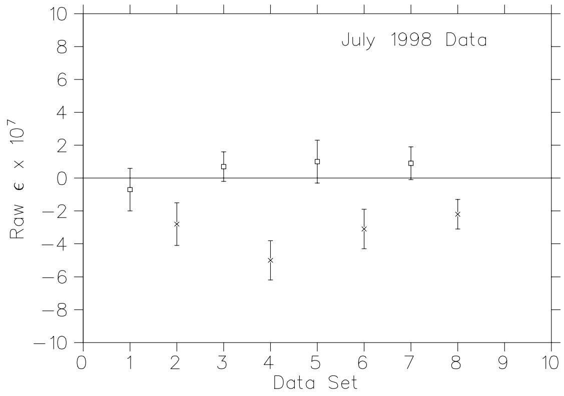

Figure 2: Raw data from July - August 1998 parity run.

Table 1: Raw Data Summary, July-August 1998 Run

Set	Raw ε ($\times 10^7$)	$\frac{\Delta I}{I}$ ($\times 10^5$)	$< yP_x >$ (μm)	$< xP_y >$ (μm)
1 +	-0.7 ± 1.3	-4.8 ± 1.1	10.7 ± 4.1	1.7 ± 2.3
2 −	-2.8 ± 1.3	-3.4 ± 1.1	1.0 ± 1.3	10.0 ± 1.8
3 +	0.7 ± 0.9	-3.9 ± 0.8	14.1 ± 1.7	3.0 ± 1.6
4 −	-5.0 ± 1.2	-9.3 ± 1.0	8.5 ± 2.4	1.9 ± 1.4
5 +	1.0 ± 1.3	-3.6 ± 0.6	9.6 ± 3.2	-2.6 ± 1.8
6 −	-3.1 ± 1.2	-5.7 ± 0.9	3.3 ± 2.2	4.6 ± 1.7
7 +	0.9 ± 1.0	-3.8 ± 0.7	15.2 ± 2.4	0.5 ± 2.0
8 −	-2.2 ± 0.9	-8.6 ± 0.7	7.4 ± 2.6	0.2 ± 1.4

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