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P. Samson

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Collider Accelerator Department Brookhaven National Laboratory

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Water Temperature vs. BtA Stability Explored

P. Sampson, C. Karns BNL



Collider-Accelerator Department Brookhaven National Laboratory Upton, NY 11973

AGS Complex Machine Studies

Water Temperature vs. BtA stability Explored

Study Period: February 18th, 2000

Participants: C. Karns

Reported by: P. Sampson, C. Karns

Machine Booster and BtA

Beam: High Intensity Protons

Tools: CBMs, Spreadsheet, BtA Harps and Booster Gauss Clock

Aim: To study the effect that the water temperature change brought on by turning the Booster Main Magnet off has on BtA and transfer efficiency.

Water Temperature vs. BTA stability explored

1. Summary

This experiment was performed as part of the ongoing effort to determine the source of unexpected steering changes in the Booster to AGS (BtA) line. Since it was commissioned, this line has proven to need steering adjustments at regular intervals. Also of concern is that beam steering does not return to nominal when a file is loaded following any changes to the line (i.e. after a study). One thought was that changes in cooling water temperature, brought on by turning the Booster Main Magnet power supply (BMMPS) off, effect BtA transport elements, since many of these devices are cooled by the same system.

It was observed that turning off the BMMPS, made its cooling water temperature drop from 98°f to 92°f or 6%. There was no observable effect on power supply read backs for elements in the BtA line, however, changes were seen in the Booster Main Ring injection field. Further study is indicated.

2. Experiment

Transport between the AGS and Booster was optimized, then archived. Data for power supply read backs, Booster Main Ring fields, BtA harp positions and Booster extraction radius were recorded. The BMMPS was then turned off and the water temperature allowed to stabilize. Once stable, the MMPS was re-energized and sets of data for the above parameters were taken every 15 minutes until the cooling water reached normal operating temperature. A total of 5 sets of data were taken. Intensities were recorded throughout the exercise.

3. Results

SpreadSheet read backs vs. Time for BtA elements:

Time	DH1	DH2-3	DH4	DH127	DH158	DH5	DV007	DV030	DV120
10:00	183.08	4212.5	172.601	14.7582	4.0256	526.99	0.9267	-1.5275	0.5604
11:00	183.76	4208.8	172.381	14.7948	4.0256	527.97	0.9194	-1.5861	0.5604
11:15	182.56	4212.5	172.308	14.7729	4.0183	527.24	0.9267	-1.5495	0.5604
11:30	182.22	4212.5	171.868	14.7729	4.0183	526.75	0.9267	-1.5568	0.5677
11:45	183.59	4212.5	172.527	14.7655	4.011	527.24	0.934	-1.5568	0.5677
12:00	183.42	4212.5	172.454	14.7655	4.0256	527.24	0.9121	-1.5128	0.5531

Time	DV181	QV1	QH2	QV3	QH4	QV5	QH6	QV7	QH8
10:00	7.8644	427.6	533.1	511.12	675.95	608.43	641.4	323.82	324.18
11:00	7.8425	427.85	532.85	511.36	680.1	607.7	641.4	323.45	329.18
11:15	7.8644	427.6	532.85	510.87	675.46	608.07	641.03	322.72	324.72
11:30	7.8718	427.36	533.1	510.87	675.71	608.43	640.67	323.45	324.3
11:45	7.8718	427.36	532.85	510.63	674.97	607.33	641.4	323.45	324.05
12:00	7.8571	427.6	532.85	511.12	678.39	607.7	641.4	323.82	323.93

Time	QV9	QH10	QV11	QH12	QV13	QH14	QH15
10:00	519.66	147.35	258.242	378.97	560.45	318.69	0.49
11:00	517.09	144.96	258.242	376.75	558.25	330.17	1.59
11:15	520.17	143.59	258.315	377.26	559.23	325.29	1.34
11:30	518.8	146.84	258.168	377.61	560.93	317.47	1.34
11:45	518.63	147.01	258.022	378.63	560.69	318.2	0.98
12:00	519.14	146.84	258.242	379.14	559.96	319.67	2.44





MW006				MW 060	
	H mean	V mean		H mean	V mean
10:00	1.36	1.09	10:00	-19.31	0.72
11:00	2.17	0.98	11:00	-16.58	0.72
11:15	1.98	1.03	11:15	-16.24	0.7
11:30	1.9	1.02	11:30	-16.63	0.72
11:45	2.01	1.01	11:45	-15.95	0.74
12:00	1.98	1.02	12:00	-15.74	0.71
MW 125			MW 166		
	H mean	V mean		H mean	V mean
10:00	-6.9	3.12	10:00	-6.79	-4.84
11:00	-5.03	3.2	11:00	-6.51	-4.39
11:15	-5	2.98	11:15	-6.52	-4.75
11:30	-5.44	3.59	11:30	-5.94	-4.49
11:45	-4.67	2.93	11:45	-6.21	-4.36
12.00	-5 33	2 29	12.00	-6.32	-4 88

Position of beam envelope in BtA vs. Time (no changes in width were observed):



The following section shows how the overall efficiency behaved during the study period, each instance is representative of scalar reading on a single pulse:

Time	BSTR input	BSTR early	BSTR late	AGS CBM	BTA efficiency
10:00	1.72E+13	1.34E+13	1.24E+13	1.06E+13	85.48%
11:00	1.70E+13	1.26E+13	1.12E+13	6.88E+12	61.43%
11:15	1.71E+13	1.27E+13	1.11E+13	9.42E+12	84.86%
11:30	1.72E+13	1.26E+13	1.11E+13	9.28E+12	83.60%
11:45	1.71E+13	1.27E+13	1.12E+13	9.50E+12	84.82%
12:00	1.71E+13	1.27E+13	1.12E+13	9.36E+12	83.57%

Scalar read backs vs. Time:



The Booster injection field was also recorded at the Booster's Injection Peaker value several times during the study period.

Gauss clock readings vs. Time

Gauss counts					
10:00	1783				
11:00	1797				
11:15	1796				
11:30	1795				
11:45	1795				
12:00	1794				



4. Conclusion:

Though turning off the Booster Main Magnet power supply does change the cooling water temperature, which is shared by BTA elements, there is no demonstrated proof that this affects the elements in the line. The data shows that before and after the water temperature change, the beam positions and power supply read backs are within normal tolerances. The fact that there appears to be some shift in the Booster's injection field after the supply is turned back on, suggests that further study of this may provide information helpful in solving the BTA instability problem.