



Diagnostic Systems Review and Related AP Issues (comments and questions)

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BPM



- **Two questions related to PUE design**
- **Could there be better design?**
- **Is there any physics implication if design is left as it is?**

Committee believes that present design is correct with standard matching to the SUM mode. Suggestion – resolve this question of matching quickly. Pete Cameron suggests that Craig Deibele from ORNL should visit BNL to resolve this question. If it is found that ORNL’s design is better then perhaps 6 (TOF) HEBT BPM’s can be corrected.

- **Make detailed requirements on specific range and compensation for nonlinear response (not as part of a short AP Table)**

BLM & WS



- **BLM's – in good shape – modification of requirements**
- **WS – all WS will be built by LANL – transfer of funds.**

C.J. talk (maximum T)- gets too hot at 2MW and even at 1MW.

Wires will get too hot during normal operation.

Probably will not be a suitable device for high-intensity measurements.

IPM



- **Suppose to be the best measurement of beam profiles. The only device which provides turn-by-turn data. In fact, the plan is to measure every 100ns.**
 - **What is reliability of this device? Check its work at RHIC.**
- 2. Under comments - 45 deg. IPM (3rd) was presented as desired – but there is no space and budget for it. Committee indicated that consistent decision should be made.**
 - 3. Roger Connolly wants to go with bigger plates (72 channels) slightly relaxing accuracy requirements to 2.2 mm – range +/- 64 mm. There are some technical issues such as how to combine two plates to cover full range (custom plate?).**
 - 4. With 2-bump – there is a 1 cm displacement. Do we need 3 mag. Bump or closed orbit will be corrected with correctors?**

IPM continued



- 5. Right now, design of magnet (done by N.T.) is E.M. – R.C. proposes permanent magnets. Then one can use 2 mag. bump with constant bump correction. Preferred bump solution will be 3 magnet bump even with permanent magnets.**
- 6. What is the effect of uncompensated magnetic fields? N.T. can provide multipoles of EM design so that we could estimate effect.**
- 7. Committee is concerned whether generated electrons will be a strong contribution to e-cloud and thus IPM could be a potential source of e-p instability. Does not seem to be a problem with electron collection plates**
- 8. Can one use IPM as a device for e-cloud studies (better than e-detector)? It is not clear how.**

LM, FV and BCM



LM:

Depth of field issue due to large beam size. It is not clear how good will be special profile resolution. Will be able to get beam size but there is a question about getting beam profile. This device will tested at RHIC but for small beam sizes.

FV:

Two video systems. Requirements on these systems are not yet fully specified. Committee suggested to check an option of simpler cameras (less rad. protection) but putting them further away.

BCM:

In good shape. Committee suggested to identify additional goals.

Tune measurement



- **Coherent tune – two ways: misinjection and BIG kicker.**
- **Incoherent - several options were presented:**
 - **Injection of a single turn into beam environment and use of high frequency BPM's (at 400MHz before decoherence)**
 - **Schottky measurement**
 - **BTF measurement – resonant pick-up.**
 - **Quadrupole pick-up.**

BIG and ED



BIG:

- **Present design has three modules (1.5 meter) which provide 0.6 mrad angle. In simulations 1 mrad angle was used. If 1 mrad angle is required this will require two more additional magnets.**
- **Additional space for these magnets – before quad – will need to take betatron phase into account. Sarah will check whether 0.6 mrad is sufficient.**
- **Calibration of the system was discussed. Note that BIG in HEBT planed for calibration was removed.**

ED:

Roger Connolly proposes fast channel plates (2) in addition to 5 e-detectors.

Laser Wire:

Good progress, especially at MEBT – more needs to be done.

AP questions



- **Is there significant impact of current BPM design on AP?**

No. There may be some impact on beta-measurements if small number of turns is injected. Maybe some impact on TOF measurements in HEBT.

- 2. It does not look like we will be able to use WS for high-intensity measurements (too hot)– the plan is to use IPM.**
- 3. IPM will be able to perform measurements for intensity range 100-1000 turns. For the measurements during first 100 turns of injection pressure bump will be required.**
- 4. Do we plan 3rd IPM (45 deg.)?**

No. There are only 2 IPM's : Horizontal and Vertical.

AP questions continued



5. Accuracy of IPM measurements is relaxed to 2.2 mm. Is it ok?

Yes.

6. With 2 magnet bump there is uncompensated displacement of 1cm. Do we need 3 magnet bump?

We need three magnet bump.

7. Present design is based on EM magnets. If we go with permanent magnets then perhaps one can stay with 2 mag. bump and just compensate displacement during tuning. Do we want EM mag.?

AP group wants present design with EM magnets. Diagnostic preference – permanent magnets. Budget issues.

8. What is the effect of uncompensated magnet multipoles?

Nick T. will provide multipoles and we will estimate the effect – should be negligible.

AP questions continued



9. Is IPM a potential source of e-cloud?

No.

10. Can we use IPM for e-cloud studies?

Probably not.

11. Can LM be a reliable device for large beam size?

Unclear. Depth in field issue – will be able to get beam size but accuracy of beam profile is in question.

12. What are the requirements for Foil-Video System? Do we need a system which can measure beam profile on the foil?

No. Simple system which just shows the spot on the foil.

AP questions continued



13. Identify precisely measurement of coherent tune.

Done. Mismatch at injection or BIG kicker.

14. Various methods of incoherent tune measurements are under study at BNL.

15. Is 0.6 mrad angle is enough for BIG cleaning?

To be studied by Sarah. Number of turns will be limited by power of switches < 100 turns. However, only 10^{-4} level is expected before cleaning so that efficiency is not critical.

16. If 1 mrad is required, make sure that betatron phase advance is taken into account when addition kickers will be place before doublet.

17. Absolute accuracy of BIG systems is under question since calibration BIG monitor from HEBT was removed.

18. Do we need additional (to 5 e-detectors) fast channel plates?

Not clear. Diagnostic group will put few of them anyway.

AP Table for Ring System



Ring System Diagnostics AP Requirements (07/30/2002)

Device	Location	Intensity [ppp]	Range	Accuracy	Resolution	Data structure	Comments
BPM (position)	Ring, HEBT,RTBT	5e10 - 2e14	+/- pipe radius	+/-1%	0.5/1.0%	aver./turn-by-turn	dual plane/high frequency correction for non-linear region average < 1.5e11 402.5MHz
BPM (phase)	HEBT	5e10 - 2e14	+/- 180 deg	+/-2 deg	0.1 deg		
BLM (1 kHz)	Linac-HEBT Ring,RTBT	2e8 - 2e14	1-4e4 rem/h 1-4e3 rem/h	1%	0.5 r/h	10 s averaging	1% of 1 W/m
BLM (35 kHz)	Linac-HEBT Ring,RTBT	2e10 - 2e14	1-4e5 rem/h 1-4e4 rem/h	1%	50 rem/h	at 6Hz rate, sel. 10 BLMs at 10Hz	
FBLM	Linac-HEBT Ring		1-1000 rem/h 1-1000 rem/h			inside mini pulse intra turn	fast; not calibrated
IPM	Ring	5e10 - 2e14	+/- 64mm	2.2mm	2.2 mm	few per turn	H,V; pressure bump for low int. below 1e12 under consideration
LM Current	Ring MEBT-to-HEBT Ring-RTBT	5e10 - 2e14	15mA - 52 mA 15mA - 100A	1% 1%	.5% .5%	inside mini pulse turn-by-turn	All are Fast Current Transf.
Tune	Ring			+/- 0.001 +/- 0.005	+/- 0.0005 +/- 0.001	req. averaging req. averaging	tune kicker/pick-up - coherent BTF and QM - incoherent
Wire	HEBT Ring RTBT	5e10 - 2e11 5e10 - 2e14 2e12 - 2e14	+/- pipe radius +/- pipe radius +/- pipe radius	10%rms width 10%rms width 10%rms width	5%rms width 5%rms width 5%rms width	40KHz 40KHz 40KHz	SEM SEM+ FBLM SEM+ FBLM
Harp	HEBT,RTBT	3e11 - 2e14	+/- pipe radius	1mm p.,10% wid.	0.5mm p.,5% wid.	single shot	target requirements
Beam-in-gap	Ring		0 - 0.1 A	20%			BIG kicker/mon., relative acc.
Foil Video	Ring	5e10 - 2e14		+/- 1mm	1mm		2 systems
e - detectors	Ring		2e8 - 2e11 (e-)	5%	1e8 (e-)	turn-by-turn	5 locations: Inj.,Coll., Ext, IPM and in the arc; fast channel plates are suggested in addition