Report

2nd Meeting of the Electron-Ion-Collider Advisory Committee (EICAC) November 2-3, 2009

Executive Summary

The Electron-Ion-Collider Advisory Committee (EICAC) held its second meeting on November 2-3, 2009 at the Thomas Jefferson National Accelerator Facility (JLab) in Newport News. The purpose of this meeting was to review progress since the first meeting, to assess developments following the earlier suggestions from the EICAC, and to discuss and comment on next steps.

The science opportunities for a high-energy electron ion collider (EIC) have been under discussion for at least a decade. In the US, an EIC Collaboration (EICC) was formed ten years ago. It has since promoted the science case and the development of an EIC facility. Brookhaven National Laboratory (BNL) and JLab have both expressed strong interest in hosting such a facility.

At the initiative of the BNL and JLab laboratory directors, the EIC Advisory Committee (EICAC) was established at the beginning of 2009. It was charged to periodically review EIC progress and to provide feedback and advice on the project development.

Following the first meeting, the EICAC made several suggestions. The first one was to develop a clear and well-defined matrix of science goals versus required accelerator performance parameters. Progress has been made towards defining the science case and several workshops have expanded on the science opportunities. Three main thrusts have been formulated: i) the precise understanding of the gluon and quark contributions to the nucleon spin; ii) the determination of the spatial and transverse momentum distribution of the partons leading to the complete 3-D structure of the nucleon; and iii) elucidation of the gluon structure in nuclei at the extremes (gluon saturation and the postulated color glass condensate). However, there is yet no explicit consensus on detailed performance parameters of the EIC, in particular the beam energy range and kinematics, and the required luminosity in the form of the requested matrix. The EICAC realizes that this is not a simple task and that it requires more work to be done. It is hoped that the planned workshop series, including the two-month workshop sequence at the INT in the fall of 2010, will be successful in producing a quantified scope for the facility.

The science focus begins to address the second of the previous suggestions of the EICAC report: to provide a short list of the most compelling science objectives that can convince, and generate support from, the broader community as represented by NSAC. The suggested list of related "golden experiments" though needs still to be established.

A further suggestion from EICAC had been to develop an overall schedule and timeline for major decisions and technical facility developments. The latter should focus on buildable, conceptual design(s) for the next NSAC long range plan, with near-term emphasis on detailed and comprehensive R&D. A central goal should be to reduce the considerable range of possibilities being discussed to a more concrete set of scenarios. The task still largely stands.

EICAC finds that there have been major efforts in developing a conceptual design for the EIC, both at BNL and JLab, supported by laboratory funds at both. The present status has two medium-term facility concepts, MeRHIC at BNL and MEIC at JLab. The BNL development is based on the use of RHIC and a new 4 GeV energy recovery linac for electrons. The conceptual design is nearing the stage needed for a CDR and includes a first cost estimate, with the exception of the coherent electron cooling (CEC). The JLab design is based on three figure-8 rings, with the electron beam injected from the 12 GeV CEBAF Upgrade. This concept is at a less mature state. It is difficult to assess the credibility of predicted performance, due to many unresolved but very challenging accelerator aspects. On the other hand, luminosity performance is predicted to be very high. No cost estimate has yet been performed.

Both projects require substantial R&D. A priority list of R&D activities, generated jointly by BNL and JLab, was presented. The EICAC largely agrees with the suggested priorities. But it also feels that to a certain extent a sequential approach and timeline needs to be established, on the one hand to accommodate R&D for items with long lead time, but also to have resolved key issues in conceptual design (such as beam-beam work) before making major investments in R&D, and finally to minimize duplication before a decision is made on the facility. The EICAC realizes that this is a complex situation and has many circular arguments. The EICAC, nevertheless, in the main body of this Report suggests a prioritized grouping of R&D activities, as necessary steps towards the solution of critical technical issues.

The EICAC supports, in spirit, the concept of the EIC community as stated by both laboratory directors; i.e., to develop a first-stage machine and to "assemble a science case that is unimpeachable." In terms of strategy though, the EICAC feels that the proponents might consider aiming for *the* EIC facility from the beginning, with a medium-range performance scope and future upgrade opportunities.

The EICAC also suggests that, at this time, the science community engage in physics planning exercises using parameterized detectors, e.g., not detailed full-scale GEANT simulations but rather responses based on parameterizations. This is important in order to understand, in terms of the physics goals, the trade-off between the resolutions and acceptances of the detectors on the one hand, and luminosity, polarization and beam energies on the other. Once the desired parameters are known, then a detailed detector design can be developed to satisfy the needs. The detector designs will also need to be developed together with the accelerator group(s) since luminosity, beam energy and acceptance of the detector are inter-related.

The science community of the EIC is in a development stage. Given the current QCD-driven programs at RHIC, JLab, and the 12-GeV Upgrade, a limited fraction of the community can devote themselves to planning for opportunities far in the future. Still, the EICC organized an influential White Paper in time for the 2007 LRP and held formal workshops and meetings. The EICAC strongly supports the continuation of these workshops; in particular the INT series in the fall of 2010 should help define the scope of the science program and performance of the facility.

EICAC feels that the facility project is clearly one that is matched to the mission and capabilities of national laboratories. It applauds the joint initiative taken by BNL and JLab. This includes providing laboratory funds to specific studies for physics and machine issues. The time is right for DOE to consider supporting critical accelerator R&D. The community should be commended as a whole on its vision and passion in terms of making the case for the next-generation QCD machine that will further and deepen our understanding of strongly interacting matter.

Detailed Report

The Science of the EIC

EICAC heard presentations and progress reports on the structure function F_L, the diffractive physics program to measure the gluon distributions in nuclei, and on the deep exclusive reaction program. In addition, there were two presentations of i) a summary of the recent INT workshop on science goals for medium-energy versions of the EIC, and of ii) an overview broadly identifying the science, "golden" measurements, and the implications for EIC energy and luminosity. The presentations were followed on the second day by a science breakout session with focus on the crispness of the science goals, milestones and timelines for improved simulations and down-selection of "golden" measurements, and on implications for machine energy, luminosity and detector R&D needs.

A diverse science program is possible with either 4(-11) GeV electrons colliding with 65 GeV protons (and the corresponding ions) as in the current JLab concept, or 4 GeV electrons colliding with 250 GeV protons (and the corresponding ions) as presented by BNL. Although not meant to be exclusive, the physics falls into three major themes:

- Nucleon spin: The EIC will extend the quark and gluon spin measurements made by fixed target experiments at various facilities and the collider at RHIC. The EIC will offer lower-x measurements for both sea quarks and for gluons. Combined with larger-x measurements at the JLab 12 GeV machine, deeply virtual Compton scattering experiments at the EIC should determine the quark orbital angular momentum in the proton. There is also hope to obtain information on the gluon orbital angular momentum from the EIC.
- Spatial structure of partons in the proton: The 12 GeV facility at JLab will carry out sensitive studies of the 2-dimensional spatial distributions of valence quarks in the proton. The EIC should extend this to sea quarks and gluons, thus giving a very satisfactory situation where longitudinal momentum and transverse spatial distributions of all the point-like constituents of the proton are determined.
- Small-x and high density gluons: Results from HERA and especially recent results on deuteron-gold scattering at RHIC have shown that dense gluonic effects should be visible in the EIC energy regime. Low-x values and thus high centre-of-mass energies are here of prime importance.

The measurement of the gluon density in nuclei is a key element of the physics program at the EIC. It is clear that inclusive cross section measurements will yield very precise measurements of the structure functions F_2 and F_L over a wide kinematic range and that these will in turn allow precision extraction of the gluon density in nuclei and a test of the standard DGLAP approach for extracting parton densities. These measurements will be available for the first time and will be the basis for a detailed understanding of the role of gluons in forming nuclear matter. The measurements may also lead to exciting results such as the observation of the color glass condensate, although one will probably have to go beyond the initial lower energy phase of the EIC to reach the necessary low Bjorken-x regime. One of the presentations also discussed the use of exclusive vector meson production to extract the gluon density. Of particular interest here is the possibility to extract the impact parameter distribution of the gluons via the t-dependence.

The geometrical arrangement of gluons could help in understanding the nature of the strong force holding nuclei together.

The report on deep exclusive reactions went further into the imaging of protons and nuclei using different probes in exclusive reactions, including deeply-virtual Compton scattering and exclusive pion production. The point was made that quark imaging is also a very interesting topic, and that the distribution of quarks is very dependent on Bjorken-x. In this case, higher Bjorken-x values are of interest, and EICAC heard of a list of interesting processes that could be measured for this purpose. To understand the feasibility of such measurements, acceptance studies are required. It is expected that these measurements would benefit from a more symmetric energy balance between the beams. These talks made clear that the EIC would be an excellent tool for a precision understanding of the momentum and geometrical distributions of quarks and gluons in nuclear matter.

The importance of the spin program was addressed in one of the summary talks on the physics at the EIC, and is clearly a major component of the EIC physics program. While there has been progress on understanding the spin structure of the proton, it is still far from being understood. The EIC would provide a greatly expanded kinematic range over which spin structure functions could be measured, and this, together with more exclusive measurements, could bring about the desired understanding of how the intrinsic angular momentum of a nucleon is shared amongst the constituents.

The two overview talks demonstrated the very wide physics program of an EIC beyond the topics discussed above, including semi-inclusive final states, coherent and incoherent diffraction, probing the partonic structure of short range nuclear forces, generalized parton distributions, transverse momentum dependent parton distributions, fragmentation, hadronization and energy loss in nuclear media, and electroweak and new physics beyond the Standard Model. There was some talk about signature measurements to benchmark how well the EIC would perform, and one measurement from each of the major programs (gluons in nuclei, 3D imaging, spin structure) could be singled out for this purpose (e.g., precision of F_L, t-distribution from an exclusive reaction, g_1 structure function).

Compared to the meeting in February 2009, EICAC saw an impressive progress in identifying and formulating the scientific goals of an electron-ion collider. In particular, the scientific interest in 'imaging the parton content of the proton' has been worked out in much more detail and presented during this meeting. At the same time, since February also the case of saturation and nuclear diffraction, to be investigated at a high energy electron-ion collider, has been considered and discussed in much more detail and presented here. Also, the two laboratories have presented their proposals which are clearly correlated with these different scientific goals.

With regard to the overall science program at the EIC, the EICAC discussed a diverse range of issues and makes the following comments.

There is already considerable material available motivating the physics program of the EIC, but presentations for outside use should be rationalized using consistent sets of assumptions. Consistent parameters should be used for both accelerator performance and detector performance for the different cases studied. More than one set of parameters should be attempted, to make clear which parameters are important for which measurement. The different experimental groups should sit together with accelerator groups and agree on sets of parameters for simulations. These parameters should be disseminated so that outside/new groups could participate in the studies.

More specifically, for the nucleon spin and for the spatial structure of partons in the nucleon it is important to do a careful study as to necessary energies, luminosities and detector performance and acceptance requirements. One might hope to get information on gluon orbital angular momentum from the EIC, but if so with what energy and luminosity specifications? With regard to small-x and high-density gluons, it is important to better understand what x-values are needed to effectively study these phenomena where the recent forward hadron correlation data from PHENIX and STAR in deuteron-gold studies could serve as typical “interesting” effect that the EIC should be able to study.

One might indeed see two different routes of interests: one looking for new phenomena in QCD at the highest energies (in particular: saturation, the partonic content of heavy ions, initial states of the formation of quark gluon plasma in heavy ion collisions etc) the other one aiming at a complete (three-dimensional) picture of the parton content of the proton, asking primarily for high luminosities (maybe at not so high energies). This has probably also to be seen in the context that the scientific communities favoring either one or the other project do not coincide. The EICAC asks that for the two proposals the quality of such measurements should be investigated.

In the view of some members of EICAC, this may leave two options to be explored in the near future: one of the two options has be favored, the other one disfavored. This will have serious consequences. Alternatively, one has to find a compromise design which serves both interests (and laboratories).

On the theoretical side, the workshops which have been held are considered extremely useful, and strongly recommend to be continued. In particular, as already mentioned above, EICAC was pleased to learn about the next series of workshops at the INT at Seattle, scheduled for the fall of 2010. One could see two major tasks to be addressed in addition to consolidating the overall science program: i) For each of the two directions, it would be very useful to prepare a concrete list of the requested measurements (including the scientific motivation, kinematic region, required accuracy etc.); and/or ii) each of the two groups should investigate to what extent their scientific goals could be reached by the other machine (i.e. 'proton imaging' etc by the BNL design, 'saturation' etc by the JLab version).

The Detector(s)

The most recent ideas were presented for a detector concept for the first stage of an EIC in a joint presentation of the BNL and JLAB studies. The detector concepts are very similar but differ in some details. There is so far not yet a fully combined study effort, but some initiatives have been proposed to move in this direction. The measurements discussed before in this report will likely impose very different constraints on the detector design: the F_L measurement needs the best possible measurement of the scattered electron and minimizing systematic uncertainties, but moderate luminosity; the exclusive processes require access to very large rapidities and precision tracking, whereas the spin measurements will require very high luminosity. Other measurements will impose requirements on particle identification, vertexing and large acceptance. It may not be possible to satisfy all these requirements in one detector design. It may therefore be wise to consider the possibility of more than one interaction region to satisfy these different requirements. This would also provide a natural way for different physics communities to group themselves.

The detector designs at this point are based on general considerations w/o detailed simulation studies to set performance parameters. The focus at this point should be on simulation work to understand the relation between detector performance and quality of the physics results and thus determine required detector parameters. These initial physics planning exercises might focus on using parameterized rather than “real” detectors. The EICAC feels that there is no need at this point to carry out detailed GEANT simulations, but rather to study responses based on parameterizations. The trade-off between the resolutions and acceptances of the detectors on the one hand, and luminosity, polarization and beam energies on the other hand for the physics can be understood with these kinds of studies. They will allow the community to compare detector variations and alternatives, and areas of stringent and less stringent requirements etc., as well as point to more detailed performance specifications and characteristics. Once the desired parameters are known, then a detailed detector design can be developed to attempt to satisfy the established needs and better understand which detector R&D is required. The detector designs will need to be developed together with the accelerator group since, e.g., luminosity, beam energy and acceptance of the detector will be correlated.

A number of benchmark processes for optimizing the detector performance need to be identified and used by the whole community in the simulation studies (e.g., heavy flavor tagging for the particle ID etc). Simulation programs with a straw man detector presently exist or are being completed, and are at a different level of sophistication (fast parameterization, GEANT3 and GEANT4 based ones). The different communities use different programs at present. While this is fine for initial feasibility studies in the short term, in the longer term it is advisable to have a limited number of options - say two - which are used by the whole community, the choice of program to use then depending on the simulation goal.

The EICAC considered it important to discuss and indicate for the near future an initial list of detector items which would require specific R&D efforts for the EIC. In doing so the EICAC is well aware that for the majority of the detector R&D the simulations discussed above have to be carried out first. To that end the R&D needs were discussed in some detail in the break-out session. In a prioritized way, R&D suggested for the near term should begin to address the following areas:

- Low-mass vertex-tracker/tracker, and integration of a TRD detector in the tracker
- particle identification at mid-rapidity for particles with momenta up to 4 GeV, e.g., using DIRC technology
- low cost photon detection, e.g., SiPMs
- ion polarimeters

Advanced studies on fast DAQ/electronics have already started in order to demonstrate that one can cope with the high data rates.

The EICAC considers it important that the detector R&D efforts are conducted jointly for MeRHIC and MEIC. Contacts with other communities like LHeC are also strongly encouraged.

The ILC has worked out an organization to actively include university groups in the detector R&D which could be a good strategy also here to widen participation. From the detector components discussed it wasn’t clear if there will be any effort on the very forward detectors, important for diffraction and nuclear fragment tagging, which may need as well optimal integration with the machine elements.

The EIC Facility

The EICAC heard presentations from both laboratories, BNL and JLab, on progress in machine design and facility concepts. In addition, a joint presentation for both laboratories described strategy and program(s) for accelerator R&D. Following these presentations on the first day, a parallel breakout session on the second day discussed accelerator aspects with focus on detailed assessments of design challenges, risks, and R&D milestones needed for each design.

The two concepts presented to the EICAC focused primarily on medium term schemes of what were called staged EIC facility configurations: at BNL 4 GeV electrons from an energy recovery linac colliding with 250 GeV protons (and the corresponding ions) from RHIC; at JLAB 4-11 GeV electrons injected from the 12GeV upgrade colliding with 65 GeV protons (and the corresponding ions) in a storage and collider ring system.

The EICAC is impressed with the amount of work that has been done on accelerator designs since the last meeting. However, the two laboratories are at very different levels of design maturity. The BNL design is very near what one would expect from a CDR, and has begun to focus attention on particular R&D needs and technical challenges arising from the design. The JLab design is incomplete, and the portions that exist are at best preconceptual. This, of course, is not a criticism but a statement reflecting the constraints and situations at the two labs.

Two realities direct the following comments. These realities are: at best only one machine will be built, and the second reality is essentially new coming out of this meeting, namely that for purposes of moving forward the committee recommends that, what were called the staged configurations (MeRHIC at BNL and MEIC at JLAB) be considered as “the project”, each with an upgrade path. It is likely with this change in expectations EICAC might see somewhat different versions of the projects at the next meeting.

It is the growing view of several members of EICAC that as soon as possible a “down select” should be made. R&D funding is limited, but there is much R&D that needs to be done in order to effectively and economically deliver an EIC. There are some R&D issues in common, but due to very different starting points of the two designs, addressing all the challenges of both is expensive and perhaps unwarranted. The highest priority on the facility side is to develop the JLAB design to a stage similar to where the BNL design is at present. This level of design should be able to be credibly costed, and should identify a comprehensive table of performances including center of mass energies and luminosities that can be achieved.

Furthermore, the EICAC would like to see high risk systems identified which are needed to achieve these parameters, with the resulting performance that would be realized if the high risk system cannot be met. For example we were told, for the present MeRHIC design what the predicted luminosity is with and without coherent electron cooling (CeC). We don't know what the MEIC performance would be without the proposed cooling, which has also yet to be demonstrated, or without traveling focusing.

Specific comments on MeRHIC: Because the RHIC facility has the ion machine already, the MeRHIC proposal is focused on the addition of an electron machine. BNL has chosen an energy recovery linac (ERL) rather than a ring, based on tune shift limitations to luminosity. The MeRHIC ERL is located at one of the RHIC interaction regions, limiting the present MeRHIC design to one detector. The performance of the ERL is beyond what has been achieved, thus demanding R&D to demonstrate the performance presented. However, the lattice is straight forward, leaving the risk with the electron gun and the ERL performance. Respective R&D priorities are given below. BNL should also attempt to see what design issues could lead to higher predicted luminosities and thus span more of the nuclear physics requirements.

Coherent electron cooling (CeC) was not included as part of the MeRHIC proposal as presented to the committee. We feel that it should be, and that the R&D on the proof of principle CeC experiment that is proposed to be done in RHIC should be included (as it is) on the list.

EICAC feels that optical stochastic cooling (OSC) should not be pursued with the same priority as CeC within the EIC R&D, at least until more is known about the predicted capability for cooling protons and ions. This does not mean that OSC is in itself not a very interesting concept worth exploring. And a well laid out listing of hoped for OSC cooling performance for various energies and species of ions, including protons, would be useful. There is also interest in this cooling scheme in other contexts. The specific issue at the EICAC meeting was if an OSC proof-of-principle experiment should be carried out at Bates within the overall EIC R&D program. The proposed experiment only cools electrons, and may be a proof of principle; however, there is significantly less synchrotron radiation from the relatively low energy hadrons, and we were not presented with what a comparable system for hadrons would look like. The EICAC believes that the overall importance of OSC R&D should be treated by the DOE NP Office as a separate question.

Specific comments on MEIC: The committee was presented with an argument for the figure-8 layout. Otherwise design work appears to have emphasized the electron ring. In deriving a preconceptual lattice, work was done on chromaticity correction, both linear and non-linear. However, even on the electron ring the dynamic aperture was not shown to the EICAC, and beam-beam work remains to be done. There was almost nothing shown for hadrons, where JLAB will need to design both the source and the rings. In light of the level of the maturity of the design, it is very difficult to assess the credibility of the performance, which will need to be better in terms of bunch length, β^*, etc., than any existing accelerator. A number of cooling systems will be needed, some of which will be beyond the state of the art. However, it is EICAC's view that the baseline design be developed assuming these systems exist before engaging in extensive R&D on them.

It should be noted that JLab satisfactorily answered the questions from the last committee meeting, addressing what the committee felt were a series of potential show stoppers. Most of which dealt with instabilities. The response is reassuring, and represents good work. However, it is difficult for EICAC (and the designers) to make credible statements of how all of these will work together without knowing the fundamental machine design. Thus the highest R&D priority for JLAB should be the design, even if that activity is not strictly considered R&D, and resources need to be made available to do the work.

The EIC proponents presented a joint list of priorities for accelerator R&D. The subsequent lists of EICAC are to a high degree identical to those with the exception of the first item (which encompasses some of the JLAB items in the table).

Highest priority:

- Design of JLab EIC
- High current (e.g. 50 mA) polarized electron gun
- Demonstration of high energy – high current recirculation ERL
- Beam-Beam simulations for EIC
- Polarized 3He production and acceleration
- Coherent electron cooling

High priority, but could wait until decision made:

- Compact loop magnets
- Electron cooling for JLab concepts
- Traveling focus scheme (it is not clear what the loss in performance would be if it doesn't work; it is not a show stopper if it doesn't)
- Development of eRHIC-type SRF cavities

Medium Priority:

- Crab cavities
- ERL technology development at JLAB

It is worth noting that from a very broad perspective the *planned performance* presented for the two accelerator designs look similar, with MeRHIC having somewhat higher energy and MEIC promising higher luminosities, particularly at the lower energies. As mentioned above, it would be useful to define a few sets of parameters (energy, luminosity, polarization) based on the expectations from each machine for simulation studies. Available space at the IR should also be defined. These can then be put together with detector designs to understand the physics capabilities for the signature (and other) measurements. These results should then be put together with expected cost, time scale for the accelerator development, and possibilities for future upgrades to higher energies and luminosity in determining which accelerator option is to be backed by the community. A committee primarily of accelerator experts should best evaluate the latter considerations on the accelerator.

The EIC Collaboration and the Science Community

The EIC Community, as mentioned above, is largely engaged in current QCD-driven experiments at RHIC and JLab, and the 12-GeV Upgrade project. The community, through the organizational structure of a loose "Collaboration" hosts workshops and has been responsible for the documentation necessary as input to the Long Range Plan process. This community is commended for its vision and passion in terms of making the case for the next-generation QCD machine that will enlighten our understanding of strongly interacting matter.

The EIC Community appears to be made of two sub-groups, roughly associated with the BNL or JLab concepts for the machine. The BNL case is more mature at this time, perhaps given that the more pressing demands on JLab users to focus on the 12-GeV Upgrade have had their central attention. Now that the Upgrade is in progress, the JLab User's Group is planning a series of workshops to develop their version of the EIC science case. We note that MeRHIC and MEIC are different machines in terms of energies and luminosities; as such, they are optimized for different core physics programs, although there is significant overlap. The MeRHIC machine leans toward low-x, high sqrt(s) studies, and for optimization of the ion side of the machine to study the proposed color glass condensate, or gluon saturation regime. The MEIC on the other hand lends itself toward 2D "tomography" studies of the nucleon, specifically gluon and sea quark distributions. At this stage both efforts are to be applauded and encouraged. Only through vigorous discussion and formal studies can the science case be sharpened and presented - *ultimately with one voice* - to the broader nuclear physics community and, in turn, to the full physics community.

This fall, an INT Workshop was held on the *Physics at a High Energy Electron Ion Collider*. Both sub-communities were represented well in the program. In the fall of 2010, a long program at the INT is scheduled that is relevant to the EIC science case: *Gluons and the Quark Sea at High Energies: Distributions, Polarization, Tomography*. It promises to be a pivotal opportunity for the joint-community to converge on a core science case having the greatest possible impact and discovery potential. In preparation, several workshop are being planned by the JLab group (we presume these are open) and the EIC Collaboration has scheduled meetings. The JLab accelerator team is encouraged to rapidly establish credible MEIC parameters for the physicists to assume, just as the MeRHIC team has already delivered. During the lead-up to the program, physics planning exercises should take place using parameterized detectors as discussed above.

The INT Program should be used to articulate the *theoretical motivation,* but also to compare those goals with reality by examining the sensitivities of simulated experiments. An outcome should be the science / machine matrix discussed earlier. At the conclusion of the INT program, we can anticipate some follow-up event(s) in 2011 where the joint community agrees on the theme of a final White Paper. Thus, it is our opinion that there remains time for vigorous debate about scientific options and priorities; however, for full consideration at the next LRP, one coherent, joint-QCD-community request should be made.

Laboratory Managements

Clearly the EIC project can only be successful if it has a strong support from the laboratories involved. The committee was pleased to learn that there is an effort in both BNL and JLAB to secure resources and a working budget for these studies. At a future review meeting the committee would want to assess whether these resources are sufficient to achieve the goals by 2012. BNL has a targeted LDRD program and has installed a task force for EIC studies; funds are available for visitors for EIC related work at JLAB.

To progress further, some assurance from lab managements would be useful, stating that, which ever facility scheme will be chosen in the end of the evaluation process, both laboratories are committed to making it a success together. General meetings, commonly organized by the whole community are strongly encouraged as before. Meetings which are organized explicitly for one community may in the long run not lead to the necessary united position of the whole community in support of the future project.

Outlook and concluding remarks

This is work in progress, with regard to the science case, the facility concept, technical issues and R&D, experimental and detector aspects, collaboration and management. It is also work in progress with regard to any external assessment, advice, comments, and recommendations as the ones made in this Report. EICAC appreciates the opportunity to be involved in this process. It is impressed by what has already been achieved and excited about what might be reached in terms of science opportunities when this project comes to fruition. We hope that the comments given in this Report are helpful towards a successful project.

However, there are many unresolved issues and unknowns and while the EICAC has tried its best in terms of unbiased advice many issues are completely open and possibly not fully appreciated also by EICAC. For example, as already discussed with BNL and JLab management, many of the specific accelerator questions might benefit from, or best be evaluated by additional accelerator experts, or by a committee (or sub-committee) primarily of accelerator physicists and engineers.

We have also not addressed the question whether other research programs beyond the three core categories described above might benefit from the unique future EIC capabilities. An example might be the search for exotic mesons of QCD (such as glueballs or gluon-rich hybrids) in a mass range (charmed sector and beyond) that cannot be addressed by the 12 GeV Upgrade at JLab, for example.

We want to conclude by thanking JLab for the hospitality extended to us during this meeting and for the interesting program and discussions that hopefully will be a step towards a successful EIC.

Membership of the Electron-Ion-Collider Advisory Committee (EICAC)

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Agenda for November 2- 3, 2009 EICAC Meeting
Thomas Jefferson National Accelerator Facility

Monday, November 2, 2009
CEBAF Center F113

8:30 – 9:00 am	**Executive session with BNL and TJNAF Management**

Open Session CEBAF Center Auditorium

09:00 – 09:30	**Overview of Recent EIC Planning at the Labs and Expectations from this and future EICAC meetings,** Steve Vigdor (BNL)/Hugh Montgomery (TJNAF)
09:30 – 10:00	**Progress Report on F_L and Diffractive Physics Program to Measure Gluon Distributions in Nuclei,** Thomas Ullrich (BNL)
10:00 – 10:30	**Progress Report on Deep Exclusive Reaction Program,** Christian Weiss (JLab)
10:30 – 11:00	**Coffee break**
11:00 – 11:20	**Progress Report on Detector/IR Integration,** Elke Aschenauer (BNL)
11:20 – 11:40	**DAQ/Electronic Systems at High Luminosity w/CW Beams** Chris Cuevas (JLab)
11:40 – 12:00	**Summary of INT Workshop on Science Goals for Medium-Energy Versions of EIC** Raju Venugopalan (BNL).
12:00 – 12:45	**Overview of Science Goals, "Golden Measurements" and Implications for Energy and Luminosity Reach of EIC,** Ed Kinney, U. Colorado
12:45 – 14:00	Lunch and Executive Session
14:00 – 14:45	**Machine Design Progress and Options at BNL,** Vladimir Litvinenko (BNL)
14:45 – 15:30	**Machine Design Progress and Options at JLab,** Geoff Krafft (JLab)
15:30 – 16:00	**Break**
16:00 – 17:00	**Accelerator R&D strategy and program(s),** Thomas Roser (BNL) /Andrew Hutton (JLab)
17:00 – 18:30	**Executive session (F113)**
18:30	**Reception**

Tuesday, November 3, 2009

Open Session CEBAF Center F113

Accelerator Breakout Session – focus on: detailed assessment of design challenges, risks, and R&D milestones needed for each design

08:30 – 10:30 am Detailed discussion of JLab and BNL designs

Open Session CEBAF Center L102/104

Science Program Breakout Session – focus on: crispness of the science goals, milestones and timelines for improved simulations and down-selection of "golden" experiments, implications for machine energy, luminosity and detector R&D needs

08:30 – 10:30 am Detailed discussion of medium-energy and full-energy science programs

10:30 – 10:45 **Break**

Open Session CEBAF Center F113

10:45 – 11:15 **Collaboration activities, progress on international involvement and strategy/timeline for next LRP,** Abhay Deshpande (Stony Brook)/Richard Milner (MIT)

11:15 – 12:00 **Open discussion of issues and future meetings, including whether the present organization adequately represents the (US) field?**

12:00 – 15:30 **Executive Session, Report Writing, Lunch (F113)**

15:30 – 16:30 **Closeout**

16:30 **Adjourn**