

Summary of Comments/Suggestions Received on Performance Measures Draft Report and Proposed Responses and Changes to the Draft Report

These are collected roughly in chronological order as received, with some grouping of similar comments. Comments on spelling, phrasing, subscripts and such were addressed and do not appear below.

In the following, MS = Milestone and PM = Performance Measure

Comment:

Section 7, box for New Performance Measure in HDHM: I have always felt that the word "recreate" in this performance measure was misplaced: who before us created tiny samples of such matter? After all, the whole universe was not a "tiny sample". Yes, I know about the occasional cosmic ray collision, but still I would give preference to "Create brief, tiny samples..."

Appendix 4, DM milestones: rephrase DM10 as "Measure jet and photon production and their correlations in A \approx 200 ion+ion collisions in the energy range from medium RHIC energies to the highest energies achievable at the LHC."

This leaves a little bit more freedom where to measure gamma-jet correlations, although the original version does so, too, because it mentions "correlations" generically, not singling out photon-jet correlations. Indeed, I interpret "correlations" to include hard-soft correlations which may signal Mach cones or other jet medium interaction effects, so this issue is covered without need for an extra milestone.

And

Appendix 4:
table: DM10:

I already complained about the 30 GeV. There's no cross-section for jets at 30 GeV. There's no luminosity upgrade in the world that will allow the measurements of jets in 30 GeV Au+Au collisions. It's simply not going to happen, no matter where. Either increase to at *least* 64 GeV

(still doubtful) or say: "at energies between $\sqrt{s_{NN}}=30$ and 5.5 TeV".

I assume the 30 GeV comes in through FAIR but to my knowledge there's no FAIR experiment that can measure jets. That's really a collider measurement. STAR just reported of the first attempts at 200 GeV and this is already hard and plagued by nasty biases.

Response:

Changed the word "Recreate" to "Create"; this appears a few other places, such as Section 4.B, but in the same sense. The effort required at RHIC and elsewhere to meet the PM and MS isn't affected.

Rephrased DM10 in Table 12 as “Measure jet and photon production and their correlations in $A \approx 200$ ion+ion collisions at energies from medium RHIC energies to the highest achievable energies at LHC.”

This maintains the sense of the MS, gives some flexibility on where the colliders actually operate, ties the c.m.energy range covered to known operating limits of machines, and allows for the possibility that the highest LHC energies may take a while to reach. The “correlations” are also kept generic, so that photon-jet as well as jet-jet are covered, which thus includes current work on medium response to jets.

Comment:

>Section 4.B Performance Measures for High Temperature, High Density
>Hadronic Matter

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>First bullet ("what does that measurement mean" bullet) While the
>connection to cosmology was certainly one of the initial drivers in
the

>field many feel that the 'Big Bang'

>connection is somewhat overstressed. It is rather unclear what impact
>the properties and features of the matter we discovered at RHIC will
>have on our understand on cosmology. I know that this was also
stressed

>in the LRP but at the same time we put much emphasize on QCD itself
and

>how RHIC and LHC will helps us understand the phases of QCD and thus
>QCD itself.

>Emphasizing solely that we recreate something that might have existed
a

>few microsec after the big bang is also a bit dangerous. This is a
very

>vulnerable connection/meaning.

>

>My suggestion would be to rather emphasize here that this is a "new
>phase of matter" and that is a BIG step towards the understanding the
>various phases of QCD (or "matter") and that we create a state that
has

>features that do not exist anywhere else: deconfined, chiral symmetry
>restored etc.

>I don't object to the big bang connection but I would not let this be
>the only 'meaning'. The referring bullets for the other fields are all
>a bit longer so adding one or two sentences wouldn't harm. The next
>bullet (why is it important) covers QCD big time so making a closer
>connection between 1st and 2nd bullet via QCD might be a good thing
too.

>

Response:

While this is in the PM section which DOE-ONP already sent to OMB and is thus something we should change only with care, two phrases can be added as suggested and would serve to benefit the sense of the section. They are:

“This matter would have features not encountered before in the laboratory, including color deconfinement and chiral symmetry restoration. Its discovery would signal the ability to study in the laboratory one of the major phase changes in the behavior of matter

itself at very high temperature, indeed the only such phase change that may be currently accessible.”

Comment:

>Evaluation of Milestone: DM8. The way the milestone is worded I have concerns
>that the assessment "Expect to exceed" is true. It is true that we
>already have the data (2008 d+Au run) needed in the can and that we are
>starting to analyze it but if we will be able to "Determine gluon
>densities at low x" is rather disputed even among the experts.
>We might be able to
>make statements about saturation phenomena and possibly the CGC but
>determining the gluon densities might at the end require more than
>p/d+Au collisions. We might be able to constrain it using massive
>modeling but I doubt we will "determine" it. I would rather put the bar
>lower and say 'Expect to Achieve'.

Response:

The data are in hand and exceeded the 2003 data set by a factor of 30 in statistics, and the kinematic reaches of the detectors were better. But the concern is focused on the interpretation of the result and our ability to model gluon densities at low x_{BJ} . This is in flux. Thus the rating is proposed to step down one level, to “Expect to Achieve”. An alternative is to change “determine” to “constrain” but this is moving the goal posts too much. A few changes in following text are also needed to reflect the lower rating.

Comment:

>
>Appendix 4, New Performance Measures
>
>We just went through the milestones for our own DOE review and I
>noticed that a couple of important milestones are not included but can
>be easily squeezed in with possibly slight changes to wording or even
>a new measure (?)
>
>1. A big fraction of efforts at RHIC currently go into
> understanding the interaction of hard probes with the medium.
> Single particle spectra are limited in what we can learn from
>them.
> 2 and 3 particle (high-pt) correlations are key here, especially
>since it allows us to probe jet-induced medium effects much more
>precise. Examples are: ridge, mach cones etc.
> They are vital, e.g. Mach cones (if existence confirmed) will give
> us the velocity of sound in the medium, clearly a property
> we need to know and which can be directly compared to lattice.
>
> DM11 talks about spectra and correlations but focuses on the
>energy
> scan & so these 'medium-response' topics don't fit in here.
>
> DM10 only mentioned 'jets' (implying reconstructed jets for most)
> otherwise that would fit in.

> May be:
 > DM10: "Measure jets, high-pt leading hadrons, and photons and their correlations.... and the response of the medium to their interaction with it", or something in that spirit
 >
 >2. DM10 jets and photons down to $\sqrt{s}=30$ GeV. That's really low with hard cross-section dropping like a rock. Cooling will be not as effective at low energies. I wonder if it wouldn't be better to leave numbers out and say "in the energy range from medium RHIC energies to the highest energies achievable at the LHC", or say *between* 30 GeV and 5.5 TeV.
 >
 >3. DM5: focuses on J/psi only. We left bottomonium out here all together. Upsilon might be the cleaner probe in many aspects since side effects such as recombination and co-mover absorption do not matter. However DM5 is listed for 2010, too early for the upsilon family. I wonder if one should add a new milestone: 2015(18?): Measure suppression of the upsilon states from 200 GeV to 5.5 TeV. The LHC experiments have a rich upsilon program.
 >
 > Another idea would be to replace J/psi with "quarkonium: but then 2010 is not working.
 >

Response:

I think the wording of DM10 in the earlier response spans the set of measurements adequately. ("Measure jet and photon production and their correlations in $A \approx 200$ ion-ion collisions at energies from medium RHIC energies to the highest achievable energies at LHC.") This also avoids the concern about being too specific about c.m.energy for the measurement.

Since DM5 is a MS from 2003, we accept the focus on J/psi only as a given input. I would leave bottomonium out of the MS. At RHIC this is a challenge due to luminosity. It should be straightforward at LHC, but the DOE program plan for LHC and the capital investments focus on calorimetry and jet and photon correlations. This is captured in DM10. The MS are supposed to be representative markers for the program and to avoid being a full program plan for the field. Besides, one wants to leave room for the next round of effort to exceed what is written down.

Comment:

>4. There's no milestone related to initial conditions, and the fundamental question of thermalization in QCD. There's no a priori knowledge on that at all. DM8 is a key for that, that is getting a rough feeling for gluon densities from pA.
 >I wonder if it's worth adding a theory milestone on that.
 >CGC/Glasma etc.

Response:

Again, I think it is best to not be overly prescriptive of the program. One hopes the theoretical effort on initial conditions moves forward well, but it strikes this observer as still early enough that writing down something as prescriptive as a MS is risky.

Comment:

>The hadronic physics measures are generally ok, but continue to suffer from the unnatural grouping of light nuclei with hadrons.

>

>The PM bullet in Section 4A says, among other things, we are making >precision measurements of

>simple nuclei to provide a quantitative understanding of their quark

>substructure. I doubt we can change that bullet at this point, but

>although it is a nice wish, it is a bad milestone by which to be

>judged.

>

>One concrete suggestion concerns the second criterion for

>"Excellent". It presently

>reads:

>

>2) Two body and three body nucleon-nucleon interactions expressed in

>a QCD basis

>

>As it stands, the wording is vague and essentially meaningless. If

we

>sharpened the

>wording and required understanding nucleon nucleon interactions from

QCD, I

>don't

>believe we could earn the rating "excellent" Hence, I suggest it be

>changed to something like:

>

>2) Ab initio calculations of light nuclei performed using three

>nucleon interactions determined from effective field theory.

Response:

Again, Section 4.A covers PM submitted by DOE-ONP to OMB, but one does need to get the physics correct in these; we have made earlier modifications to do this, for example in fundamental interactions Section 4.D. Thus the third item under Section 4.A now reads: "3) ab-initio calculations of light nuclei performed using two- and three-nucleon interactions determined from an effective field theory linked to QCD;"

If the phrase "linked to QCD" is objectionable, please comment. An intent of the original PM was to emphasize the importance of that linkage in the development of modern theories applied to JLab results.

Comment:

> It seems to me that Appendix 3 simply repeats verbatim tables that

> are also in the body of the report. Is this Appendix needed? Or, am I

> mis-understanding something?

Response: We had this discussion before. The main body flows better if the results are included there, but the set of appendices seemed incomplete without them. So they ended up both places.

Comment :

a) On old RHIC milestones... I think "Expect to Achieve" on DM5 is generous. However, I wonder if DM6 shouldn't be considered "Achieved". Also, you say "The existence of a deconfined, thermalized medium is determined." I agree, but is this generally agreed on? Following this you say "Its properties, such as temperature history, equation of state, energy and color transport (via jets) and screening (via heavy quark production) are characterized." That seems way too generous (and heavy quark should be J/psi, or heavy quarkonia).

b) ON new RHIC milestones... The RHIC PAC did not approve the low-energy scan. It seems this scan will take considerably more justification to gain approval, making the deadline for DM11 difficult. I also have a worry about including energy dependence of J/psi in the milestones (DM5). Perhaps if "available at RHIC" becomes "available at RHIC w/ sufficient statistics."

Response:

The phrase about a "deconfined, thermalized medium..." comes from the PM in Section 4.B. It is central to the original argument to justify building RHIC, thus I think it should stay as is. The debate is still in progress about whether the medium is thermalized (the phrase has to be taken to mean the strongly-coupled QGP nowadays, since that is what the theoretical analysis of experimental data point to, but the concept still applies) but since 7 years remain before the PM deadline of 2015, this still seems a reasonable, if difficult-to-prove, criterion to judge progress.

On DM5 I would note that data sets are in hand for Au-Au, Cu-Cu, d-Au and p-p and at 130 and 200 GeV. The running at lower c.m. energy (60, 20) likely has skimpy statistics, but one can argue from a physics point of view that the entire SPS fixed-target dataset at 17 GeV (and lower) for Pb-Pb and In-In, plus their limited p-A and O,S-Pb data, also can be brought to bear on the physics question. So I don't think the end-date is out of the question. The PAC decision on low-energy running means the data-sets in hand will have to do by the 2010 deadline, but the other data sets are enough. I'd rather not add the remark about "with sufficient statistics", since I'm not sure how that really adds to "Measure..." unless one is specific about size of error bars. The existing MS are only explicit on that point for discovery measurements, e.g. FI7/FI14 on double beta decay.

On DM6, an initial set of the needed data is in hand and analysis results presented at Quark Matter 2008, true enough. But there is still time for the runs with the hadron-blind detector to improve the signal-to-noise of the data. So I'd suggest to leave the completion status as-is until this plays out. Admittedly, the new detector has to work this next run to have an impact by the 2010 due date.

On DM11, which needs the low-energy run at RHIC, the due date is 2015. This still leaves plenty of time to schedule the runs, and the nearness of this date coupled with

LHC startup taking over the highest-energy domain might act as a useful stimulus to address the issues which concerned the RHIC PAC at its recent meeting.

Comment and Response:

(I reproduce here, in reverse chronological order, the last stages of the exchange with Michael Ramsey-Musolf about the new MS added under Neutrinos and Fundamental Interactions). I did change "elementary particles" to "nuclei, light hadrons and leptons" in FI12, as noted next. I suggest that we have reached closure on this set of comments.

Hi Glenn et al,

I like the general spirit of Glenn's suggestions. I agree about combining the hadronic PV milestones. For the last theory milestone, I'd like to change "elementary particles" to "nuclei, light hadrons, and leptons" because "elementary particle" on the one hand is too broad and on the other doesn't capture the nuclear component.

Also, I think changing the date to mesh with Glenn's list is fine.

I do understand Glenn's concern about the PVES milestone. I developed this one with K Kumar (after some back and forth with Larry) who suggested the "establish feasibility". In principle, it could be made more specific. I don't think the precision benchmark for the 12 GeV experiments will change as we are already pushing the state of the art. The "establish feasibility" was sort of a compromise between saying nothing about the prospective 12 GeV program and saying too much that may not be realistic. There is, in fact, a lot of work going on to develop the 12 GeV parity program so it seemed to me we should include some benchmark for this.

Thanks,
Michael

On Aug 1, 2008, at 5:08 PM, Young, Glenn R. wrote:

Dear PM committee,
Michael Ramsey-Musolf has suggested some added milestones for the Fundamental Interactions area. These would add to table 15 in App.4 of the report. I thought it would be most efficient to respond to Michael and copy all of you so we might hope to converge faster. So please have a look; if this is OK, silence or a 'yes, OK' email will suffice. If not, please pipe up.
Regards,
Glenn

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Dear Michael,

Here is your list of new milestones for FI, then some suggestions.

- Your List -----
1. Determine the implications of improved neutron and atomic electric dipole moment searches for the cosmic baryon asymmetry by carrying out new computations of EDMs and quantum transport calculations for electroweak baryogenesis. [2012: expect to achieve]
 2. Complete computations of parity-violating observables in few-nucleon systems as needed to determine the sensitivity of future PV experiments to the lowest order, PV nucleon-nucleon interaction. [2011]
 3. Analyze the implications for possible new fundamental interactions of precise measurements of parity-violating electron scattering asymmetries; weak decays of the neutron, nucleon, pions, and muons; and the g-factor of the muon. [2015: expect to achieve]
 4. Complete measurements of parity violating electron scattering asymmetries that are part of the 6 GeV Jefferson Lab program and establish feasibility of carrying out new experiments to measure PV asymmetries in polarized Moller and deep inelastic electron-deuteron scattering at 12 GeV. [2014]

----- Suggestions -----

I'd like to take your second one and combine it with the existing FI8 milestone by inserting "and key computations" thusly:

(revised FI8) " Perform independent measurements and key computations of parity violation in few-body systems to constrain the non-leptonic weak interaction."

OK?

On the other three, I suggest some shortening in some places. On the fourth, I'd prefer to keep the first part but avoid the second part about establishing feasibility since I'm worried it becomes somewhat "indefinite" for a milestone. I think I mean by that it becomes harder to say one has achieved it, i.e. what if the needed precision shifts between now and the due date? Then what appeared feasible might not. We can also get some experimenters (pick any two, ha ha) to argue about what "feasible" means. There is also an aspect of not wanting to write a program plan for the field and the agencies, an argument I'm going to use again in responding to a suggestion about the RHIC milestones in a later note.

So I'd like to take the other three as follows. Please (please please) let's change the date on the first by one year later, then it meshes better with the existing set and I can keep the master set of labels.

New FI10 (your #1) [2013]
Determine the implications of improved dipole moment searches for the cosmic baryon asymmetry by carrying out new computations of EDMs and quantum transport calculations for electroweak baryogenesis. [2013]

New FI11 (your #4) [2014]

Perform measurements of parity violating electron scattering asymmetries using the highest energies available at Jefferson Lab program.

New FI12 (your #3) [2015]

Analyze the implications for possible new fundamental interactions of precise measurements of parity-violating electron scattering asymmetries, weak decays of the elementary particles, and the muon g-factor.

Then the "new FI10,11,12" in the June draft of the report become "new FI13,14,15", given the proposed due dates.

Comments?

Regards, and thanks for the input,
Glenn

Comment:

I read the Performance measures carefully and compared the definition of "Excellent" among the subfields. What strikes me is the vagueness of the definition of "Excellent" for NS and NA, actually to a point where I think they have to be revised.

For the other subfields "excellent" has crisp and clear definitions, e.g.:

2-body and 3-body NN interactions expressed in QCD basis (HP) or determine properties such as EOS, transport coefficients etc. (DM) or double beta decay life times extended 10-fold.

These are hard criterion which are relatively easy to judge if reached or not. For NS they read:

measurements performed, dependence studied, that and this measured.

This is like at RHIC saying "jets" measured. Here, however (and correctly), "jets" are just the means to get to the transport coefficient of the plasma and the latter is what is mentioned in the performance measure, not the jet. Any measurement can be good and bad; an observation can tell me a lot or be completely useless. A measurement is done for a purpose, there must be something to learn from it and that should be the measure. I understand that this might not be easy but it otherwise reads like a measure for stamp collecting. Now, these are the measures as defined in 2003 and they are what they are. However, in section (7), first sentence we say that there's no need to alter them since they capture everything while for RHIC we add another measure for a very hard number: viscosity.

I would urge you to try to revise the NS definition of "Excellent" to make them more "precise" at a level comparable to that of the other subfields. Again, we cannot change the 2003 ones but we can revise them in section (7) and make them more meaningful. Observing another nucleus with neutron skin is not really a performance measure.

Response:

The definition of Excellent under Section 4.C, the PM for Nuclear Structure and Nuclear Astrophysics, reads as submitted by DOE to OMB:

Definition of “Excellent” - 1) Extensive measurements on stable and exotic nuclei and the drip lines are performed; 2) their structure is established and the isospin dependence of effective interactions studied; 3) new nuclei with neutron skins are observed and studied; 4) reactions for several astrophysical processes, including some r-process nuclei, are measured

While the first item does depend nearly entirely on experimental work, the second item would seem to capture the theoretical effort performed in conjunction, with the specific item on isospin dependence of effective interactions being a central physics question at NSCL, HRIBF, ATLAS, and in the future FRIB. The third item is again experiment-based, but such nuclei are quite rare and pose a significant challenge to the general understanding of structure. For the fourth item, it would indeed seem there should be a definite tie to astrophysical theory, thus for definiteness a tie to nucleosynthesis is now inserted in the text, to wit: “4) reactions for several astrophysical processes, including some r-process nuclei, are measured and their implications for nucleosynthesis determined”. One cannot progress in understanding the rp- and r-processes without accumulating the detailed information on nuclei and the specific reaction pathways, working out the resulting predicted synthesis pathways and resulting abundances, and comparing to astronomical observation, so this would seem to incorporate the needed “precision” in the definition of Excellent.

Comment :

page 8: 'injector' upgrades at RHIC ? I assume that refers to the EBIS source. I would rather say 'ion source' than 'injector'. Not really the same thing.

Response:

Changed to “ion source”

Comment

On page 8 (also p.30, 46, 69)

"RHIC-II upgrade". I'm not so sure about the terminology. Officially (Steve Vigdor might correct me here) RHIC-II was tied to the e-cooling and that is off the table and replaced by the 10x cheaper stochastic cooling.

It might be better to replace "RHIC-II upgrade" with "RHIC luminosity upgrade" which is more precise and avoids any confusion of what is meant with RHIC-II.

And

Section 7 after the "box".

Again the RHIC-II issue as discussed above. The first one is fine since in the LRP RHIC-II was still on the table but stochastic cooling is *not* RHIC-II. So I would replace the 2nd one also with "the overall timescale for an RHIC luminosity upgrade will be substantially shortened".

Response: From discussion with the BNL management and in turn their understandings with DOE, we agree it seems best to phrase this as the “RHIC luminosity upgrade”, which has thus been done at all such places in the text. This will separate the issue of the type of cooling used, together with any other means to increase integrated luminosity, from the issue that matters for the report, which is obtaining datasets in a given time with an order of magnitude larger counting statistics than now feasible.

Comment:

Section 4.B in the middle under the definition of "Excellent".
Replace (via heavy quark production) with (via quarkonium suppression).
Heavy quark production does not tell us anything about screening but about heavy quark energy loss.

Response: this is correct. Fixed to say ‘heavy quarkonium’.

Comment:

Section 6, RHIC milestone evaluation, Page 21: "there have a been a few scientific discoveries".

Not clear how I have to read this: it's either belittling it or it is very sarcastic. Since the documents dwells later on the surprising finding of the strongly coupled system and in the LRP we use the term "major discoveries" we should not shy away from that here.

I suggest: "... there have been major discoveries, notably"

Response: “few” changed to “significant”

Comment:

MS FI4 and FI5 evaluations (Appendix 9) the CKM unitarity depended in an essential way on a new value for V_{us} , less so than for V_{ud}

Response: Text modified and references added kaon decay work to reflect this

Comment

Definition of Re/mu not clear

Response: Fixed format to match literature and added a phrase to define.

Correction

It was stated on page 9 that the 2002 LRP assumed a constant level of effort budget, and that this was used in the 2003 PM report. While this was the budget assumed for the 2003 PM report, the 2002 LRP also considered a number of other budget scenarios. The text now reflects this.