

# **The K Computer and Advanced Institute for Computational Science**

**Kimihiko Hirao**

Advanced Institute for Computational Science (AICS) RIKEN  
7-1-26 Minatojima-minami, Chuo, Kobe  
650-0047 Japan

The Nobel Prize in Chemistry 2013 was awarded to Martin Karplus, Michael Levitt and Arieh Warshel "for the development of multiscale models for complex chemical systems". They laid the foundation for the powerful computer programs that are used to understand and predict chemical processes of giant molecules such as proteins. This is the first time that the Nobel Prize was awarded to the simulation study. Computer simulation has truly become the critical third pillar for scientific discovery along with experiment and theory. In future, Nobel Prizes will definitely be awarded to simulation studies performed on the supercomputer.

The K computer started the official operations in September, 2012. One year has passed since then and exciting results using the K computer are coming in a wide range of science and engineering.

The K computer won the top position on TOP500 in 2011 achieving a LINPACK benchmark performance of 10 petaflops - becoming the first supercomputer ever to reach this milestone. The K computer, led by RIKEN and built by FUJITSU, is a pure, homegrown supercomputer, from the R&D of the processors to system design and manufacturing. It is the general-purpose supercomputer. Contrary to many other recent very large systems, it does not utilize GPUs or other accelerators. It is capable of sustained performance of 1 petaflops on real applications.

Computer simulation is becoming more and more important for contemporary science and engineering. Simulations performed on the supercomputer will drive progress in science and technology and play an important role in solving difficult problems that we face as a society. There are very critical issues that need to be solved - global warming, alternative energy, disaster mitigation, new materials, healthcare, security, etc. Simulations should not only be able to reproduce and explain phenomena but also predict phenomena. The role of simulations will become increasingly larger, and the results that they provide will undoubtedly greatly affect society. If we can raise the reliability of simulations, simulations will become all the more attractive as a research tool.

Our institute, AICS was established in 2010. AICS is the Japanese flagship research institution in computational science and computer science. It is an organization charged with operating and managing the K computer and pursuing research and development by promoting strong collaborations between computer scientists and computational scientists. Plotting and developing Japan's strategy for high performance computing, including defining the path to exascale computing, is also the important mission of AICS.

I will present frontiers opened by the K computer. The challenge and possibility of high performance computing will be discussed.