

Summary of The Existing MR Beam Diagnostics for Use in Main Injector

C.M. Bhat and D. Johnson
Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois 60510*
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Abstract

A survey of the beam diagnostic devices reusable from the Main Ring and their existing operational limitations have been made. Possible places of using these devices in the Main Injector and their operational requirements have been investigated.

Introduction

Previously a summary of the instrumentation requirements for the Main Injector has been given in MI76. In this report we revise them and give more specific MI requirements. Also summarize reusable beam diagnostic devices from the Main Ring and their existing limitations. Some qualitative facts regarding MI requirements are listed in the Table I. More details regarding the beam loss and beam intensity monitors are listed in tables II,III, and IV. For other devices the details are being determined.

Table I. Summary of Beam Diagnostic Instrumentation for the MI and Available devices from the MR.

Type/Location	Ring	P8	P1	A1	P2	P3	Abort	Total	Available from MR*
POSITION MONITORS									
New FMI style	203							203	To be built
Existing MR style		34	14	14	7	32	3	104	216
Large Aperture ¹	5							5	To be built
Booster Style		17						17	24(?)
Tuned Detector			3		2	6		11	-
LOSS MONITORS									
Ion Chambers	231	51	19	16	7	32	3	359	252
INT. MONITORS									
Resistive Wall ²	2							2	2
Toroid		2	1	1	2	1	1	8	6
DCCT	1							1	1
High Gain RF slow spill Monitors			1					1	To be built
PROFILE MONITORS									
Flying Wire	2							2	3
Wire Grid ³	6	4	2	2	2	3	2	21	19
Non-destructive ⁴	2								To be built
DAMPERS⁵									
Horizontal	1							1	1
Vertical	1							1	1
SCHOTTKY DET.									
Horizontal	1							1	Being Built
Vertical	1							1	Being Built
SCRAPERS⁶									
Horizontal		1						1	2
Vertical		1						1	2

* Hardware can mostly be transferred to MI without any significant changes. The electronics will be modified to meet MI needs.

¹ Large aperture beam position monitors are expected to be installed at the proton upstream end of the quads 101, 402, 522, 608, and 622 (i.e. adjacent to lambertsons in injection/extraction straight sections). These will be newly built.

² Presently there are two resistive wall monitors: one old type nearly 2GHz dynamic range wall monitor and other one is new type 6GHz. We may have to build a new one to replace the old style monitors.

³ Presently there 19 wire chambers are available from MR. We are investigating alternative techniques like OTR monitors or thin film FLAG as beam profile monitors in the beam line .

⁴ Presently there are no non-destructive type beam profile monitors in the MR. We are investigating the feasibility of using residual gas MCP type beam profile monitors in Booster and MR as well as MI.

⁵ Damper plates and high level will be recycled from MR. The LL has to be modified.

⁶ There are two pairs of scrapers available; one from Booster to MR beam line and the other from MR. We plan to reuse a pair of scrapers in Booster to MI beam line. In MI we do not intend to use any scrapers.

Beam Loss Monitors:

Table II. Loss Monitors : MR Status and MI Requirements

NUMBER OF BLM AVAILABLE FROM MR AND TYPE	MI REQUIREMENTS	COMMENTS
<p>252</p> <p>Argon gas filled Tevatron type BLMs. These BLMs are linear in the range of 0.001rad to 100rad (instantaneous). The expected total dynamic range is $\simeq 10^6$. The lower limit is set by electronics.</p>	<p>359(total)</p> <p>Primarily BLMs are same as in MR. Should be capable of detecting 0.1% beam loss at full intensity (i.e. 0.1mRad/ft of MI ring at 8GeV and 1.0mRad/ft of MI ring at 150GeV) instantaneously.</p>	<p>Need additional 107 BLMs</p> <p>The Electronics may have to be changed</p>

Presently the MR BLMs are used to findout (qualitatively) where the MR beam is lost during the acceleration cycle. The electronics are setup in such a way that the integrated counts (radiation) will be reset to zero at the end of each MR cycle. The minimum radiation loss detected is about .5mRad on BLM display. Instantaneous losses directly from the tunnel at each BLM may be plotted.

Resistive Wall Monitors :

Table III. Resistive Wall Monitors : MR Status and MI Requirements

# RESISTIVE WALL MONITORS AVAILABLE FROM MR AND TYPE	MI REQUIREMENTS	COMMENTS
<p>2</p> <p>One is old style, Length \simeq 5in beam pipe: round, $3\frac{1}{4}$in (?) Frequency range upto 2 GHz.</p> <p>One new style Length \simeq 1 meter beam pipe: round, $3\frac{1}{4}$in dia. Frequency range 4kHz- 6GHz.</p>	<p>2</p> <p>Two new style monitors are needed to measure .5-15ns bunches.</p> <p>(One for monitoring bunch structure during coalescing and other operations, and second for beam diagnostics studies.)</p>	<p>One New style Resistive wall monitor will be built and . part of the electronics from old style resistive wall monitor can be used.</p>

Toroid and DCCT :

Table IV. Beam Intensity Monitors: MR Status and MI Requirements

#	NAME	PRESENT OPERATIONAL CONDITION	MI OPERATIONAL REQUIREMENTS	COMMENTS*
1.	M:BIM10 M:BIM50 4.75"ID	These Monitors are in 8GeV Booster to MR beam line. Beam PL =.15-1.59 μ sec, electronic OR =10-500mA. Presently:15mA-250mA.	Two Monitors are needed in 8GeV beam line between Booster to MI. Beam PL=.15-1.59 μ sec, electronic OR = 1-600mA.	Can be used in MI
2.	M:A11TRO 6.5"ID	This is in A11 sector of MR to measure the intensity of the 8GeV beam transferred from Booster. Beam PL =.15-1.59 μ sec, electronic OR = 10-500mA.	Needed in MI to measure the intensity of the transferred 8GeV beam from Booster. Beam PL =.15-1.59 μ sec, electronic OR = 1-600mA.	Can be used in MI
3.	M:IBEAMS M:IBEAMM M:IBEAM 6.5"ID (DCCT)	This is in A17 in sector of the MR to measure circulating beam. electronic OR = 380 μ A-380mA.	Needed to measure circulating beam in MI. electronic OR = 140 μ A-600mA	Can be used in MI
4.	M:ABTINT	This monitor is in C0 Abort line. Beam PL =.2-20 μ sec, electronic OR =10-500mA	Needed to measure MI40 aborted beam. Beam PL =.1-10 μ sec, OR =10-640mA	Can be used in MI.

PL = Pulse Length, OR = Operating Range.

Table IV (continued)

#	NAME	PRESENT OPERATIONAL CONDITION	MI OPERATIONAL REQUIREMENTS	COMMENTS
5.	M:TOR100	This is in AP1 beam line (F17) to measure 8GeV (or 120GeV) pbar (or protons) from pbar source (or from MR). Beam PL = .2-20 μ sec, electronic OR =10-500mA.	This is needed to measure 8GeV (or 120GeV) pbar (or protons) from pbar source (or from MI). Beam PL =.2-10 μ sec, OR =1-600mA. (5-6E12p/batch)	Continue to use in F17
6.	-	-	Two monitors are needed in beam lines P1 and P2 Beam PL= 10 μ sec, OR = 0.1-640mA for fixed target runs, OR = 0.1-35mA for collider runs, OR = 1E4-1E5p/s for Resonant extraction.	New
7.	-	-	One monitor is needed in beam line P3. Beam PL= 10 μ sec, OR = 1E4-1E5p/s for Resonant extraction.	New
8.	-	-	Needed in A1 beam line to measure pbar beam from MI to Tevatron. OP = 1-4mA, Beam PL = 1.6 μ sec.	New

PL = Pulse Length, OR = Operating Range.

* The required dynamic ranges of the beam intensity monitors in MI are larger in almost every case. Hence the electronics setup have to be changed.