Spin Facilities in North America*

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Spin physics is an important ingredient in the research programs of the major electron and proton accelerators in Canada and the United States. We review here briefly the present and future facilities at TRIUMF, LANL, BNL, FNAL, SSC, Bates, CEBAF, and SLAC.

In the area of proton accelerators the 500 MeV cyclotron at TRIUMF provides approximately 1 μ A of polarized protons with an average polarization of 70%. Ongoing ion source developments may allow for an increase to 5 μ A with an average polarization of 80%. The spin physics program involves both polarized proton and polarized neutron scattering experiments. The program will dramatically change in the next years should the TRIUMF proposal to build a 100 μ A 30 GeV synchrotron, KAON, be constructed. Preliminary machine design work to control the polarization of such a machine is under consideration. The layout of the external beams as presently construed does not allow for the direct use of primary protons and thus precludes a polarized proton program. This oversight will most likely be corrected in the next version.

At LANL, the LAMPF linac provides beams of $\sim 10^{11}$ polarized protons/second, at energies of 200-800 MeV accelerated in parallel with unpolarized protons. The spin physics program at this facility is large and varied, running the gamut from polarized proton and neutron scattering to pion scattering on polarized targets. LANL is also planning to increase the polarized proton intensity by a factor of 3-10 through the development of a new ion source. Further down the path are plans to construct a 60 GeV, 25 μ A machine using the present linac as the injector.

At BNL the spin physics program is at the 30 GeV AGS. This program covers a very wide area such as the measurement of the anomalous magnetic moment of the muon, the measurement of one and two spin effects in polarized proton-proton scattering, the polarization transfer in hyperon production, etc. The AGS accelerates 2×10^{10} polarized protons/pulse to energies typically above 12 GeV/c (70% polarization) to 22 GeV/c (45% polarization). With the completion of the Booster in 1990, and it operating as an accumulator ring, the polarized proton intensity will rise to 4×10^{11} /pulse. The unpolarized proton intensity would rise to 5 μ A. As at the other laboratories, a significant ion source effort is underway to

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raise the intensity at least another factor of ten to 4×10^{12} polarized protons/pulse. Currently under design is a Stretcher, which would supply 10 μA of protons and 2.5 μA of polarized protons. In addition, the AGS will supply polarized protons to the proposed Relativistic Heavy Ion Collider, RHIC. This machine would have a polarized proton luminosity of $10^{32} \text{ cm}^{-2} \text{ sec}^{-1}$ at a center-of-mass energy of 0.6 TeV. RHIC would require two Siberian snakes per ring to preserve the polarization.

The highest energy polarized proton and antiproton beams, 200-600 GeV/c, are available at the Tevatron at FNAL. They are produced from a beam of lambda and antilambda particles produced with 800 GeV/c protons. For polarized protons one obtains fluxes of $10^7 - 10^8$ (200-600 GeV/c) at 45% polarization. For polarized antiprotons one obtains fluxes of $10^5 - 10^6$ (200-400 GeV/c) at 45% polarization. The physics program with this beam has just begun to measure the total cross section differences for spin parallel and antiparallel, and the production of pions and neutral hyperons.

One cannot say a great deal about the SSC. Work at various workshops indicate that the acceleration of polarized protons might be possible. The order of ten Siberian snakes seem to be required. What has become obvious is the necessity to test out the snake ideas at some of the lower energy machines in the next several years.

In the domain of electron machines, we begin with the 1 GeV machine at Bates. This facility provides 80 milliamperes of a bright and small energy spread beam. In the ring an internal jet target is available. Projected luminosities of $10^{32} - 10^{34} \text{ cm}^{-2} \text{ sec}^{-1}$ are projected with this jet target.

At CEBAF, a recirculated, superconducting electron linear accelerator, designed to deliver a CW electron beam of 200 μA at 4 GeV is under construction. Polarized electron operation is planned as part of the physics program. Experiments such as parity violation studies with longitudinally polarized electrons, measurement of the neutron electric form factor, etc. are envisioned. The polarized electron injection system is being developed in collaboration with several external institutions.

The highest energy polarized electrons will become available at the SLC in SLAC. The polarized electrons will be accelerated to 50 GeV (50% polarization) and collided at the final focus. With a sample of $10^5 - 10^6$ Z^0 decays, and by measuring the difference in the leptonic forward-backward asymmetry, one would measure the Z^0 mass to $\leq 40 \text{ MeV}/c^2$ and $\sin^2 \theta_w$ to 0.0003. The SLC is expected to be the prototype for the TLC, TeV Linear Collider. The plan is to provide 500 GeV polarized electrons (85% polarization). One linac would produce 500 GeV electrons and a second one would provide 500 GeV positrons. At the collision point, 1 TeV energy would then be available.

In conclusion, I would like to thank my colleagues at Bates, CEBAF, FNAL, LANL, SLAC, and TRIUMF for providing me with the details of their accelerator facilities.

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