1988 Summer Study on High Energy Physics in the 1990s,
Snowmass, Colorado, 6/27-7/15/88.

AGS II*

Y.Y. Lee and D.I. Lowenstein
AGS Department, Brookhaven National Laboratory
Associated Universities, Inc., Upton, NY 11973

At present, the AGS slow extracted beam current is 1 µA. With the completion of the Booster in 1990 and the associated AGS modifications, the current will rise to 4-5 µA. With the subsequent addition of the Stretcher, which is under design, the current will rise to 8-10 µA and approximately 100% duty factor. We are now examining the possibility of a further enhancement to a current level of 40-50 µA CW.

Let us first examine the capabilities of each of the present AGS accelerators. The Linac is capable of running ten pulses a second of 30 mA H⁻ ions with a 500 µsec pulse length. The Linac output current exceeds the input capabilities of the Booster. The Booster is capable of pulsing ten cycles a second. Because of the large power swing both in real and reactive power, the Booster is limited presently to operate at 7.5 Hz and an energy to 1.5 GeV. One way to overcome this limitation would be to pulse, out of phase, an equivalent electrical device (another matched accelerator) as an analog to a flywheel so as to smooth the power swing.

At present, the AGS is capable of cycling every 1.2 seconds. The pulse rate is limited mainly by two factors. One is the limitations of the main magnet power supply and the second is the peak voltage of the present radio frequency acceleration system. Both of these can be improved. The highest current that can be achieved is when one matches all the accelerators to the repetition rate of the Linac. Our scheme assumes that one does not replace either the Linac or the AGS.

The first stage in the intensity increase program is the introduction of the Stretcher ring. This machine, which is now under design, allows protons to debunch and then slow extract with ≈ 100% duty factor. Since the AGS would not operate with a flattop cycle, the repetition rate and thus the delivered proton intensity would be increased by a factor of two. The implementation of just the Stretcher would provide 10 µA CW current. The CW feature is the necessary aspect of any high intensity facility.

We next propose to increase the Booster energy to 2.8 GeV and the repetition rate to 10 Hz. This is below the Booster transition energy and well within the capabilities of this machine. The Booster is already designed to operate at the increased dB/dt rate. The increased Booster energy is motivated by the energy swing solution described below.

We further propose to introduce a Post-Booster accelerator. This machine would operate at 10 Hz and accelerate protons to an energy above the AGS transition energy. Post-Booster swing could be made to complement that of the Booster and thus overcome the Booster repetition rate limitations. The AGS main ring power supply cycling limitations would also be eased due to the reduced AGS beam energy swing. The Post-Booster would be designed to have the same magnetic energy difference swing as the Booster. These two machines would operate at the same repetition rate but 180° out of phase with each other. To reduce the construction costs by minimizing the number of tunnels, it would be desirable to install the Post-Booster in the same tunnel as the Collector ring. The Collector ring requires a minimum circumference of three times that of the Booster ring. The Post-Booster would thus have a circumference three times that of the Booster, 75% of the AGS.

The Collector would be a short term (0.4 sec) intermediate storage ring. This machine would reside in the Post-Booster tunnel. The function of this ring is to temporarily store three Post-Booster pulses prior to injection into the AGS. The AGS would accept the three Post-Booster pulses (9 bunches) stored in the Collector and one additional pulse (3 bunches) directly from the Post-Booster for a total of 12 bunches. The Post-Booster and the Collector would inject into the AGS every 400 milliseconds. We show in Table I the estimated proton currents at various implementation stages of the above-mentioned proposal. The delivered currents are for slow extracted beam operation.

| Option | TABLE I | |
	Duty Factor (%)	Delivered Current (µA)
AGS	35	1.0
+Booster	35	4.0- 5.0
+Stretcher	100	8.0-10.0
+Post-Booster & Collector	100	40.0-50.0