BNL-104615-2014-TECH

AGS/AD/Tech Note No. 187;BNL-104615-2014-IR

# ACCUMULATOR BOOSTER FOR THE AGS AS A HEAVY ION BOOSTER

Y. Y. Lee

April 1983

Collider Accelerator Department

**Brookhaven National Laboratory**

**U.S. Department of Energy**

USDOE Office of Science (SC)

# DISCLAIMER

Accelerator Department
BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
Upton, NY 11973

AGS Division Technical Note
No. 187

# ACCUMULATOR BOOSTER FOR THE AGS AS A HEAVY ION BOOSTER

Y.Y. Lee and L.W. Smith

April 15, 1983

Acceleration of heavy ions in the AGS by boosting the existing tandem van deGraaff facility energy with a cyclotron has recently[1] been proposed. Also, a study[2] by M.Q. Barton suggests that heavy ions up to A = 32 could be injected directly from the tandem into the AGS and, that with the proposed cyclotron, ions up to A = 130 could be injected. The study reports that the only difficult technical problem is the AGS rf system.

In this note we would like to point out the possibility of using the proposed[3] AGS accumulator/booster ring to accomplish the acceleration between the tandem and the AGS. We briefly discuss three technical areas involved: 1) A/B ring rf system, 2) A/B ring magnetic field and 3) injection into the A/B ring. Injection into the AGS would be as described in Reference 3.

## RF System

There are a large number of free 3-m straight sections in the A/B ring. If three new rf cavities were installed each with a frequency sweep of a factor of 2.5, the sytem could accept heavy ions with $\beta \gtrsim 0.04$ corresponding to 0.75 MeV/amu. With the ion currents available, there would be no appreciable loading on the cavities.

## Magnetic Field

The A/B bending magnetic field at injection depends on the charge-to-mass ratio, Z/A, and is approximately

$$217\ A/Z \text{ Gauss}$$

for ions of 0.75 MeV/amu.

Because of the design of the A/B ring magnets, they could produce precise fields of very low value. The final energy of ions in the A/B ring is approximately

$$1000\ Z/A\ \text{MeV/amu},$$

making injection into the AGS much easier because of the higher magnetic field in the AGS. Injection into the AGS is feasible for even the heaviest ions. Acceleration of ions other than fully stripped must still await improvement of the AGS vacuum system.

Injection

Injection into the A/B ring could be multilturn into horiziontal phase space as is suggested for injection into the AGS in Reference 2. Another method is to use charge exchange (stripping) injection into the A/B ring. Since the emittance of the tandem beam is very small, one could arrange a very narrow stripping foil which would intercept a very small fraction of the recirculating beam in the A/B ring.[4] We estimate the accumulated current, $I_o$, in terms of incoming (tandem) current, $I_i$, as

$$I_o/I_i = \frac{P}{f(1-P)}$$

where P is the probability of an ion of the desired charge state emerging from the stripping foil and f is the fraction of the circulating beam reintercepted by the stripping foil. Although the quantity, P, is not precisely known, it appears[5] to be near to 20%. Extrapolating from some Monte Carlo injection studies in the design of the A/B ring, we estimate $f \approx 1\%$. We then get

$$I_o/I_i \cong 25.$$

For example, a 20 n-amp $^{197}Au$ current from the tandem gives $2.3 \times 10^7$ ions in the A/B ring or $\approx 1.4 \times 10^8$ ions in the AGS with six A/B loads fast extracted into the AGS.

Although the points made in this note are by no means a design, the concept looks sufficiently interesting and cost saving to merit a more detailed examination.

References

1. Proposal for a Heavy Ion Facility at Brookhaven, BNL Informal Report BNL-30630 (1982).

2. M.Q. Barton, Acceleration of Heavy Ions in the AGS, BNL-32713.

3. A/B Ring Proposal, BNL Informal Report BNL-32949 (1983).

4. Y.Y. Lee, AGS Division Technical Note 186 (1983).

5. H.D. Betz, Review of Modern Physics 44, 465 (1972).

mn

Distribution: Department Administration
Department S&P Staff
C. Chasman
P. Reardon
A. Schwarzschild
P. Thieberger