



BNL-105236-2014-TECH

Booster Technical Note No. 192; BNL-105236-2014-IR

IMPROVEMENT of the BOOSTER HEAVY ION INJECTION LINE

J. Xu

May 1991

Collider Accelerator Department
Brookhaven National Laboratory

U.S. Department of Energy
USDOE Office of Science (SC)

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MAY 14, 1991

ALTERNATING GRADIENT SYNCHROTRON DEPARTMENT
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK 11973

For the original injection line lattice, the emittance dilution factor due to vertical dispersion mismatch will be:

$$F = \left[1 + \frac{\Delta p}{p} \left(\frac{0.126}{\epsilon_o} \right)^{1/2} \right]^2. \quad (3)$$

From reference 4 $\epsilon_o \approx 1 \text{ mm}\cdot\text{mrad}$, then

$$F = \left[1 + 0.35 \frac{\Delta p}{p} \right]^2 \quad (4)$$

where $\frac{\Delta p}{p}$ is expressed in 10^{-3} . The emittance dilution factors F corresponding to various $\frac{\Delta p}{p}$ are shown in the following table,

F	1.83	1.38	1.14
$\frac{\Delta p}{p} (10^{-3})$	1	0.5	0.2

For the improved lattice, F due to η'_y mismatch can be expressed as follows

$$F = \left[1 + 5.7 \times 10^{-3} \frac{\Delta p}{p} \right]^2. \quad (5)$$

F due to β_y , α_y small mismatch is 1.007. Both F 's equal 1 approximately. The emittance dilution is negligibly small. One thing should be pointed out is that the maximum β_y in this lattice is approximately 100 meters, but the beam size remains well within the 4" aperture of the quadrupoles. Another possibility to improve this line is to tune the upstream line focusing parameters or to tune the whole line from Tandem to booster injection point.

Acknowledgments

I am thankful to Dr. A.G. Ruggiero for valuable discussion and Dr. S. Tepikian and J. Milutinovic for their help in running SYNCH program.

References

1. R.C. Gupta, R. Damm, Y.Y. Lee and W.T. Weng, *H⁻ and Heavy Ion Injection Lines for the Booster*, Booster Technical Note No. 90, Sept. 1987.
2. J. Milutinovic, private communication, 1991.
3. J. Xu, J. Claus and A.G. Ruggiero, *A Feedback Device to Damp the Coherent Oscillations from Injection Errors in RHIC*, AD/RHIC Technical Note No 74, 1990.
4. Booster Design Manual, p. 4-16.

Table 1.

1" MAD" Version 7.2/VAX	Copyright (C) 1988 by CERN.
Date and time of this run:	25-APR-9 16:16:12

```

MQFC3 : QUAD,L=0.25,K1=.554569
MDR:DRIFT,L=.30
HIKICK:SBEND,L=1.6,ANGLE=-.180056

HILA:DRIFT,L=2.0
HILB:DRIFT,L=.30
HILC:DRIFT,L=.30
HILD:DRIFT,L=.30
HILE:DRIFT,L=1.5
HILF:DRIFT,L=.5
HILG:DRIFT,L=3.0
HILH:DRIFT,L=.40
HILI:DRIFT,L=1.30
HILJ:DRIFT,L=.40
HILK:DRIFT,L=1.70
HILL:DRIFT,L=.50
HILM:DRIFT,L=.3
HILN:DRIFT,L=1.0

HIDC:SBEND,L=.450,ANGLE=-.34906585,TILT=.11017
HIDB:SBEND,L=.450,ANGLE=.34906585,TILT=.110170
HIDA:SBEND,L=.450,ANGLE=.34906585,TILT=.0

HIQFA:QUAD,L=.150,K1=3.01531400678
HIQFB:QUAD,L=.150,K1=2.97376034875
HIQFC:QUAD,L=.150,K1=3.4999999916
HIQFD:QUAD,L=.150,K1=1.987117

HIQDA:QUAD,L=-.150,K1=-1.08624681663
HIQDB:QUAD,L=.150,K1=0
HIQDC:QUAD,L=.150,K1=-2.00000
HIQDD:QUAD,L=.150,K1=-2.96600878394
HIQDE:QUAD,L=.1500,K1=-3.19999999
HIQDF:QUAD,L=-.150,K1=-2.00000
HIQDG:QUAD,L=.150,K1=-1.46334111601

HIBST:LINE=(2*HIDC,HILM,2*HIQDG,HILN,2*HIKICK,MDR,MQFC3)
HINTER:LINE=(HILD,2*HIQDC,HILE,2*HIQFD,HILF,2*HIQDD,HILG,2*HIQFB,HILH,&
2*HIQDE,HILI,2*HIQFC,HILJ,2*HIQDF,HILK,2*HIQFD,HILL)
HILINC:LINE=(HIQDA,HILA,2*HIDA,HILB,2*HIQDB,HILC,2*HIDB)
HILINE:LINE=(HILINC,HINTER,HIBST)

USE,HILINE

```



```
TOTAL_LENGTH = 23.100000      MUX = 1.545331      MUY = 0.972635
DELTA(S) = 0.000000 mm      DMUX = -1.484248    DMUY = -0.240087
                           BETAX(MAX) = 13.975694   BETAY(MAX) = 21.818149
                           DX(MAX) = 4.940430     DY(MAX) = 0.390587
```

```
## WARNING ## TWISS1: TWISS PARAMETERS FOR DELTA(P)/P = 0.00000000 MAY BE WRONG DUE TO COUPLING.
```

```
## WARNING ## TWISS1: TWISS PARAMETERS FOR DELTA(P)/P = 0.00000000 MAY BE WRONG DUE TO COUPLING.
```


LINC	BML	QDF	LK	FD	LL						
		QDA	LA	DA	LB	QDB	QDB	LC	DBR	DBR	
LIN	BML	LINC	NTER	BST							

