Joint Institute
for Computational Fundamental Science
(JICFuS)
http://www.jicfus.jp/en/

CCS at U. Tsukuba / RIKEN AICS

Yoshinobu Kuramashi

Plan of Talk

- Mission of JICFuS

- Organization

- K Computer and HPCI Strategic Field Program

- Other Activities

- Summary

Mission of JICFuS (1)

Organization of three institutes for advancing computational fundamental sciences

- Center for Computational Sciences (CCS) of U. Tsukuba
  - Long history to develop parallel supercomputers since 1970s
  - CP-PACS ranked No. 1 on the Top 500 in Nov. 1996
  - Collaborations between computational and computer scientists
- High Energy Accelerator Research Organization (KEK)
  - Research on particle physics using supercomputers since 1980s
- National Astronomical Observatory of Japan (NAOJ)
  - Providing computing resources to the fields of astronomy and astrophysics
- Partner Organizations
  - U. Tokyo, YITP of Kyoto U., RCNP of Osaka U., Chiba U., Tokyo Institute of Technology, RIKEN Nishina Center,
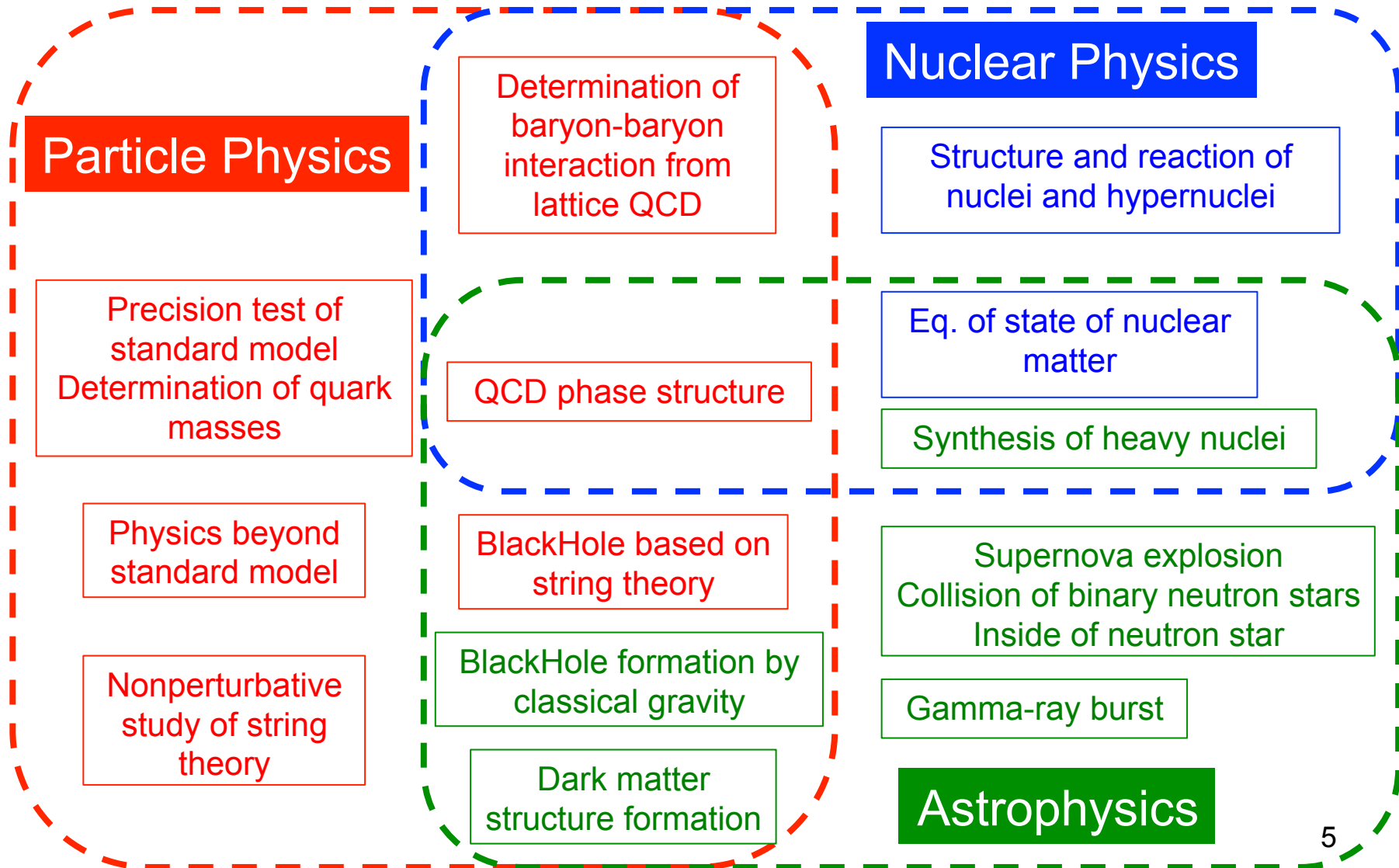
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Mission of JICFuS (2)

Major objectives

- Provide extensive and strong support to computational scientists
  − advise researchers across Japan on topics such as using supercomputers more effectively and developing new algorithms

- Provide a common place for computational fundamental scientists and computer scientists
  − A place for both sides to interact and actively exchange ideas on a routine basis

- Creation of new fields of research
  − Promote collaborative interdisciplinary research between computational fundamental scientists in different fields
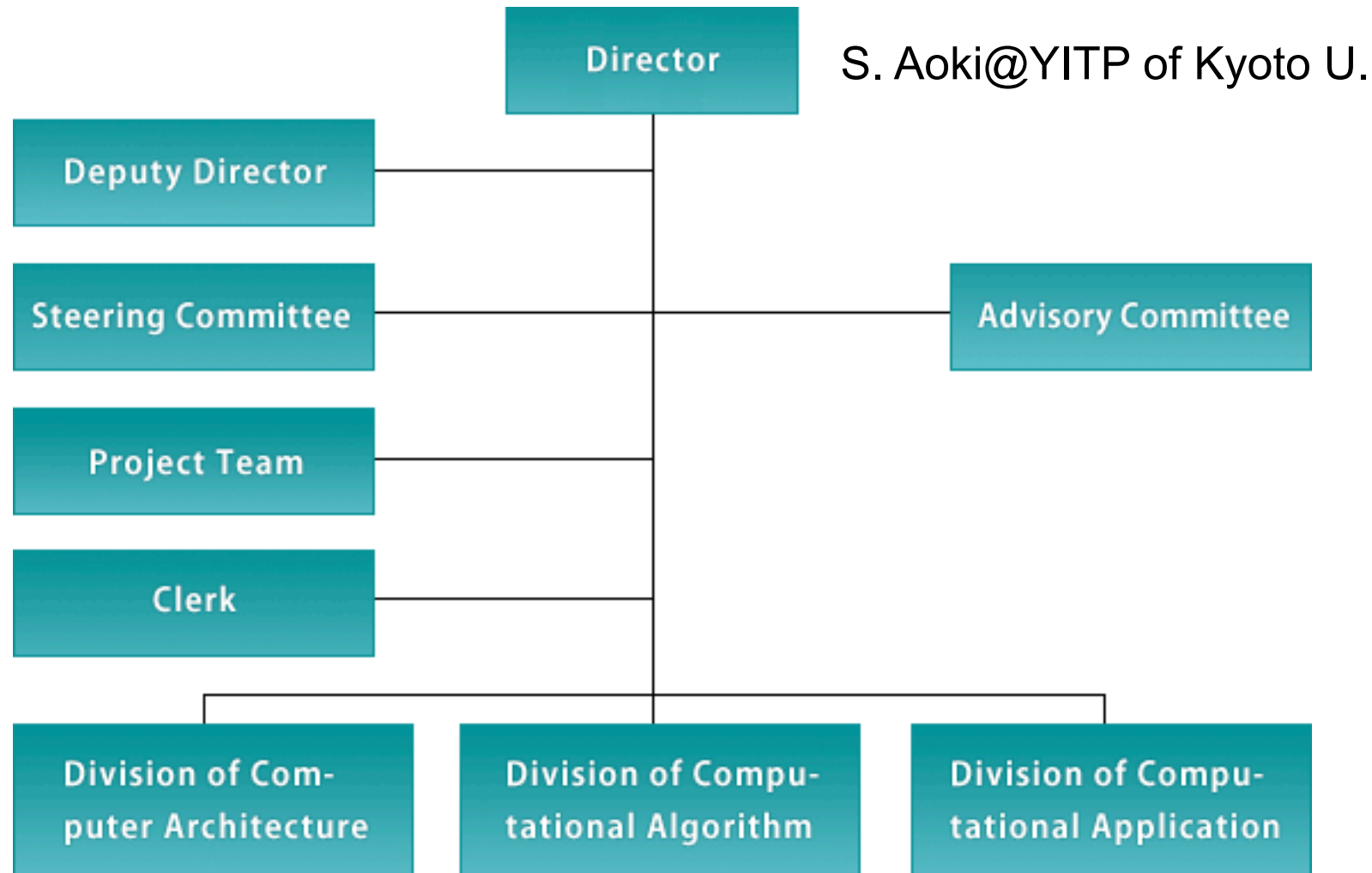
Interdisciplinary Research

Particle Physics

Nuclear Physics

Determination of baryon-baryon interaction from lattice QCD

Structure and reaction of nuclei and hypernuclei

Precision test of standard model Determination of quark masses

QCD phase structure

Eq. of state of nuclear matter

Synthesis of heavy nuclei

Physics beyond standard model

BlackHole based on string theory

Supernova explosion Collision of binary neutron stars Inside of neutron star

Nonperturbative study of string theory

BlackHole formation by classical gravity

Gamma-ray burst

Dark matter structure formation

Astrophysics

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Organization

S. Aoki@YITP of Kyoto U.

Steering Committee

Regular meeting every other month

Name	Institute	Research Field
S. Aoki	YITP of Kyoto U.	Particle Physics
J. Makino	Tokyo Institute of Technology	Astrophysics
S. Hashimoto	KEK	Particle Physics
M. Umemura	CCS of U. Tsukuba	Astrophysics
K. Yabana	CCS of U. Tsukuba	Nuclear Physics
M. Sato	CCS of U. Tsukuba	Computer Science
T. Boku	CCS of U. Tsukuba	Computer Science
T. Ishikawa	KEK	Particle Physics
T. Sakurai	CCS of U. Tsukuba	Computer Science
F. Yuasa	KEK	Particle Physics
K. Tomisaka	NAOJ	Astrophysics
Y. Kuramashi	CCS of U.Tsukuba	Particle Physics
T. Hatsuda	RIKEN Nishina Center	Nuclear Physics
T. Otsuka	U. Tokyo	Nuclear Physics
T. Nakatsukasa	RIKEN Nishina Center	Nuclear Physics
M. Shibata	YITP of Kyoto U.	Astrophysics
R. Matsumoto	Chiba U.	Astrophysics

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Chronology

Feb. 1, 2009	JICFuS was established
Sep. 27, 2010 ～ Mar. 31, 2011	"Strategic Programs" Feasibility Study Field 5 "The origin of matter and the universe"
Apr. 1, 2011	Strategic Programs for Innovative Research (SPIRE) Field 5 "The origin of matter and the universe" started (～ Mar. 31, 2016)
Sep.28, 2012	K computer for public use started

What is Strategic Field Program?

K computer and Strategic Field Program

Overview of Project

- Development of 10 Pflops-class system in Kobe

  ⇒ named "K computer" by public competition

- Development of grand challenge applications in nano science and life science

- Buildup of a research center in computational science around the 10 Pflops-class system

  ⇒ Advanced Institute for Computational Science (AICS) at Kobe

- Project period (construction) is from Japanese FY 2006 to FY2012

- RIKEN is responsible for the computer development

  Note: independent of RIKEN-BNL-Colombia Collab.

Site for K computer

Tsukuba

Kobe

Kyoto

Tokyo

Osaka
Kyoto

**Shin-Kobe
(Shinkansen)**

**Sannomiya
(Downtown)**

Port Island

AICS

Port Liner 'Monorail'

Kobe Airport

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Some Photo

Front view of AICS

Rack

Logo

Computer room
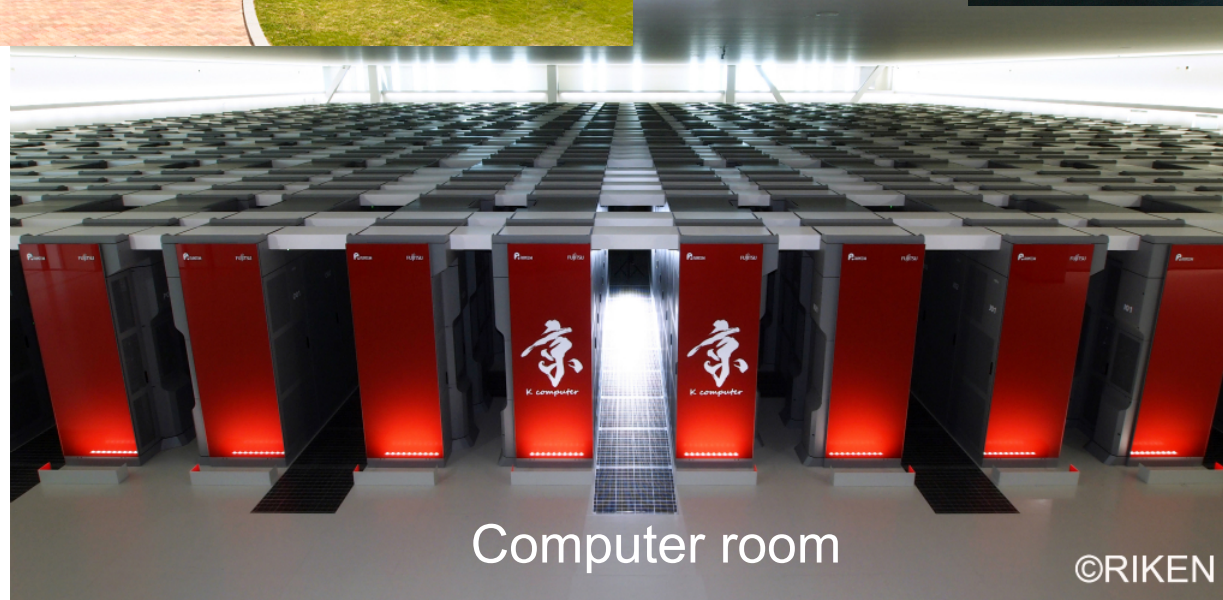
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Strategic Field Program

For strategic use of K computer

- Government selected 5 strategic fields in science and technology for importance from national view point

- For each field, Government also selected a core institute

- Each core institute is responsible for organizing research and supercomputer resources in the respective field and its community, for which they receive

  − priority allocation of K computer resources

    ($\geqq$8% for each field)

  − funding to achieve the research goals

    (～$5M/field/year)
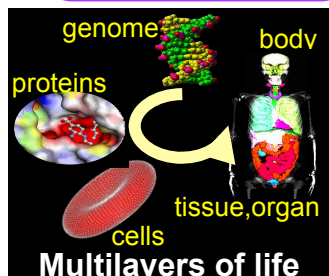
- Program period is from Japanese FY 2011 and to FY2015

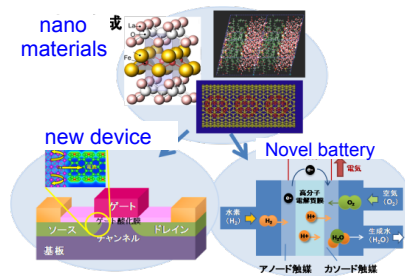# Strategic Fields and Core Institutes

JICFuS

strategic field

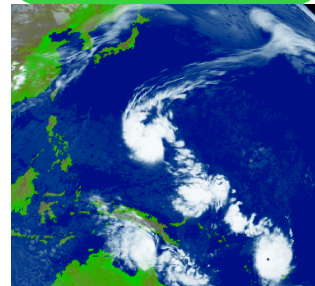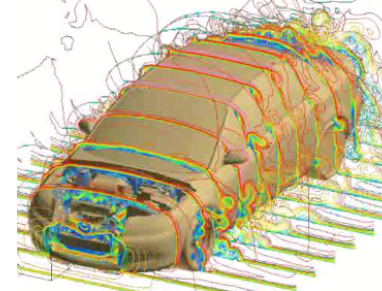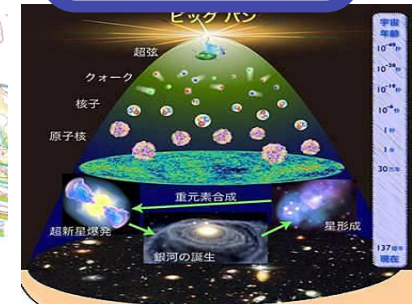| Life science & Medicine	New materials & Energy	Global change prediction	Next generation engineering	Matter & Universe

core institute

RIKEN	Institute for Solid State Physics U. Tokyo	Earth Simulator Center JAMSTEC	Institute for Industrial Science U. Tokyo	JICFuS (CCS of U.Tsukuba)
Life science Community	Materials science Community	Earth science Community	Engineering Community Industry	Basic science Community
Supercomputer resources	Supercomputer resources	Supercomputer resources	Supercomputer resources	Supercomputer resources

Research Subjects

Research of the following subjects is carried out using K computer

① Determination of the baryon-baryon interactions using lattice QCD at the physical point

【Leader: Y. Kuramashi @ CCS in U. Tsukuba】

② Elucidation of nuclear properties using ultra large-scale simulations of quantum many-body systems and its applications

【Leader: T. Otsukua @ U. Tokyo】

③ Clarification of the processes underlying supernova explosions and the formation of black holes

【Leader: M. Shibata @ YITP of Kyoto U.】

④ Investigation on the formation of first-generation stars in the Universe out of density fluctuations of dark matter

【Leader: J. Makino @ Tokyo Institute of Technology】

Dark matter simulation performed on the K computer won the Gordon Bell Prize in November, 2012.

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Other Activities

- **Management of efficient use of computational resources**
  - User-support for optimizing the computer performance
  - Promotion of exploratory research, especially, for young scientists
  - ILDG/JLDG ⇒ Overview by Yoshié-san on Tue.

- **Creation of a research network**
  - Workshop, school, lecture series
  - Personnel development
  - Fostering cooperation across different fields

    ex. Joint WS for Field 5 and Field 2 (material science)

- **Public relations**   Overview by Yabe-san on Tue.
  - Obtain public understanding of research on fundamental sciences

Summary

- JICFuS is an organization for advancing computational fundamental sciences
    - CCS, KEK and NAOJ including other partner institute
    - Computational scientists in particle physics, nuclear physics, astrophysics and computer scientists

- HPCI Strategic Field Program
    - Four research subjects to use K computer
    - Activities to promote computational sciences in field 5

- Future plan
    - International collaboration
    - Cooperation with other fields (material science)
    - Another program after HPCI Strategic Field Program?