



Brookhaven  
National Laboratory

BNL-104185-2014-TECH

AGS.SN312;BNL-104185-2014-IR

## Emittance Measurements in the LTB and BTA Lines

P. Sampson

April 1993

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.

<b>AGS Complex Machine Studies</b> <b>(AGS Studies Report No. 312)</b> <b>Emittance Measurements in the LTB and BTA Lines</b>
<b>Study Period:</b> Various (see tables below)
<b>Participants:</b> P. Sampson
<b>Reported by:</b> P. Sampson
<b>Machine(s):</b> Linac / Booster / AGS (transfer lines)
<b>Beam:</b> Proton

The TWISS parameters of the beam in the LTB and BTA transport lines were measured several times in FY93 and 94.

The data analysis methods utilize acquired harp profiles and the MAD models for each line. Two are presently available, the 'bmline\_emit' program on the AGS DCS (Apollo) and EMIT, run on BNLDAG. Descriptions of each method can be found in the help file for 'bmline\_emit'.

The results are projected to the initial point for each line. For LTB this point is tank 9 and for BTA it is F6 in the Booster.

Tables 1 and 2 show LTB results for FY93 and 94 respectively. Table 3, Booster extraction parameters. Tables 4 and 5 are FY93 and FY94 BTA results.

Methods are as follows; REPORTED - as reported to the MCR by LINAC personnel, EMIT - from 'bmline\_emit' analysis, BNLDAG - from EMIT on the BNLDAG, MODELED -as reflected by a MAD model of the Booster.

**Table 1**

<b>DATE/ METHOD</b>	$\alpha_X$	$\beta_X$	$\epsilon_X$	$\alpha_Y$	$\beta_Y$	$\epsilon_Y$
2/93 - REPORTED	1.13	3.4	.8	-1.0	5.0	.6
2/93 - EMIT	2.18 +/- .22	5.32 +/- .53	1.59 +/- .14	-1.05 +/- 1.6	4.24 +/- 2.19	.99 +/- .62
2/93 - BNLDAG	2.63 +/- .05	6.41 +/- .12	1.41 +/- .08	-.49 +/- .12	5.03 +/- .66	.52 +/- .016

**Table 2**

<b>DATE/ METHOD</b>	$\alpha_X$	$\beta_X$	$\epsilon_X$	$\alpha_Y$	$\beta_Y$	$\epsilon_Y$
REPORTED 4/94	.67	2.12	2.32	-.12	2.63	1.96
2/94 - EMIT	1.80 +/- .25	7.24 +/- .53	2.39 +/- .35	.11 +/- .20	3.40 +/- .68	1.51 +/- .38
2-94 - BNLDAG	1.46 +/- .07	6.10 +/- .24	2.45 +/- .11	-.41 +/- .05	3.77 +/- .18	1.76 +/- .08
3-94 - EMIT	2.57 +/- 3.38	8.7 +/- 8.9	2.15 +/- 2.6	-.14 +/- .29	3.12 +/- .86	1.43 +/- .47
3-94 BNLDAG	3.98 +/- .96	14.94 +/- 3.4	1.47 +/- .37	-.19 +/- .07	2.33 +/- .2	1.75 +/- .12

BTA measurements were also taken in both FY93 and FY94. Extraction energy, rf harmonic and frequency were different from year to year.

**Table 3**

YEAR	RADIUS	RF FREQ/ HARMONIC	MOMENTUM	KINETIC ENERGY
STORE 1993	2mm	4.086 MHz/3	2.153 GeV/C	1.410 GeV/C
MEASURED 1994	7mm	2.754 MHz/2	2.311 GeV/C	1.561 GeV/C

Differences between the modeled parameters and results for FY94 indicate that the model must be modified.

Horizontal profile widths used to calculate emittance parameters are not corrected for dispersion.

**Table 4**

DATE/ METHOD	$\alpha_X$	$\beta_X$	$\epsilon_X$	$\alpha_Y$	$\beta_Y$	$\epsilon_Y$
MODELED VALUES	1.7	12.09	n/a	-.71	4.56	n/a
4-93 EMIT	2.35 +/- .09	13.37 +/- 1.95	4.39 +/- .94	.47 +/- .26	4.76 +/- .62	1.61 +/- .22
4-93 BNLDAG	2.11 +/- .23	13.36 +/- 1.03	4.69 +/- .44	-.27 +/- .06	2.51 +/- .21	2.19 +/- .12

Table 5

DATE/ METHOD	$\alpha_X$	$\beta_X$	$\epsilon_X$	$\alpha_Y$	$\beta_Y$	$\epsilon_Y$
2-94 EMIT	4.27 +/- .22	34.61 +/- 1.59	3.14 +/- .21	-.60 +/- .06	3.45 +/- .80	.59 +/- .04
2-94 BNLDAG	4.55 +/- .22	36.23 +/- 1.62	3.35 +/- .12	-.61 +/- .16	3.07 +/- .25	.67 +/- .10
4-94 EMIT	7.26 +/- .41	41.8 +/- 2.41	9.56 +/- .18	-.45 +/- .08	3.01 +/- .54	1.33 +/- .15
4-94 BNLDAG	6.64 +/- .36	37.99 +/- 2.21	9.20 +/- .36	-.54 +/- .06	3.98 +/- .21	1.56 +/- .06