

A Preliminary Lattice for RHIC with 20 cm Beam Separation in the Arc and 30 cm Beam Separation in the Straight Section

S. Y. Lee

August 1984

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.

A Preliminary Lattice for RHIC with
20 cm Beam Separation in the Arc and
30 cm Beam Separation in the Straight Section

S. Y. Lee
BNL, August 8, 1984

A reference design of the RHIC lattice described in the RHIC proposal¹⁾ has the 30 cm. beam-beam separation in the arc and insertion regions. There are reasons from the cost and construction point of view to design a lattice with 20 cm beam-beam separation in the arc region while maintaining 30 cm beam-beam separation in the straight experimental section. This short note is intended to investigate the feasibility of such a lattice design. Some important features of the original RHIC lattice have been fully retained, e.g. (1) long dispersion free straight section; (2) integral multiple of 2π in the phase advance through the insertion region; (3) the length of L_{12} and L_{67} are long enough for possible beam dump and beam injection, respectively; (4) β_H^{\max} and β_V^{\max} should be less or equal to 300 m for the aperture requirement; (5) β_H^* and β_V^* at the crossing point should be as small as possible.

A simple modification to the original lattice is to move the dispersion suppressor set BS Q5 BS of the inner insertion away from the crossing point while the corresponding set of the outer insertion toward the crossing point²⁾. Through this arrangement, we reach a preliminary solution, which gives:

$$\beta_H^* \times \beta_V^* = 0.95\text{m} \times 8.83\text{m}$$

$$\beta_H^{\max}(\text{QC}) = 282.4\text{m}$$

$$\beta_V^{\max}(\text{Q1}) = 242.5\text{m}$$

$$\beta_V^{\max}(\text{Q5}) = 255\text{m}$$

The strength of the focusing magnets are given by the following table:

<u>Quads</u>	Inner insertion	Outer insertion
QC	.13339581	.13339581
Q1*	.07968545	.07968545
Q1	.02916885	.03112382
Q2	.10503435	.09662240
Q3	.12894909	.13012411
Q4	.10004414	.10959580
Q5	.09751903	.09433017
Q6	.11334441	.11001080
Q7	.15359849	.15043661
Q8	.04495559	.04521152

where the strength of the quadrupoles is expressed in the unit of meter⁻².
The betatron function and the dispersion function in the insertion region are shown in Fig.1.

Comparing the present preliminary lattice to the RHIC design, we observe that the luminosity is about 2/3 of the original reference design, however $\beta_{H,V}^{\max}$ here is also reduced by about 10-20%. We conclude from the present study that a lattice of reasonable quality for 20 cm arc beam-beam separation and 30 cm beam-beam separation in the long straight section is feasible. More work is still needed if the magnet design favors this choice.

References

1. RHIC and Quark matter, Preliminary RHIC proposal, BNL-51801
2. J. Claus, Private communication.

