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INITIAL PERFORMANCE OF THE MAGNET SYSTEM IN THE SPLITTER/COMBINER SECTION OF THE CORNELL-BROOKHAVEN ENERGY-RECOVERY LINAC TEST ACCELERATOR

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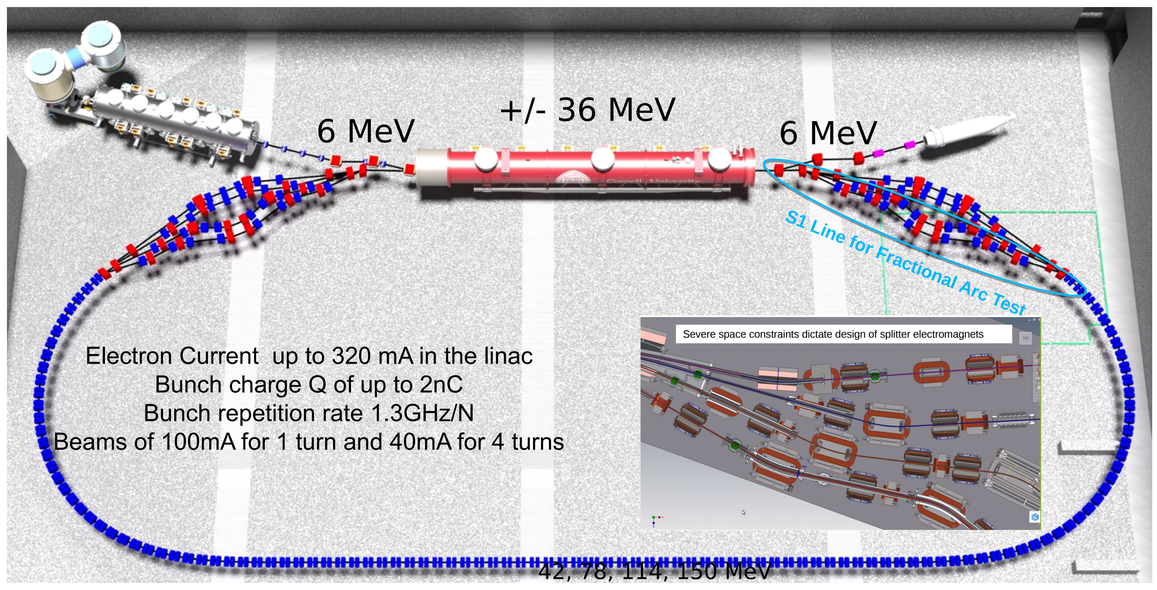
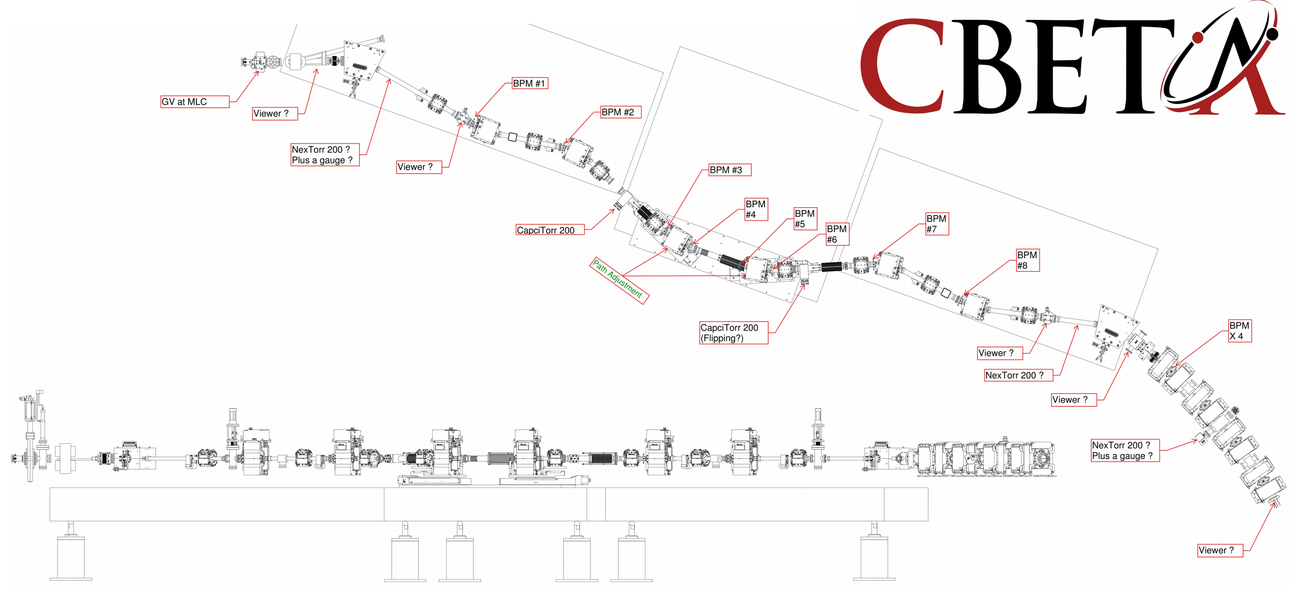
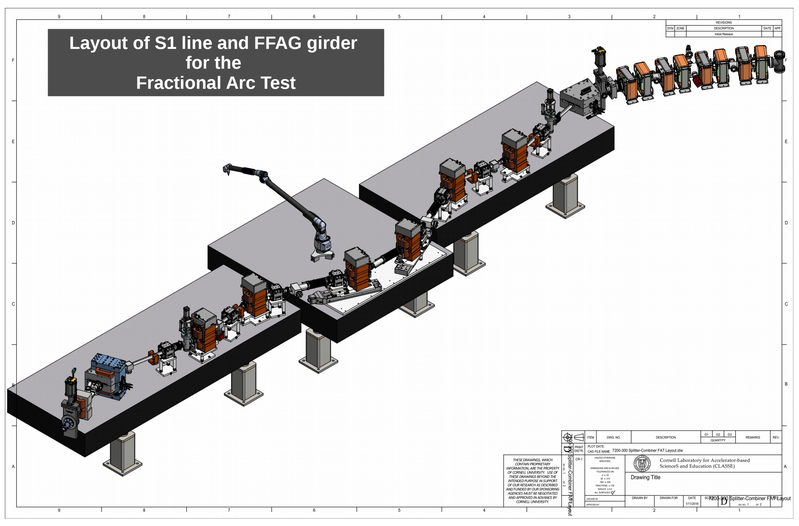
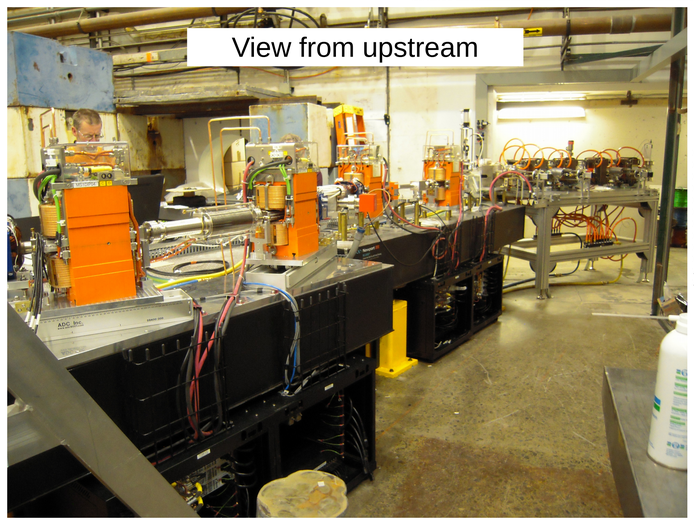
Abstract

The Cornell-Brookhaven Energy-recovery Linac Test Accelerator is a four-pass, 150-MeV electron accelerator with a six-cell 1.3 GHz superconducting-RF linear accelerator and a fixed-field alternating-gradient (FFAG) return loop made up of Halbach-style quadrupole magnets. The optics matching between the linear accelerator and the return loop is achieved with a conventional magnet system comprised of 50 dipole magnets and 64 quadrupole magnets in four beamlines at each end of the linac. The 42-, 78-, 114- and 150-MeV electron beams are separated into independent vacuum chambers in order to allow for the path-length adjustment required by energy recovery. We report on the first beam tests of the initial installation of the splitter/combiner section at the exit of the linac. The vacuum system of the 42-MeV S1 line was installed during the first week of April. Nine dipole and four quadrupole magnets were installed and surveyed into position the following week, and the water cooling system was commissioned. A 6-MeV beam passed through the line on April 11 with no need for adjusting pre-set magnet excitation currents. One week later, time-of-flight measurements were used to calibrate and phase the individual superconducting RF cavities. The S1 magnet settings were then scaled up to achieve 5-cavity, 42-MeV operation through the first nine FFAG permanent-magnet quadrupoles. This initial Fractional Arc Test will conclude on May 18, when the installation of the remaining seven splitter/combiner lines and the return loop will begin. CBETA operations are scheduled to begin in early 2019.

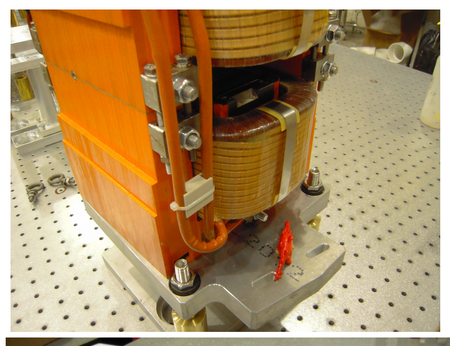


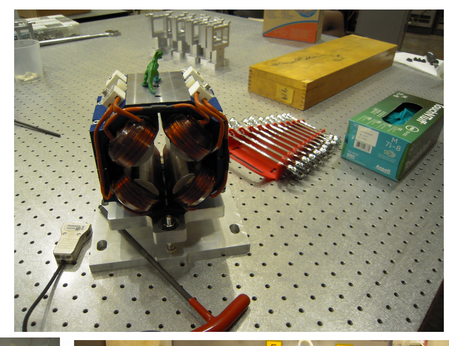


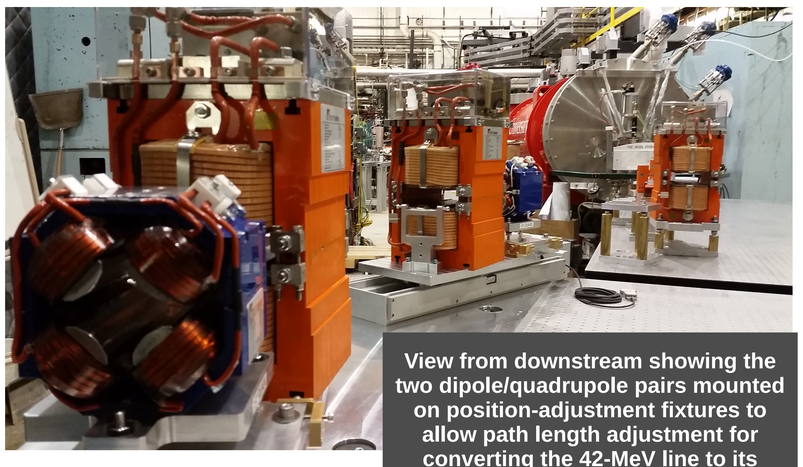




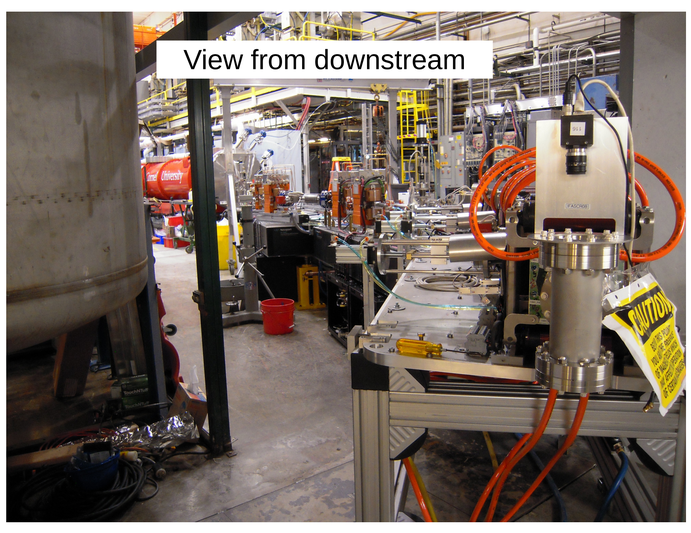
	Type	S Position (m)	Length (m)	Momentum (MeV)	B field (T)	B integral (T-m)	Bd angle (degrees)	Bd Radius (m)	Sagitta (cm)	Gradient (T/m)	L (mH)	NI kA-turns	Power Supply (V)	(A)	Curr Density A/mm^2
1	MD1DIP01 H-dip-4-A	22.473	0.100	6.000	0.0408	0.0052	0.000	0.000	0.000	0.000	230.00	0.592	1.4	1.7	0.33
2	MS1DPB01 H-common	23.155	0.214	41.997	-0.3634	-0.0793	27.502	0.445	1.278	0.000	2.57	-4.469	-11.9	-223.5	-9.66
3	MS1DIP02 H-dip-1	24.483	0.160	41.997	0.2195	0.0440	-17.991	-0.509	-0.627	0.000	9.10	3.270	2.9	62.9	2.72
4	MS1DIP03 H-dip-1	25.368	0.160	41.997	-0.3805	-0.0763	31.226	0.294	1.083	0.000	9.10	-5.670	-5.0	-109.0	-4.72
5	MS1DIP04 H-dip-1	26.597	0.160	41.997	0.2839	0.0569	-23.262	-0.393	-0.810	0.000	9.10	4.231	3.7	81.4	3.52
6	MS1DIP05 H-dip-1	27.392	0.160	41.997	0.2839	0.0569	-23.262	-0.393	-0.810	0.000	9.10	4.231	3.7	81.4	3.52
7	MS1DIP06 H-dip-1	28.622	0.160	41.997	-0.3805	-0.0763	31.226	0.294	1.083	0.000	9.10	-5.670	-5.0	-109.0	-4.72
8	MS1DIP07 H-dip-1	29.505	0.160	41.997	0.2468	0.0495	-20.225	-0.453	-0.705	0.000	9.10	3.678	3.2	70.7	3.06
9	MS1DPB08 H-common	30.818	0.214	41.997	-0.3417	-0.0746	27.502	0.445	1.278	0.000	2.57	-4.203	-11.2	-210.1	-9.09
10	MS1QUA01 Quad-1-A	23.938	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	34.00	0.000	0.0	0.0	0.00
11	MS1QUA02 Quad-1-A	24.909	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	34.00	0.000	0.0	0.0	0.00
12	MS1QUA03 Quad-1-A	25.594	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	-1.222	34.00	-0.248	-1.1	-3.0	-0.63
13	MS1QUA04 Quad-1-A	26.312	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	1.799	34.00	0.365	1.7	4.4	0.93
14	MS1QUA05 Quad-1-A	27.608	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	0.104	34.00	0.021	0.1	0.3	0.05
15	MS1QUA06 Quad-1-A	28.326	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	-0.675	34.00	-0.137	-0.6	-1.7	-0.35
16	MS1QUA07 Quad-1-A	29.010	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	34.00	0.000	0.0	0.0	0.00
17	MS1QUA08 Quad-1-A	29.981	0.150	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	34.00	0.000	0.0	0.0	0.00
18	MS1CRV01 V-cor-2	23.745	0.045	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.000	0.0	0.0	0.00
19	MS1CRV02 V-cor-2	25.030	0.045	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.000	0.0	0.0	0.00
20	MS1CRV03 V-cor-2	28.842	0.045	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.000	0.0	0.0	0.00
21	MS1CRV04 V-cor-2	29.812	0.045	41.997	0.0000	0.0000	0.000	0.000	0.000	0.000	0.00	0.000	0.0	0.0	0.00

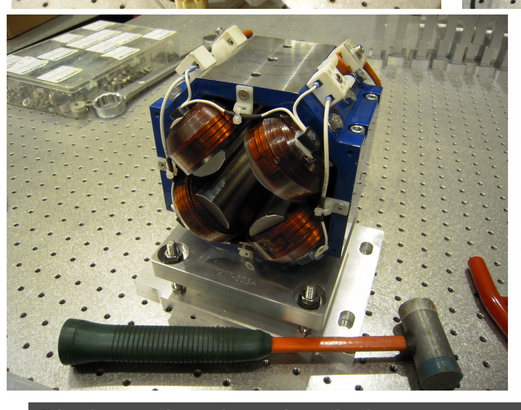


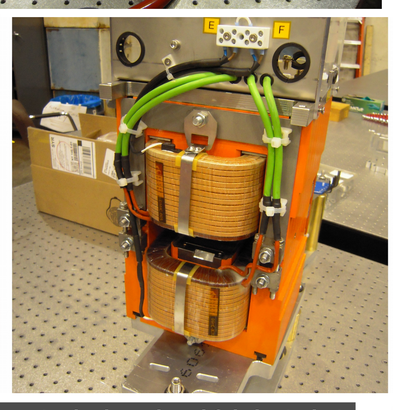




View from downstream showing the two dipole/quadrupole pairs mounted on position-adjustment fixtures to allow path length adjustment for converting the 42-MeV line to its energy-recovery configuration.







Dipole, quadrupole, and vertical corrector magnets designed and fabricated at Elytt/Neurus Technologies, Madrid, Spain

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