

Vertical Beam Size and Emittance at Low and High Intensity

E. Raka

August 1977

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.EY-76-C-02-0016 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.

Date 8/8,9,11,15,26,29,31/77

Experimenters E. Raka

Subject Vertical Beam Size and Emittance at Low and High Intensity

OBSERVATIONS AND CONCLUSION

Purpose: To measure the vertical emittance of the AGS beam at different intensity levels and momenta in order to determine the magnitude of phase space dilutions that are present.

AGS Conditions: Measurements were made parasitically on SEB runs at 5 GeV and $\approx 3 \times 10^{12}$ protons/pulse and normal 28.5 GeV SEB running at $\approx 9.5 \times 10^{12}$ /pulse; linac current ≈ 70 mA. ≈ 110 μ sec at high intensity and 5-6 turns at low intensity.

Procedure: The J19 vertical targets were used to remove either 5 or 10% of the beam from the top or bottom. Records of the beam frequency and gauss clock reading were made at the end of the loss pattern as observed on the normalized current transformer. The latter signal was measured before and after by an A to D converter and the difference multiplied by five displayed.

Results:

	Size	$\beta\gamma$	GC	Emittance*	Time	
3×10^{12}	1.45"	1.33	--	20.5 $\pi \mu$ radM	95 msec	
6 turns 79 mA	.77"	5.34	--	23.2 "	175 "	
3×10^{12}	1.215"	1.34	--	14.5* "	96 "	*90% emittance
5 turns 76 mA						
9.5×10^{12}	1.675"	1.39	2459	28.5 "	94 "	
72 mA	.845"	6.88	12625	36 "	194 "	
	.795"	6.88	"	31.8 "* "	194* "	*zero theta skew quad program on.
$1.3 \times 10^{12*}$	1.88"*	.686	--	17.7 "* "	52*	*i.e. injection spiraling beam only

* 95% except as noted.

Comments: Both the low and high intensity results indicate that the emittance growth from about twice injection momentum to near transition energy can be controlled. There is still significant growth from injection to a $\beta\gamma \approx 1.4$ although the accuracy of the spiraling beam measurement is less than that of the others. Also HEBT emittance of $\approx 5 \pi$ for 90% have been obtained by J-L LeMaire which imply considerable dilution in the injection process. The latter is apparently only mildly intensity dependent.