Extending Atomic Energy Research by Combining Computational Science, Theory, and Experimentation

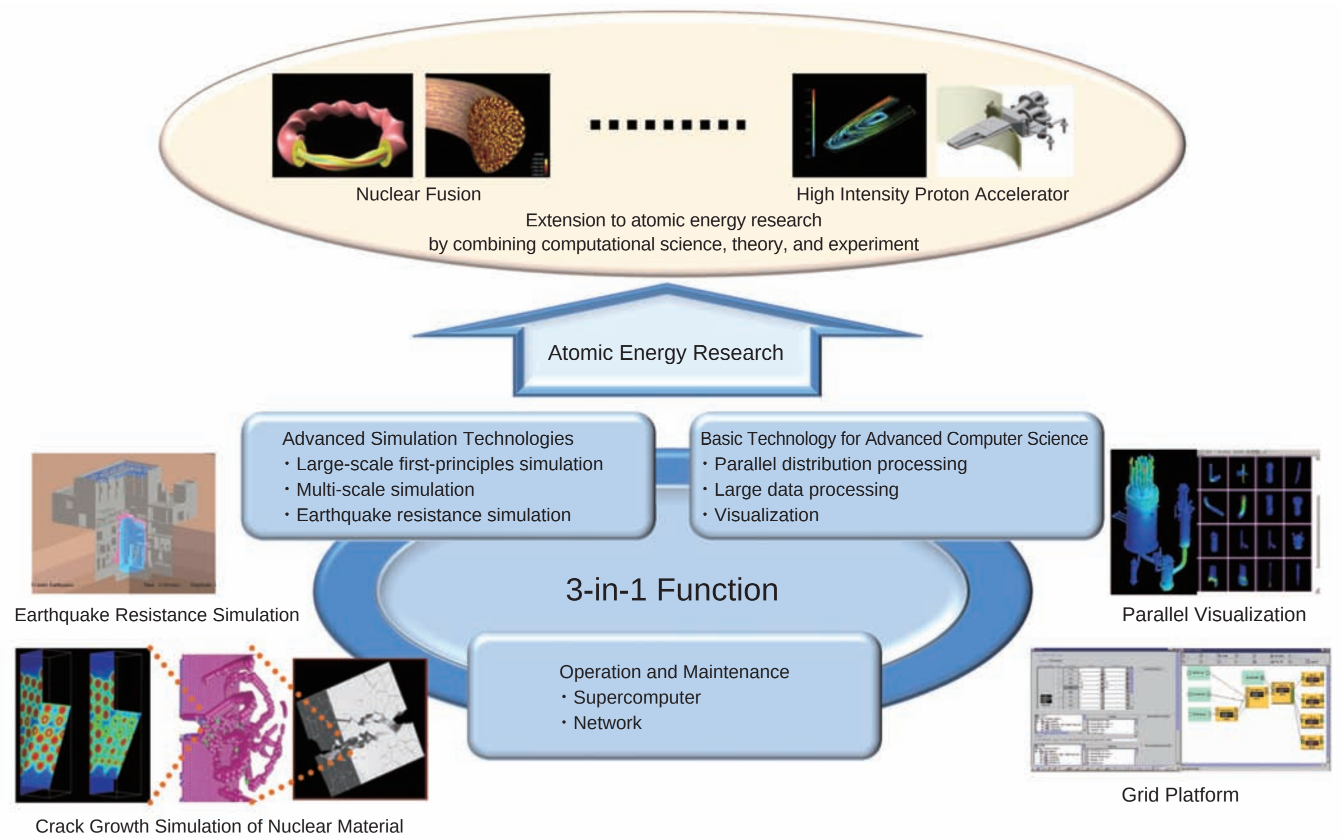

Fig.12-1 Role and achievements of computational science in supporting atomic energy research
We promote three missions while conducting atomic energy research using computational science: the development of basic technology for computer science, the development of advanced simulation technologies, and support for operation and maintenance of computer systems.

Remarkable progress has been made in simulation technologies and basic technologies that support computational science research since the invention of the supercomputer in the 1980s. Similar progress has been made in computational science, which has come to be recognized as a third research method, along with theoretical and experimental methods.

In atomic energy related fields, computational science has an important role in forecasting and analysis of phenomena that are difficult to investigate experimentally or through observation. We believe that progress in atomic energy research and development will increasingly require the use of computational science and large-scale and long-term experiments.

Therefore, in order to support such large - scale calculations, the Center for Computational Science & e-Systems (CCSE) has three missions: the development of basic technology for computational science, the development of advanced simulation technologies, and support for operation and maintenance of supercomputer systems, as shown in Fig.12-1. In addition, we combine computational science, theory, and experimentation, and work toward the development of atomic energy research that uses computational science.

For example, in the field of atomic energy, the degradation of nuclear material and nuclear fuel due to aging and the earthquake resistance of nuclear reactor facilities have been investigated both theoretically and experimentally, and the effects of the degradation of nuclear material and nuclear fuel due to aging and the earthquake resistance of nuclear reactor facilities have been analyzed. We believe that computational science will enable us to perform forecasting and analysis that have hitherto posed problems with respect to cost and scale.

Regarding the analysis of degradation of nuclear material due to aging, crack growth mechanisms in steel are investigated from the atomic scale to the macro scale.

For the purpose of analyzing the earthquake resistance of nuclear reactor facilities, a virtual vibration simulator has been constructed and long-term simulations are being carried out. The results indicate that this is an effective method for investigating the seismic responses of nuclear reactor facilities.

Moreover, we are developing new computer techniques and computer programming methods. These techniques are applied to plasma stability research and they support plasma stability research and development.

In the future, we will extend atomic energy research by developing basic technologies for computational science and advanced simulation technologies. In addition, using the techniques we develop, we will promote cooperation between research organizations inside and outside JAEA.