**OPTIMIZATION OF PARAMETERS
FOR THE INLINE-INJECTION SYSTEM
AT BROOKHAVEN ACCELERATOR
TEST FACILITY**

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7/10/17

2017-09-17

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OPTIMIZATION OF PARAMETERS FOR THE INLINE-INJECTION SYSTEM AT BROOKHAVEN ACCELERATOR TEST FACILITY (ATF)

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ABSTRACT

We present some of our parameter optimization results utilizing code PARMLEA, for the ATF Inline-Injection System. The new solenoid- Gun - Solenoid -- Drift-Linac Scheme (Fig. 2) would improve the beam quality needed for FEL and other experiments at ATF as compared to the beam quality of the original design injection system (Fig. 1). To optimize the gain in the beam quality we have considered various parameters including the accelerating field gradient on the photoathode, the Solenoid field strengths, separation between the gun and entrance to the linac as well as the (type and size) initial charge distributions. The effect of the changes in these parameters on the beam emittance is also given.

References:

Z. Parsa, *Development of the Alternate Entry Port for the ATF*, IEEE 1993, 0-7903-1203-1/93, p. 2723 (1993), and Refs. therein; also Z. Parsa, S.Ko, Optimization of the Photocathode - Linac separation for the ATF Injection System (1993), CAP-ATF TN #17.

We present some of our parameter optimization results for the Brookhaven Inline-Injection system, obtained with Program PARMELA (modified version on the UNIX Workstation, which gives slightly different results than the version we regularly have used in collaboration with L. Young. This version is used as a test for comparison with other calculations with this program version at ATF).

For convenience in interpreting the beam positions and profiles shown in the Figures, Table 1 shows the labeling of the elements in the beam line utilizing the input format for the code PARMELA.

The change in the beam emittance with variations in the initial particle distributions (with 66 MV/m field on the cathode) are shown: In Tables 2-1 to 2-4 (for flat, 1σ , 2σ , and 3σ Gaussian distributions), for the case of $I=0$; and in Tables 3-1 to 3-3 (for flat, 1σ , and 2σ Gaussian distributions), with solenoid current $I=2180$ amp. Figures 1 and 2 gives sketches of the original and new ATF injection systems. The new injection system consists of a solenoid - gun - solenoid inline with the linac, combination which could improve the beam quality needed for FEL and other experiments (compared to the original ATF double bend design (see Fig 1)). In this scheme the 1st solenoid (proceeding the gun) bucks the magnetic field of the 2nd solenoid to assure 0 (no degrading) field on the photocathode. Comparison of these figures provides the effects of the variations in the initial particle distributions and the solenoid field on the beam emittance.

Comparison of the results presented in Tables 2 and 3 (with 66 MV/m the field gradient on the cathode) to those shown in Figures 3 to 13 (with 100 MV/m field gradient on the cathode) further illustrates, the advantage of applying a higher accelerating gradients at the photocathode (avoiding the beam emittance growth). Figures 3 to 13 show the variations in the distance between the gun exit and the linac entrance, as well as the effects of the variations in the solenoid field (current) on the beam. In moving from the cathode through the gun the emittance first increases then decreases and diminishes. As the beam drifts out of the gun it accelerates and the beam emittance grows due to space charge (electron bunch self field) defocusing forces. By using a solenoid we compensate for the space charge defocusing forces. The location of the waist changes with the change in the solenoid field strength, as can be seen in Figures 3 to 13.

Additional figures and beam profiles for the new injection scheme with other solenoid field strengths as well as the results obtained with various initial distributions were given in our earlier papers (See Ref.).

Figure 1. A sketch of the Brookhaven ATF (original design) Injection system with the transport beamline from the gun to the linac entrance. Showing the positions of the magnetic elements.

Figure 2. A sketch of the Brookhaven ATF (new design) Inline-Injection system with the Solenoid+Gun+Solenoid combination placed inline with the linac.

Table 1. Shows the labling of the elements in the beam line (in PARMELA format) from the Cathode (at $z=0$), through the RF Gun and at various points (distance z from the cathode) to the Linac entrance.

n	z1	element	z2	dz
1	0.0	cell	2.6	2.625
2	2.6	cell	5.2	2.625
3	5.2	cell	7.9	2.625
4	7.9	drift	10.0	2.100
5	10.0	drift	12.0	2.000
6	12.0	drift	14.0	2.000
7	14.0	drift	16.0	2.000
8	16.0	drift	17.5	1.500
9	17.5	drift	20.0	2.500
10	20.0	drift	22.0	2.000
11	22.0	drift	24.0	2.000
12	24.0	drift	26.0	2.000
13	26.0	drift	28.0	2.000
14	28.0	drift	30.0	2.000
15	30.0	drift	32.0	2.000
16	32.0	drift	34.0	2.000
17	34.0	drift	36.0	2.000
18	36.0	drift	38.0	2.000
19	38.0	drift	40.0	2.000
20	40.0	drift	42.0	2.000
21	42.0	drift	44.0	2.000
22	44.0	drift	46.0	2.000
23	46.0	drift	48.0	2.000
24	48.0	drift	50.0	2.000
25	50.0	drift	54.0	4.000
26	54.0	drift	58.0	4.000
27	58.0	drift	62.0	4.000
28	62.0	drift	66.0	4.000
29	66.0	drift	70.0	4.000
30	70.0	drift	75.0	5.000
31	75.0	drift	80.0	5.000
32	80.0	drift	85.0	5.000
33	85.0	drift	90.0	5.000
34	90.0	drift	95.0	5.000
35	95.0	drift	100.0	5.000

SUMMARY:

We presented some of our results, for the ATF Inline-Injection System utilizing PARMLEA. As we showed previously, the alternate solenoid - Gun - Solenoid -- Linac Scheme (Fig. 2) would improve the beam quality needed for FEL and other experiments at ATF as compared to the beam quality of the original design injection system (Fig. 1). To optimize the gain in the beam quality we have considered various parameters including the accelerating field gradient on the photocathode, the Solenoid field strengths, separation between the gun and entrance to the linac as well as the (type and size) initial charge distributions. The effects of the changes in these parameters on the beam emittance were shown in Tables 2 and 3, and Figures 3 to 13.

Additional figures and beam profiles for the new injection scheme with other solenoid field strengths as well as the results obtained with various initial distributions were given in our earlier papers (See Ref.). With solenoid-Gun-solenoid straight injection into the linac scheme we can reduce the emittance dilution due to space charge forces, and produce the beam needed for FEL, IFEL and other laser acceleration experiments. The effects of variations in the solenoid strengths and d the distance from the photocathode to the linac entrance was studied and can be detrimental to the quality of beam. Figures 3-13 shows the effects of the variation in d on the beam profile for various solenoid field strengths. These figures further illustrate how the position of waist changes with the change in initial parameters such as solenoid strength and the distance d between the cathode and linac.

BNL RF GUN			(0.9mm); 5.15ps, 66.6MV/m, 1nC; phi=43.0					
nel no.	part in	part out	rms, n x	emax, n x, 90%	emax, n x, 100%	rms, n y	emax, n y, 90%	emax, n y, 100%
1	6000	6000	.3710	1.8965	7.5032	.3650	1.9078	7.5130
2	6000	6000	.4050	2.0929	7.4041	.3984	2.0956	7.2271
3	6000	6000	.4808	2.4656	8.6621	.4743	2.4764	8.3155
4	6000	6000	.5263	2.6922	9.1601	.5196	2.7105	8.8950
5	6000	6000	.5715	2.9017	9.6159	.5644	2.9388	9.5261
6	6000	6000	.6165	3.1329	10.1563	.6087	3.1546	10.1313
7	6000	6000	.6624	3.3557	10.8301	.6538	3.3859	10.7640
8	6000	6000	.6977	3.5277	11.3646	.6884	3.5278	11.2764
9	6000	6000	.7579	3.8219	12.2366	.7476	3.7812	12.1545
10	6000	6000	.8074	4.0639	12.9443	.7964	4.0064	12.8732
11	6000	6000	.8580	4.2817	13.6296	.8463	4.2603	13.6168
12	6000	6000	.9092	4.5001	14.3166	.8968	4.4993	14.3512
13	6000	6000	.9609	4.7426	14.9878	.9478	4.7458	15.1237
14	6000	6000	1.0135	4.9932	15.6546	.9996	5.0088	15.8503
15	6000	6000	1.0661	5.2466	16.3453	1.0515	5.2904	16.5678
16	6000	6000	1.1175	5.4960	17.0562	1.1022	5.5351	17.2743
17	6000	6000	1.1719	5.7533	17.7489	1.1559	5.8054	17.9816
18	6000	6000	1.2266	6.0180	18.4627	1.2099	6.0762	18.6763
19	6000	6000	1.2811	6.3353	19.1810	1.2638	6.3577	19.4361
20	6000	6000	1.3344	6.6116	19.9775	1.3163	6.6259	20.1564
21	6000	6000	1.3877	6.8800	20.7226	1.3690	6.9056	20.8798
22	6000	6000	1.4415	7.1722	21.4507	1.4221	7.1752	21.6149
23	6000	6000	1.4961	7.4424	22.1767	1.4761	7.4502	22.3874
24	6000	6000	1.5497	7.7007	22.8821	1.5291	7.7354	23.1566
25	6000	6000	1.6576	8.2359	24.3398	1.6358	8.2977	24.6523
26	6000	6000	1.7649	8.7715	25.7330	1.7420	8.8348	26.0482
27	6000	6000	1.8719	9.3085	27.1455	1.8479	9.4040	27.4193
28	6000	6000	1.9792	9.8717	28.5925	1.9540	9.9536	28.8340
29	6000	5895	2.0844	10.5401	29.4955	2.0478	10.5107	29.5794
30	6000	5330	2.1628	11.1152	28.8258	2.0942	10.9096	28.7490
31	6000	4706	2.1583	11.2282	28.4399	2.0820	10.8515	28.2516
32	6000	4208	2.0861	10.6266	29.5316	2.0343	10.5194	28.9825
33	6000	3799	1.9894	10.0923	30.5949	1.9959	10.0423	29.5350
34	6000	3457	1.9069	9.6483	31.5914	1.9114	9.4774	29.7902
35	6000	3169	1.8229	9.2926	30.0121	1.8466	9.2680	30.2737

Table 2-1. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with I=0, and “flat” beam.

Table 2-2. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with I=0, "Gaussian distribution, and 1 σ cut.

BNL RF GUN			(0.9mm) ; 5.15ps, 66.6MV/m, 1nC; phi=43.0					
nel no.	part in	part out	rms, n x	emax, n x, 90%	emax, n x, 100%	rms, n y	emax, n y, 90%	emax, n y, 100%
1	6000	6000	.4297	1.9115	13.1721	.4115	1.8329	13.0765
2	6000	6000	.4555	2.1142	12.1315	.4370	2.0238	11.9881
3	6000	6000	.5573	2.6176	13.0043	.5366	2.5082	12.5367
4	6000	6000	.6144	2.9255	13.3601	.5929	2.7947	12.6595
5	6000	6000	.6712	3.2174	13.6370	.6490	3.0890	12.7926
6	6000	6000	.7291	3.5112	13.9708	.7062	3.3574	13.0317
7	6000	6000	.7884	3.8036	14.4362	.7649	3.6253	13.4598
8	6000	6000	.8336	4.0231	14.8259	.8095	3.8307	13.8075
9	6000	6000	.9099	4.3995	15.5191	.8848	4.1821	14.3829
10	6000	6000	.9713	4.7226	16.0811	.9454	4.4820	14.8506
11	6000	6000	1.0329	5.0207	16.6560	1.0059	4.7486	15.3234
12	6000	6000	1.0954	5.3331	17.2313	1.0673	5.0230	15.7921
13	6000	6000	1.1575	5.6314	17.8060	1.1283	5.3061	16.2746
14	6000	6000	1.2205	5.9197	18.4161	1.1901	5.6072	16.7505
15	6000	6000	1.2847	6.2409	19.0057	1.2530	5.8934	17.3027
16	6000	6000	1.3477	6.5310	19.5575	1.3149	6.1961	17.9180
17	6000	6000	1.4116	6.8537	20.1284	1.3776	6.5030	18.5549
18	6000	6000	1.4756	7.1851	20.6939	1.4404	6.8124	19.1883
19	6000	6000	1.5395	7.4847	21.2921	1.5030	7.1312	19.8395
20	6000	6000	1.6033	7.7867	21.8605	1.5655	7.4327	20.4576
21	6000	6000	1.6670	8.1108	22.4306	1.6280	7.7516	21.0779
22	6000	6000	1.7320	8.4443	22.9787	1.6918	8.0712	21.6900
23	6000	6000	1.7962	8.7929	23.5577	1.7548	8.3596	22.3460
24	6000	6000	1.8606	9.1223	24.1671	1.8178	8.6664	23.0155
25	6000	6000	1.9885	9.7496	25.3456	1.9433	9.3086	24.3067
26	6000	6000	2.1169	10.4079	26.5543	2.0691	9.9260	25.5984
27	6000	6000	2.2467	11.0947	27.7089	2.1965	10.5432	26.8585
28	6000	5863	2.3668	11.8152	28.2696	2.3215	11.2441	27.6168
29	6000	5235	2.4330	12.4517	26.9355	2.3760	11.8080	26.6530
30	6000	4686	2.4566	12.7190	26.8706	2.4089	11.9695	26.6364
31	6000	4172	2.4426	12.6033	26.7604	2.3915	12.1203	26.8519
32	6000	3711	2.3976	12.4315	27.0423	2.3352	11.9915	27.9772
33	6000	3331	2.3475	12.1435	27.7279	2.2667	11.6767	27.9292
34	6000	2980	2.2544	11.3968	28.5764	2.1856	11.0768	27.2720
35	6000	2684	2.1890	11.2021	27.4573	2.1222	10.7291	27.7605

Table 2-3. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with I=0, "Gaussian distribution, and 2 σ cut.

BNL RF GUN			(0.9mm); 5.15ps, 66.6MV/m, 1nC; phi=43.0					
nel no.	part in	part out	rms, n x	emax, n x, 90%	emax, n x, 100%	rms, n y	emax, n y, 90%	emax, n y, 100%
1	6000	6000	.8096	3.4528	38.2458	.8050	3.3517	43.6499
2	6000	6000	.8142	3.4606	45.1723	.8091	3.3231	51.4595
3	6000	6000	.8490	3.6153	49.8454	.8422	3.4776	55.8061
4	6000	6000	.8590	3.6732	51.9732	.8522	3.5209	57.8025
5	6000	6000	.8697	3.7374	53.8403	.8631	3.5792	59.5785
6	6000	6000	.8862	3.8108	55.2302	.8798	3.6522	60.9412
7	6000	6000	.9061	3.9106	56.3319	.9005	3.7738	62.0877
8	6000	6000	.9221	3.9992	56.9971	.9171	3.8654	62.4327
9	6000	6000	.9497	4.1123	57.9137	.9461	3.9987	62.9159
10	6000	6000	.9724	4.2166	58.5759	.9700	4.1051	63.2252
11	6000	6000	.9957	4.3181	58.9786	.9943	4.2339	63.4827
12	6000	6000	1.0197	4.4093	59.3224	1.0192	4.3559	63.7031
13	6000	6000	1.0440	4.5209	59.6173	1.0444	4.4616	63.9169
14	6000	6000	1.0686	4.6209	59.8758	1.0700	4.5635	64.1298
15	6000	6000	1.0936	4.7349	60.2048	1.0959	4.6680	64.2612
16	6000	6000	1.1189	4.8537	60.4144	1.1220	4.7853	64.4067
17	6000	6000	1.1449	4.9940	60.6350	1.1488	4.9220	64.6648
18	6000	6000	1.1706	5.1305	60.8402	1.1754	5.0198	64.8026
19	6000	6000	1.1966	5.2901	61.0281	1.2022	5.1653	64.9364
20	6000	6000	1.2225	5.4030	61.3040	1.2289	5.3442	65.0443
21	6000	6000	1.2502	5.5242	61.4884	1.2576	5.4986	65.0740
22	6000	6000	1.2780	5.6594	61.6672	1.2862	5.6518	65.2787
23	6000	6000	1.3058	5.7910	61.8107	1.3149	5.8066	65.4509
24	6000	6000	1.3336	5.9070	62.0054	1.3436	5.9384	65.5471
25	6000	6000	1.3902	6.1801	62.3460	1.4019	6.1879	65.7735
26	6000	6000	1.4485	6.4952	62.8548	1.4620	6.4928	66.1358
27	6000	6000	1.5080	6.7815	63.3106	1.5232	6.7619	66.3304
28	6000	6000	1.5689	7.0856	63.6085	1.5857	7.0629	66.5155
29	6000	6000	1.6301	7.4161	63.9668	1.6484	7.3680	66.7559
30	6000	6000	1.7089	7.7832	64.4552	1.7292	7.7577	67.1181
31	6000	6000	1.7879	8.1557	64.8898	1.8103	8.1613	67.5116
32	6000	5580	1.8517	8.5907	62.7116	1.8734	8.6010	65.2338
33	6000	4954	1.8727	8.9490	58.6590	1.8903	8.9199	61.1833
34	6000	4463	1.8559	9.0042	56.1746	1.8953	9.1118	58.3844
35	6000	3972	1.8205	8.7067	54.0812	1.8549	8.9783	56.1183

Table 2-4. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with I=0, "Gaussian distribution, and 3 σ cut.

BNL RF GUN			(0.9mm) ; 5.15ps, 66.6MV/m, 1nC; phi=43.0					
nel no.	part in	part out	rms, n x	emax, n x, 90%	emax, n x, 100%	rms, n y	emax, n y, 90%	emax, n y, 100%
1	6000	6000	.9106	3.7444	57.8080	.9289	3.6943	54.2099
2	6000	6000	.9255	3.7498	64.6580	.9434	3.7635	57.1810
3	6000	6000	.9620	3.9205	66.4477	.9818	3.9346	62.5888
4	6000	6000	.9715	3.9871	68.4161	.9917	4.0132	63.2662
5	6000	6000	.9808	4.0357	70.4465	1.0016	4.0770	64.0481
6	000	6000	.9948	4.1246	71.0559	1.0164	4.1507	64.3489
7	6000	6000	1.0125	4.2150	71.4012	1.0350	4.2516	63.7177
8	6000	6000	1.0266	4.2963	71.5504	1.0500	4.3403	64.4801
9	6000	6000	1.0508	4.4363	71.7738	1.0758	4.4821	66.2711
10	6000	6000	1.0705	4.5469	71.8864	1.0968	4.5710	67.3943
11	6000	6000	1.0900	4.6330	71.9308	1.1177	4.6576	68.3176
12	6000	6000	1.1097	4.7096	71.9181	1.1388	4.7460	69.0770
13	6000	6000	1.1297	4.7911	71.8546	1.1600	4.8367	70.0170
14	6000	6000	1.1499	4.8802	71.7176	1.1814	4.9238	70.9200
15	6000	6000	1.1701	4.9715	71.5822	1.2028	5.0089	71.5309
16	6000	6000	1.1907	5.0739	71.4169	1.2246	5.0959	72.1284
17	6000	6000	1.2122	5.1738	71.2375	1.2471	5.2270	72.7474
18	6000	6000	1.2338	5.2723	71.0171	1.2697	5.3487	73.3091
19	6000	6000	1.2555	5.3743	70.7458	1.2925	5.4637	73.8901
20	6000	6000	1.2782	5.4746	70.4186	1.3163	5.5710	74.2876
21	6000	6000	1.3007	5.5932	70.0975	1.3399	5.6802	74.6815
22	6000	6000	1.3231	5.6955	69.7685	1.3633	5.7844	75.0799
23	6000	6000	1.3462	5.8348	69.4431	1.3874	5.8966	75.4670
24	6000	6000	1.3698	5.9768	69.1367	1.4120	6.0144	75.9072
25	6000	6000	1.4174	6.2132	68.5119	1.4617	6.2984	76.6742
26	6000	6000	1.4659	6.4256	67.9064	1.5122	6.5921	77.3763
27	6000	6000	1.5173	6.6821	67.2582	1.5656	6.8563	77.9768
28	6000	6000	1.5692	6.9525	66.6299	1.6195	7.1254	78.5645
29	6000	6000	1.6222	7.2110	65.9679	1.6745	7.3804	79.1213
30	6000	6000	1.6895	7.5453	65.1078	1.7442	7.7017	79.8535
31	6000	6000	1.7578	7.9185	64.3299	1.8149	8.0660	80.5240
32	6000	5925	1.7981	8.1621	56.8055	1.8611	8.2847	82.1138
33	6000	5208	1.8177	8.4874	53.5680	1.8918	8.5587	76.6298
34	6000	4691	1.8064	8.6253	51.6332	1.9008	8.7584	73.0376
35	6000	4214	1.7670	8.5938	49.2558	1.8879	8.8707	70.4206

Table 3-1. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system, solenoid current of I=2180, with a "flat" beam.

BNL RF GUN			(0.9mm); 5.15ps, 66.6MV/m, 1nC; phi=43.0					
nel no.	part in	part out	rms, n x	emax, n x, 90%	emax, n x, 100%	rms, n y	emax, n y, 90%	emax, n y, 100%
1	6000	6000	.2452	1.1608	7.7638	.2397	1.1407	8.2648
2	6000	6000	.3336	1.6365	9.4924	.3261	1.6213	9.5992
3	6000	6000	.2232	1.0511	7.0692	.2191	1.0351	7.2727
4	6000	6000	.2242	1.0560	7.2282	.2208	1.0461	7.2868
5	6000	6000	.2262	1.0772	7.2827	.2243	1.0619	7.2565
6	6000	6000	.2302	1.0889	7.0575	.2292	1.0890	7.1350
7	6000	6000	.2350	1.1043	7.4178	.2357	1.1193	7.2931
8	6000	6000	.2394	1.1336	7.8249	.2414	1.1518	7.3818
9	6000	6000	.2455	1.1599	8.2383	.2508	1.1861	8.0376
10	6000	6000	.2491	1.1743	8.4427	.2578	1.2041	8.1966
11	6000	6000	.2530	1.1799	8.4848	.2634	1.2275	8.0961
12	6000	6000	.2571	1.1952	8.8031	.2661	1.2274	8.7521
13	6000	6000	.2602	1.2137	9.0218	.2685	1.2371	9.2181
14	6000	6000	.2613	1.2196	9.1556	.2698	1.2426	9.5545
15	6000	6000	.2611	1.2177	9.2052	.2702	1.2449	9.7918
16	6000	6000	.2611	1.2140	9.2602	.2703	1.2480	9.9999
17	6000	6000	.2608	1.2098	9.2372	.2700	1.2533	10.1634
18	6000	6000	.2603	1.2004	9.2450	.2696	1.2518	10.2911
19	6000	6000	.2597	1.1961	9.3640	.2690	1.2452	10.3640
20	6000	6000	.2589	1.1843	9.5198	.2683	1.2426	10.4337
21	6000	6000	.2582	1.1791	9.6356	.2676	1.2359	10.4989
22	6000	6000	.2572	1.1756	9.7123	.2666	1.2352	10.5085
23	6000	6000	.2561	1.1742	9.7994	.2655	1.2355	10.4689
24	6000	6000	.2547	1.1702	9.8365	.2642	1.2269	10.4022
25	6000	6000	.2517	1.1631	9.8937	.2612	1.2084	10.2375
26	6000	6000	.2479	1.1470	9.8074	.2575	1.1893	10.0170
27	6000	6000	.2436	1.1342	9.7323	.2532	1.1722	9.8420
28	6000	6000	.2382	1.1101	9.4413	.2480	1.1499	9.6529
29	6000	6000	.2321	1.0850	9.0855	.2419	1.1251	9.5024
30	6000	6000	.2228	1.0410	8.6623	.2327	1.0779	9.1275
31	6000	6000	.2122	.9922	8.3486	.2220	1.0266	8.5563
32	6000	6000	.1997	.9244	7.7601	.2094	.9673	7.8259
33	6000	6000	.1853	.8633	7.0363	.1951	.9053	7.3390
34	6000	6000	.1699	.7951	6.7576	.1797	.8301	7.4200
35	6000	6000	.1542	.7164	6.7521	.1637	.7540	7.5077

Table 3-2. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system, solenoid current of I=2180, with a "Gaussian distribution, and 1 σ cut.

'BNL RF GUN (R=.04) (0.9mm); 5.15ps, 66.6MV/m, 1nC; phi=43.0 . '								
nel no.	part in	part out	rms, n x	emax, n x, 90%	emax, n x, 100%	rms, n y	emax, n y, 90%	emax, n y, 100%
1	6000	6000	.3572	1.5017	14.4280	.3446	1.4707	13.8732
2	6000	6000	.4123	1.7307	16.4855	.3952	1.6636	16.2587
3	6000	6000	.3446	1.4639	12.5882	.3314	1.3989	12.2198
4	6000	6000	.3460	1.4663	12.6450	.3324	1.4087	11.7472
5	6000	6000	.3479	1.4832	12.3690	.3348	1.4305	11.7570
6	6000	6000	.3513	1.4958	11.6009	.3390	1.4502	11.8923
7	6000	6000	.3557	1.4996	10.2656	.3457	1.4769	11.9923
8	6000	6000	.3597	1.5240	9.4593	.3522	1.5160	12.1799
9	6000	6000	.3657	1.5525	11.4778	.3631	1.5857	12.6562
10	6000	6000	.3696	1.5708	12.8902	.3712	1.6425	13.2941
11	6000	6000	.3729	1.5942	13.7198	.3778	1.6577	13.4073
12	6000	6000	.3745	1.6126	14.1186	.3821	1.6629	13.2785
13	6000	6000	.3752	1.6284	14.3030	.3845	1.6842	13.0730
14	6000	6000	.3746	1.6308	14.4050	.3848	1.6967	13.0193
15	6000	6000	.3733	1.6327	14.4906	.3838	1.6985	13.0111
16	6000	6000	.3719	1.6356	14.5489	.3826	1.6909	12.9181
17	6000	6000	.3703	1.6309	14.6070	.3810	1.6925	12.8917
18	6000	6000	.3682	1.6241	14.6974	.3791	1.6893	13.0784
19	6000	6000	.3656	1.6118	14.7806	.3766	1.6792	13.2465
20	6000	6000	.3625	1.5960	14.8975	.3736	1.6692	13.4340
21	6000	6000	.3591	1.5825	15.0211	.3703	1.6508	13.6119
22	6000	6000	.3556	1.5659	15.1159	.3669	1.6332	13.7618
23	6000	6000	.3520	1.5503	15.2360	.3634	1.6155	13.9293
24	6000	6000	.3483	1.5375	15.3487	.3599	1.5990	14.0833
25	6000	6000	.3406	1.5083	15.5486	.3522	1.5704	14.3594
26	6000	6000	.3324	1.4704	15.7328	.3441	1.5221	14.6127
27	6000	6000	.3236	1.4403	15.9472	.3354	1.4892	14.8654
28	6000	6000	.3143	1.3943	16.1308	.3261	1.4474	15.0886
29	6000	6000	.3042	1.3549	16.3297	.3161	1.4057	15.2869
30	6000	6000	.2904	1.2890	16.6044	.3022	1.3390	15.5131
31	6000	6000	.2755	1.2176	16.8731	.2872	1.2764	15.6944
32	6000	6000	.2592	1.1458	17.2398	.2709	1.2076	15.9034
33	6000	6000	.2421	1.0723	17.7165	.2534	1.1301	16.1705
34	6000	6000	.2243	.9902	18.3357	.2350	1.0527	16.5009
35	6000	6000	.2062	.9025	19.1361	.2162	.9622	16.9267

Table 3-3. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with solenoid current $I=2180$, a "Gaussian distribution, and 2σ cut .

BNL RF GUN			(0.9mm) ; 5.15ps, 66.6MV/m, 1nC; phi=43.0					
nel no.	part in	part out	rms, n x	emax, n x, 90%	emax, n x, 100%	rms, n y	emax, n y, 90%	emax, n y, 100%
1	6000	6000	.6968	3.0448	25.7063	.6926	2.9687	29.0730
2	6000	6000	.7645	3.2953	38.4460	.7626	3.1897	40.5704
3	6000	6000	.7633	3.2905	30.1589	.7548	3.2148	36.3098
4	6000	6000	.7726	3.3156	31.2611	.7642	3.2620	37.8081
5	6000	6000	.7813	3.3507	31.8636	.7739	3.3122	38.3457
6	6000	6000	.7904	3.3595	31.5396	.7850	3.3674	39.3224
7	6000	6000	.7996	3.4496	29.9747	.7977	3.3852	41.4154
8	6000	6000	.8065	3.4632	28.7494	.8080	3.4398	41.8552
9	6000	6000	.8181	3.5013	29.7911	.8258	3.5114	40.0654
10	6000	6000	.8272	3.5187	39.4488	.8395	3.5752	36.6919
11	6000	6000	.8353	3.5460	47.8206	.8510	3.6617	40.7925
12	6000	6000	.8411	3.5555	53.9021	.8594	3.6722	43.3185
13	6000	6000	.8452	3.5781	57.9719	.8649	3.7020	44.7987
14	6000	6000	.8484	3.5733	60.6714	.8690	3.7285	45.7532
15	6000	6000	.8512	3.5920	62.6302	.8722	3.7595	46.4854
16	6000	6000	.8537	3.6086	64.1616	.8752	3.7859	47.1376
17	6000	6000	.8560	3.6014	65.4703	.8778	3.8034	47.7575
18	6000	6000	.8579	3.6083	66.6554	.8801	3.7981	48.3658
19	6000	6000	.8595	3.6121	67.7561	.8821	3.7857	48.9636
20	6000	6000	.8607	3.6136	68.8066	.8837	3.7844	49.5572
21	6000	6000	.8615	3.6090	69.8074	.8849	3.7856	50.1335
22	6000	6000	.8620	3.6055	70.7664	.8858	3.7742	50.6898
23	6000	6000	.8621	3.6091	71.6815	.8862	3.7731	51.2257
24	6000	6000	.8618	3.6150	72.5559	.8862	3.7728	51.7263
25	6000	6000	.8600	3.5869	74.1791	.8850	3.7604	52.6517
26	6000	6000	.8565	3.5672	75.5732	.8820	3.7368	53.3962
27	6000	6000	.8514	3.5310	76.6529	.8772	3.7107	53.9397
28	6000	6000	.8446	3.4958	77.3710	.8707	3.6810	54.2826
29	6000	6000	.8360	3.4492	77.8714	.8621	3.6390	54.4754
30	6000	6000	.8233	3.3893	79.7851	.8492	3.5834	54.8552
31	6000	6000	.8091	3.3393	82.8442	.8352	3.5103	57.5053
32	6000	6000	.7947	3.2815	83.4316	.8221	3.4439	59.9301
33	6000	6000	.7834	3.2014	81.8143	.8109	3.4189	59.8486
34	6000	6000	.7775	3.1564	77.7248	.8035	3.3865	57.8039
35	6000	6000	.7746	3.1253	71.6925	.7984	3.3468	54.0897

Figures 3 -1 to 3-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -5 shows the beam profile at position ($ne=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figures 4 -1 to 4-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 4 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figures 5 -1 to 5-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figures 6 -1 to 6-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figures 7 -1 to 7-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7-3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp

Figure 7 -4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7 - 5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 7-8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figures 8 -1 to 8-10 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8-4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 8 -8 shows the beam profile at position (ne=27) $z=58$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -9 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -10 shows the beam profile at position (ne=35) $z=95$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figures 9 -1 to 9-9 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9-4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9-8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9-9 shows the beam profile at position (ne=34) $z=90$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figures 10 -1 to 10-9 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10-4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10-8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10-9 shows the beam profile at position (ne=34) $z=90$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figures 11 -1 to 11-9 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11-4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11-8 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11-9 shows the beam profile at position (ne=34) $z=90$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figures 12 -1 to 12-10 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-8 shows the beam profile at position (ne=27) $z=58$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-9 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-10 shows the beam profile at position (ne=35) $z=95$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figures 13 -1 to 13-10 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -2 shows the beam profile at position (ne=2) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -3 shows the beam profile at position (ne=3) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-4 shows the beam profile at position (ne=4) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -5 shows the beam profile at position (ne=5) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -6 shows the beam profile at position (ne=10) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -7 shows the beam profile at position (ne=20) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-8 shows the beam profile at position (ne=27) $z=58$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-9 shows the beam profile at position (ne=30) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-10 shows the beam profile at position (ne=35) $z=95$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

TABLE CAPTIONS:

Table 1. Shows the labling of the elements in the beam line (in PARMELA format) from the Cathode (at $z=0$), through the RF Gun and at various points (distance z from the cathode) to the Linac entrance.

Table 2-1. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with $I=0$, and “flat” beam.

Table 2-2. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with $I=0$, “Gaussian distribution, and 1σ cut.

Table 2-3. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with $I=0$, “Gaussian distribution, and 2σ cut.

Table 2-4. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with $I=0$, “Gaussian distribution, and 3σ cut.

Table 3-1. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system, solenoid current of $I=2180$, with a “flat” beam.

Table 3-2. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system, solenoid current of $I=2180$, with a “Gaussian distribution, and 1σ cut.

Table 3-3. Shows variation of emittance through the gun, at the the gun exit and out side of the gun through the drift space(s) to the Linac entrance. With 66 MV/m field on the cathode for the Inline-Injection system with solenoid current $I=2180$, a “Gaussian distribution, and 3σ cut.

FIGURE CAPTIONS:

Figure 1. A sketch of the Brookhaven ATF (original design) Injection system with the transport beamline from the gun to the linac entrance. Showing the positions of the magnetic elements.

Figure 2. A sketch of the Brookhaven ATF (new design) Inline-Injection system with the Solenoid + Gun + Solenoid combination placed inline with the linac.

Figures 3 -1 to 3-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -2 shows the beam profile at position ($ne=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -3 shows the beam profile at position ($ne=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -4 shows the beam profile at position ($ne=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -5 shows the beam profile at position ($ne=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -6 shows the beam profile at position ($ne=10$) $z=20$ with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -7 shows the beam profile at position ($ne=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 3 -8 shows the beam profile at position ($ne=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figures 4 -1 to 4-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2140$ amp.

Figure 4 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -2 shows the beam profile at position ($ne=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -3 shows the beam profile at position ($ne=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -4 shows the beam profile at position ($ne=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -5 shows the beam profile at position ($ne=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -6 shows the beam profile at position ($ne=10$) $z=20$ with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -7 shows the beam profile at position ($ne=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figure 4 -8 shows the beam profile at position ($ne=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2160$ amp.

Figures 5 -1 to 5-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -2 shows the beam profile at position ($ne=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -3 shows the beam profile at position ($ne=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -4 shows the beam profile at position ($ne=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -5 shows the beam profile at position ($ne=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -6 shows the beam profile at position ($ne=10$) $z=20$ with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -7 shows the beam profile at position ($ne=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 5 -8 shows the beam profile at position ($ne=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figures 6 -1 to 6-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -2 shows the beam profile at position ($ne=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -3 shows the beam profile at position ($ne=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -4 shows the beam profile at position ($ne=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -5 shows the beam profile at position ($ne=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -6 shows the beam profile at position ($ne=10$) $z=20$ with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -7 shows the beam profile at position ($ne=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figure 6 -8 shows the beam profile at position ($ne=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2200$ amp.

Figures 7 -1 to 7-8 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7 -1 shows the beam profile at position ($ne=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7 -2 shows the beam profile at position ($ne=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7-3 shows the beam profile at position ($n_e=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7-4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7-5 shows the beam profile at position ($n_e=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7-6 shows the beam profile at position ($n_e=10$) $z=20$ with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figure 7-7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 7-8 shows the beam profile at position ($n_e=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2400$ amp.

Figures 8-1 to 8-10 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8-1 shows the beam profile at position ($n_e=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8-2 shows the beam profile at position ($n_e=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8-3 shows the beam profile at position ($n_e=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8-4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -5 shows the beam profile at position ($n_e=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -6 shows the beam profile at position ($n_e=10$) $z=20$ with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2180$ amp.

Figure 8 -8 shows the beam profile at position ($n_e=27$) $z=58$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -9 shows the beam profile at position ($n_e=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figure 8 -10 shows the beam profile at position ($n_e=35$) $z=95$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2500$ amp.

Figures 9 -1 to 9-9 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -1 shows the beam profile at position ($n_e=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -2 shows the beam profile at position ($n_e=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -3 shows the beam profile at position ($n_e=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9-4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -5 shows the beam profile at position ($n_e=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -6 shows the beam profile at position ($n_e=10$) $z=20$ with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9-8 shows the beam profile at position ($n_e=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figure 9-9 shows the beam profile at position ($n_e=34$) $z=90$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2600$ amp.

Figures 10 -1 to 10-9 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -1 shows the beam profile at position ($n_e=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -2 shows the beam profile at position ($n_e=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -3 shows the beam profile at position ($n_e=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10-4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -5 shows the beam profile at position ($n_e=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -6 shows the beam profile at position ($n_e=10$) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10-8 shows the beam profile at position ($n_e=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figure 10-9 shows the beam profile at position ($n_e=34$) $z=90$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=2800$ amp.

Figures 11 -1 to 11-9 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -1 shows the beam profile at position ($n_e=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -2 shows the beam profile at position ($n_e=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -3 shows the beam profile at position ($n_e=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11-4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -5 shows the beam profile at position ($n_e=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -6 shows the beam profile at position ($n_e=10$) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11-8 shows the beam profile at position ($n_e=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figure 11-9 shows the beam profile at position ($n_e=34$) $z=90$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3000$ amp.

Figures 12 -1 to 12-10 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -1 shows the beam profile at position ($n_e=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -2 shows the beam profile at position ($n_e=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -3 shows the beam profile at position ($n_e=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -5 shows the beam profile at position ($n_e=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -6 shows the beam profile at position ($n_e=10$) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-8 shows the beam profile at position ($n_e=27$) $z=58$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-9 shows the beam profile at position ($n_e=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figure 12-10 shows the beam profile at position ($n_e=35$) $z=95$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3400$ amp.

Figures 13 -1 to 13-10 shows the beam profile at various positions (distance z from the cathode), with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -1 shows the beam profile at position ($n_e=1$) $z=0$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -2 shows the beam profile at position ($n_e=2$) $z=2.6$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -3 shows the beam profile at position ($n_e=3$) $z=5.2$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-4 shows the beam profile at position ($n_e=4$) $z=7.9$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -5 shows the beam profile at position ($n_e=5$) $z=10$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -6 shows the beam profile at position ($n_e=10$) $z=20$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13 -7 shows the beam profile at position ($n_e=20$) $z=40$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-8 shows the beam profile at position ($n_e=27$) $z=58$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-9 shows the beam profile at position ($n_e=30$) $z=70$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

Figure 13-10 shows the beam profile at position ($n_e=35$) $z=95$, with the Inline-Injection system of Solenoid + Gun + Solenoid combination inline with the linac. With Solenoid current of $I=3800$ amp.

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*Work performed under the auspices of U.S. Dept. of Energy contract DE-AC02-76-CH00016.

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