Institute Laboratory Assessment Interim Review

Radiation Laboratory

Laboratory Head: Hideto EN'YO (D. Sci)

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Place: Nishina Hall, Nishina Center, Wako, RIKEN

Reviewer:

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Report

(Order of the reviewers is arbitrary)

Reviewer 1

The work of Dr. Hideto En'yo lies in a field of hadron physics which is, however, much wider than usually considered to be. His major work is the RHIC spin physics at BNL. He has been leading the RBRC which RIKEN established for the study. After long effort, his group was able to extract interesting result that gluons carry little fraction of nucleon spin. It will be important to quantify the result in the future precise experiment. The study relies on the PHENIX detector whose major aim is relativistic heavy ion physics. Dr. En'yo has been successful to cooperatively include such activity in his group by promoting distinct and talented physicists. Consequently he also made substantial contribution for the development of the relativistic heavy ion physics. Another activity is the study of medium modification of hadron properties which was carried out at KEK. Their result is interesting although consensus among community has not been obtained. He ideally presented their result by clarifying its characteristics and carefully discussing other conflicting researches. The study could be one of major researches in the future J-PARC. He has achieved astonishing work during his term. His group is now playing one of major roles in the field of nuclear physics. He has been productive not

only in physics but also growing physicists. During interview of group members, we recognized that everyone is satisfied by being his group member. This fact clearly shows that he has been a good manager. Only minor worry is that everyone is so satisfied that we hear little about strong intention to go beyond.
In summary, his activity is ranked highest and further development in the future can be expected.

Reviewer 2

The Chief Scientist of the Radiation Laboratory (RL), Dr. En'yo, has successfully and thoroughly transformed RL from a traditional (nucleon-based) nuclear physics group to a QCD-motivated hadron physics group. This transition had already been initiated by his predecessor Dr. Ishihara, who established the Riken BNL Research Center (RBRC) and secured the funding for the RHIC-spin program.
However, Dr. En'yo expanded the RL activities beyond his initial mandate by bringing the heavy ion physics under his umbrella. A synergy resulted from this excellent decision, e.g., RIKEN's contribution to the vertex tracker was beneficial to both spin and heavy-ion programs.
As for the RHIC-spin program, the measurement of the gluon contribution to the proton spin is about to end, somewhat unexpectedly (the gluon having contribution turned out to be very small), but other important measurements such as the anti-quark polarization are still underway. The program is quite exciting for the next several years.With the upgraded PHENIX detector, the heavy ion program will likewise continue to yield important physics results.
The study of in-medium hadron-mass modification, the KEK experiment started by Dr. En'yo while he was still in Kyoto, has produced tantalizing results, which need further confirmation by an upgraded experiment being planned at J-PARC.
We were at first a bit puzzled after Dr. En'yo's presentation in which he spent only about two minutes on the future directions. We later understood that his vagueness is due to the upcoming restructuring of the RIKEN Nishina Center in which Dr.En'yo is expected to play a major role, and the future of RL is likely to be in the hands of En'yo's successor.
All in all, the group is now in a golden era, and it will be a real challenge (for En'yo's successor) to maintain this level of excellency into the next decade. This success has been made possible primarily due to Dr. En'yo's physics insight reinforced by his superb management skills, but it is due also to the great freedom he has enjoyed in reallocating

various resources.

Reviewer 3

Major physics objectives in Dr. En'yo's laboratory are (i) spin physics at RHIC, (ii) relativistic heavy-ion collisions at RHIC and (iii) the modification of meson properties in nuclei at KEK. In all three topics, renowned achievements are obtained in the past 8 years. In particular, the spectral modification of phi-meson in nuclei found by KEK-E325 experiment lead by Dr. En'yo gave a great impact on world-wide experimental and theoretical activities in nuclear and hadron physics. It is indeed the first serious experiment which addresses the fundamental question of partial restoration of chiral symmetry in cold nuclear matter. Dr. En'yo created a very comfortable working environment in his lab., so that young researchers can focus on his/her researches and maximize their outputs. Also, Dr. En'yo supports theoretical physicists as contract researchers for past 8 years. This gives a very good opportunity for young theorists to interact and exchange ideas with forefront experimental researchers in the lab. Plans as continuation of the current research activities (i)-(iii) have bright futures at RHIC and J-PARC. I highly recommend to utilize J-PARC to make further progresses in the fundamental physics developed in Dr. En'yo's lab.

Reviewer 4

Dr. En'yo took over the Chief Scientist position seven years ago from Dr. Ishihara, who had initiated the RIKEN collaboration with Brookhaven National Laboratory on the RHIC spin program. The goals were to investigate the spin behavior of the constituents of the proton through colliding polarized protons at the RHIC accelerator at BNL, as well as to develop a strong international collaboration on RHIC physics. RIKEN supported this program through significant hardware contributions, by setting up a group of young scientists at RIKEN to work on the program in the Radiation Laboratory, and by setting up the RIKEN BNL Research Center (RBRC), based at BNL. All of this was initiated by Dr. Ishihara, and brought to fruition by Dr. En'yo. This work is ongoing. However, it is now clear that the major goals have been met: we understand that the gluon carries little of the proton's spin, and the two centers, the Radiation Laboratory and RBRC, are major players in the international effort to understand the structure of the proton.

RIKEN investments in this program, including a major investment in special “Siberian Snakes” and “spin rotators”, made under Dr. Ishihara and completed under Dr. En'yo; special polarimeters for RHIC and the AGS (pre-accelerator for RHIC), a special helical dipole designed and built by RIKEN and a Japanese company, a speculative test experiment to develop a polarimeter that would monitor the spin direction of the RHIC proton beams at collision, and a new collaboration with the BELLE experiment at KEK to measure whether polarized quarks self-analyze their spin direction, important for interpretation of RHIC results, all initiated and done under Dr. En'yo, have all succeeded.

Polarized proton collisions achieve 60% polarization, measured to 5% of itself, with spin direction monitored at PHENIX, using these central contributions from RIKEN. Gluon spin contribution to the proton spin has been limited to be small, less than the contribution needed to make up the full proton spin after accounting the contribution from quark spin. Further data will constrain this even more. The BELLE result for quark spin analysis has been used to determine the transverse spin structure of the proton using RHIC and also Deep Inelastic Scattering (DIS) data from DESY and CERN. The subject of the spin structure of the proton, initiated with data from DIS, is now extremely active world wide, and the Radiation Laboratory and RBRC members play a major role.

I believe that it is important to recognize Dr. En'yo for his success both with the development of the Radiation Laboratory and RBRC. The staff of both were recruited and are led by Dr. En'yo (the experimental group of RBRC), and work together. Both groups are impressive, and this should be attributed to Dr. En'yo and to Dr. Ishihara.

For the near future, measurements of the W boson will give the first flavor-separated measurements of quark and anti-quark polarizations in the proton. The first data are being taken now. Indeed, this work is based on studies done by Dr. En'yo while he was at Kyoto, and were part of the initial RHIC Spin Proposal. By 2010, a new vertex detector developed under Dr. En'yo's leadership, will become available and will allow measurements of the gluon polarization with great precision, as well as heavy quark production. New experiments at J-PARC and RHIC on di-lepton production will test a fundamental prediction of the theory of the strong interaction, QCD. Transverse spin asymmetries seen in DIS should be seen at J-PARC and RHIC with the same magnitude and opposite sign, resulting from opposite interference effects of the scattering amplitudes. This prediction of QCD, if confirmed, would be a cornerstone of understanding the strong interaction at the amplitude level. If it fails, it calls into question our understanding of QCD. This program should be accessible in the next five

years.

For the further future, RHIC will probably focus on adding an electron beam, colliding polarized electrons with polarized protons to reach higher energy for precision studies of the proton structure. The electrons would also be used to probe heavy nuclei to study the saturation of gluons in these nuclei. The program is several years from approval, and would be anticipated in the late 2010s. This would require a new RIKEN-BNL collaboration, if RIKEN decided to go in this direction.

Reviewer 5

The research productivity of the RIKEN "Radiation Laboratory" under the leadership of Prof. Hideto En'yo has been outstanding. Members of the group have been involved and in many cases have led some of the most novel and significant achievements in high energy nuclear physics in the past decade: Measurements of the gluon polarization in the proton, discovery of the ``perfect liquid'' in heavy ion collisions at RHIC, study of meson modifications in cold nuclear matter, and observation of rho-meson broadening at the CERN SPS. The group has also shown leadership in the PHENIX upgrade program and made critical contributions to the accelerator technology which permits RHIC to operate as the world's first and only polarized proton collider. The Chief Scientist has established an environment in which junior people feel recognized and are rewarded for their efforts, and has also made some key and insightful hires that have strengthened an already strong group.