



Brookhaven  
National Laboratory

BNL-101939-2014-TECH

AD/RHIC/27;BNL-101939-2013-IR

## Does Post Linac After Tandem Give More Gold in the RHIC

Y. Y. Lee

August 1987

Collider Accelerator Department  
**Brookhaven National Laboratory**

**U.S. Department of Energy**

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-AC02-76CH00016 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

## **DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

7/12/87 → ac

AD/RHIC-27

Accelerator Development Department

Brookhaven National Laboratory  
Associated Universities, Inc.  
Upton, New York 11973

RHIC Technical Note No. 27

Does Post Linac After Tandem  
Give More Gold in the RHIC

Y. Y. Lee

August 11, 1987

## DOES POST LINAC AFTER TANDEM GIVE MORE GOLD IN THE RHIC

Y. Y. LEE

There have been considerable discussions over whether it is advantageous to accelerate heavy ions after the Tandem before injecting into the AGS Booster. In this note, we compare possible scenario of a post accelerating linac with the standard numbers in the RHIC conceptual design report except the affordable space charge tune shift could be .3 tune unit rather than .1 assumed in the report.

We consider two energies of post accelerator of 2.5 MeV and 4.5 MeV. We assume the charge state obtainable for each energy after stripping is three less than the ones given in G. R. Young's RHIC note (RHIC-PG-23 1983) --Experimentally it has been shown that the formula used by Young over estimates the charge state by about three--. Figure 1 is from Young's note and shows average charge state after stripping and efficiency at 200, 500, and 900 MeV corresponding to 1, 2.5 and 4.5 MeV per nucleon. Table I summarizes the result of calculations.

TABLE I

The current available to inject into the Booste

	RHIC Stand.	2.5 MeV	4.5 MeV
Ion Source Current(p A)	200	200	200
Q at Tandem Terminal	13	13	13
Stripping efficiency(%)	19	19	19
Tandem Transmission(%)	75	75	75
Liac bunching efficiency(%)* ----		60	60
Final energy/Nucleon (MeV)	1	2.5	4.5
	.0463	.0729	.0976
Q final	33	45	52
Stripping Efficiency(%)	17	17	17
Final Current(p A)	5	3	3

\*The number corresponds to the experience at AGS linac with two prebunchers. Prebunching with a chopper at the ion source would not help because one throws out half the beam at this point.

In order to estimate the number of gold ions injected into the Booster we need further assumptions. The maximum length of the Tandem pulse, and number of effective turns one can inject into the Booster. Since the emittance of the Tandem beam is sufficiently small compare to the acceptance of the Booster, injection efficiency or maximum number of the turn one can inject into the Booster is dominated by the thickness of the inflector septum. Other words injection is independent of the size of the final emittance of the incoming beam. The experience at the AGS proton injection shows up to 15 effective turns of the beam could be stacked out of twice as many actual turns injected. Since the emittance of the Tandem beam is much smaller than that of the proton linac beam, we like to assume up to 20 effective turns can be injected into the Booster. We assume the length of the Tandem beam pulse is sufficiently long enough to achieve maximum ions inside the Booster. The table II summerizes the result.

TABLE II

Number of gold ions available to inject into the RHIC

	RHIC Standard	2.5 MeV	4.5 MeV
Injecting Current(pμA)	5	3	3
Revolution Time(μsec)	14.53	9.24	6.70
No. Ion in 20 Turns(10 <sup>9</sup> )	9.1	3.5	2.6
Space Charge Limit( $\Delta V = .3$ )(10 <sup>9</sup> )	6.6	16.3	31.
Final Energy (MeV/Nucleon)	350	588	740
Stripping efficiency(%)	50	85	95
Ions for RHIC(10 <sup>9</sup> )	3.3*	3.0	2.5

\*Space charge tune shift  $\Delta V = .3$

As can be seen in the table, unless one improve the ion source current there is no advantage to post accelerate the ions prior to injecting into the Booster.

