Comments of the KMI International Advisory Board

from

John Ellis (Chair), Gerardus 't Hooft, Taichiro Kugo,

Katsuhiko Sato, Joseph Silk

(Members Takaaki Kajita and Masanori Yamauchi were not present at the meeting)

February 20th, 2019

Current Activities

We were impressed by the high level of research activity and enthusiasm demonstrated by KMI members during the Symposium, which promises well for the future. Overall, we think that KMI is well organized, with a programme that is well focused on the dark universe. Its members are in general performing excellent research that has strong international impact, as measured by the numbers of highly-cited and hot papers they publish. The impact of KMI is further enhanced by the meetings it holds and supports, its international research collaborations and agreements, the schools it organizes that attract many international participants, and its outreach events.

KMI members participate in a wide range of frontline particle physics experiments, including both larger and smaller collaborations. We congratulate KMI members on being active in well-identified projects within the larger collaborations such as ATLAS and Belle II, and believe that they are successful in maintaining a visible brand image within these teams. KMI is also to be congratulated on its leading role in the smaller LHCf experiment at the LHC. KMI is also active in neutron experiments and participates strongly in several Japanese neutrino experiments. We note that KMI is expanding its activities in direct dark matter detection, with participation in the world-leading XENON series of experiments and the development of an innovative idea for detecting the directionality of dark matter scattering using an emulsion technique.

We were particularly impressed by the excellent results produced by Hitomi during its very short lifetime. We were therefore very glad to hear that a way forward has been found to continue X-ray astrophysical observations after the unfortunate Hitomi accident, via XRISM and subsequent missions, enabling KMI to continue playing an important role in this interesting field.

Theoretical particle physics is currently in a challenging phase: the Standard Model (SM) is very successful, but many ideas for possible new physics beyond it have yet to bear experimental fruit. Theoretical activities at KMI cover a wide range from QCD to string theory and cosmology via attempts to push beyond the SM. KMI is therefore well equipped to play an important role in the deployment of new theoretical ideas. We were impressed by the presentation at the Symposium of KMI work on heavy-ion collisions, which may offer an arena for probing fundamental theories such as the AdS/CFT correspondence.

Future Activities

KMI is in a position to continue its important role in accelerator-based particle physics in the coming years. Belle II has a very rich panorama of interesting research opportunities. In addition to tests of the Kobayashi-Maskawa model, these include exotic hadrons, which present many puzzling features, B-decay anomalies, which may well provide indications for physics beyond the SM, and the search for light dark matter. The research interests of the KMI ATLAS team align well with the priorities for measurements at HL-LHC, including precision studies of the top quark and the Higgs boson. We also support the plans of the team to continue searches for subtle signatures of new physics. Theoretical advice will be essential to maximize the physics extracted from accelerator experiments. These will be complemented by non-accelerator experiments searching for dark matter and new manifestations of CP violation. We are glad to know that the Hyper-K experiment has now been given the go-ahead, and note that it can probe deeply two aspects of the origin of matter: CP violation in the neutrino sector as in the Maki-Nakagawa-Sakata model and the possibility of baryon decay. We note also the capabilities of future neutron experiments to look for CP violation beyond the Kobayashi-Maskawa model.

Gravitational physics is an emerging hot topic in astrophysics and cosmology, following the discovery of gravitational waves and upcoming probes of physics near or at the horizons of black holes. We stress the importance of searches for gravitational waves in the mid-frequency range, with projects such as DECIGO, which may reveal signals of cosmological phase transitions that might create primordial black holes as dark matter candidates in one of the few allowed windows, as well as astrophysical sources. Synergies with theoretical advances will be crucial in this area. A developing area in theoretical physics is at the boundary between gravity and quantum information theory, which may provide new insights into the origin and nature of space-time.

Another hot topic in astrophysics and cosmology is the epoch of reionization and the preceding dark ages. Observations are starting to probe this era, opening up a new frontier, and there is considerable interest around the world, including in China. In this connection we encourage efforts to formalize participation in SKA. In parallel, we look forward to the results from XRISM and other X-ray observations of violent events in later phases of the universe.

Other Activities

We value very highly KMI's educational activities, particularly the schools it organizes, which attract many international students, and are worthy of support by Nagoya University. We also think that KMI's outreach activities are important tools for maintaining and building support within the university and in the broader community. KMI has some great research stories to share, and outreach is not only invaluable for developing its brand, but might also provide opportunities for crowdfunding some of its research activities.

Internal Re-Organization of KMI

We understand the motivations to renew the internal structure of KMI provided by the changing roles of its first generation of inspiring scientific leaders and the need to provide opportunities for a new generation of younger leaders to take KMI forward. We also support in general terms the ambitions to streamline the internal administration of KMI and aim for greater simplicity.

That said, the specific advantages of the details of the internal re-organization being planned were not completely clear to us. In particular, we stress the importance of maintaining close connections between theory and experiment. This is the case in astrophysics, in particular where research activities often straddle the boundary between theory and experiment. We wonder, therefore, whether KMI is giving consideration to the establishment of a specific division for astrophysics.

External Re-Organization

The imminent advent of the Nagoya University International Advanced Research Organization (IARO) offers opportunities and risks.

On the one hand, it marks the recognition by the leadership of Nagoya University that KMI is doing excellent research, publishing many top-cited papers. Moreover, the IARO could provide a structure for the University to focus additional resources to safeguard and build upon this success.

On the other hand, it will be important to guarantee the identity and autonomy of KMI, so as to maintain its research thrust and develop the international recognition of its distinctive brand.

In particular, the embedding of KMI within the IARO should not become an excuse for transferring resources to other activities. Rather, it should strengthen the visibility of the university's commitment to KMI's forefront research, by providing more support in the form of human and financial resources.