

# Burning Plasma Simulation Initiative: BPSI

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# Background

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- **Experiments: Significant Progress in Diagnostics**
  - High resolution in space and time
  - Electromagnetic field in plasmas
  - ITER burning plasma: more than 10 years from now
- **Theory: Better Understanding in Nonlinear Physics**
  - Structure formation, zonal flow, . . .
- **Simulation: Detailed Simulation of Individual Phenomenon**
  - Exponential growth of computation resources and network speed
  - Progress in computation technique
  - Lack of methodology to describe a entire picture of plasmas

# Burning Plasma Simulation

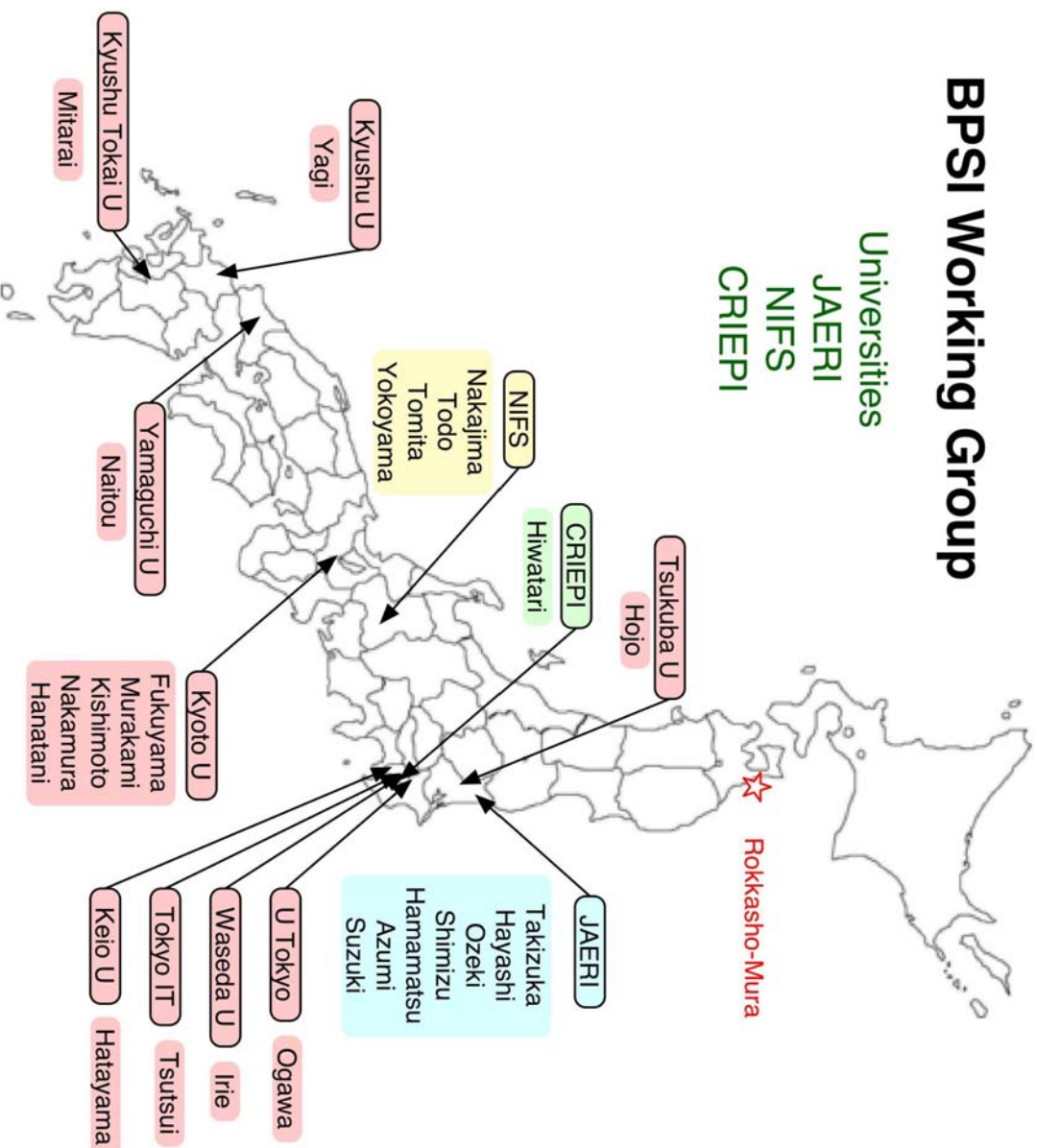
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- **Why needed?**
  - To predict the behavior of burning plasmas
  - To develop reliable and efficient schemes to control them
- **What is needed?**
  - **Simulation describing a burning plasma:**
    - **Whole plasma** (core & edge & divertor & wall-plasma)
    - **Whole discharge** (startup & sustainment & transients events & termination)
    - **Reasonable accuracy** (comparison with experiments)
    - **Reasonable computer resources** (still limited)
- **How can we do?**
  - Gradual increase of understanding and accuracy
  - Organized development of simulation system

# BPSI: Burning Plasma Simulation Initiative

Research Collaboration among Universities, NIFS and JAERI

## BPSI Working Group



# Targets of BPSI

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- **Framework** for collaboration of various plasma simulation codes
  - **Common interface** for data transfer
  - **Reference core code**, TASK
  - **Helical configuration** included
- **New Physics** in interactions of phenomena with different time and space scales (e.g.)
  - **Transport during and after a transient MHD events**
  - **Transport in the presence of magnetic islands**
  - **Core-SOL interface**
- **Advanced technique** of computer science
  - **Parallel computing**: PC cluster, Massively Parallel, Vector-Parallel
  - **Distributed computing**: GRID computing, Globus, ITBL
  - **Visualization**: Parallel visualization, VisiGRID

# Activities of BPSI

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- **Meetings**

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<b>2002 Aug</b>	Preparatory discussion (NIFS)	
<b>2003 Aug</b>	1st BPSI meeting	(Kyoto U)
<b>2003 Dec</b>	US-Japan workshop	(Kyoto U)
<b>2004 Mar</b>	2nd BPSI meeting	(Kyushu U)
<b>2004 Aug</b>	3rd BPSI meeting	(Kyushu U)
<b>2004 Sep</b>	US-Japan workshop	(PPPPL)
<b>2005 Sep</b>	US-Japan workshop	(Kyushu U)

- **Support** from various resources

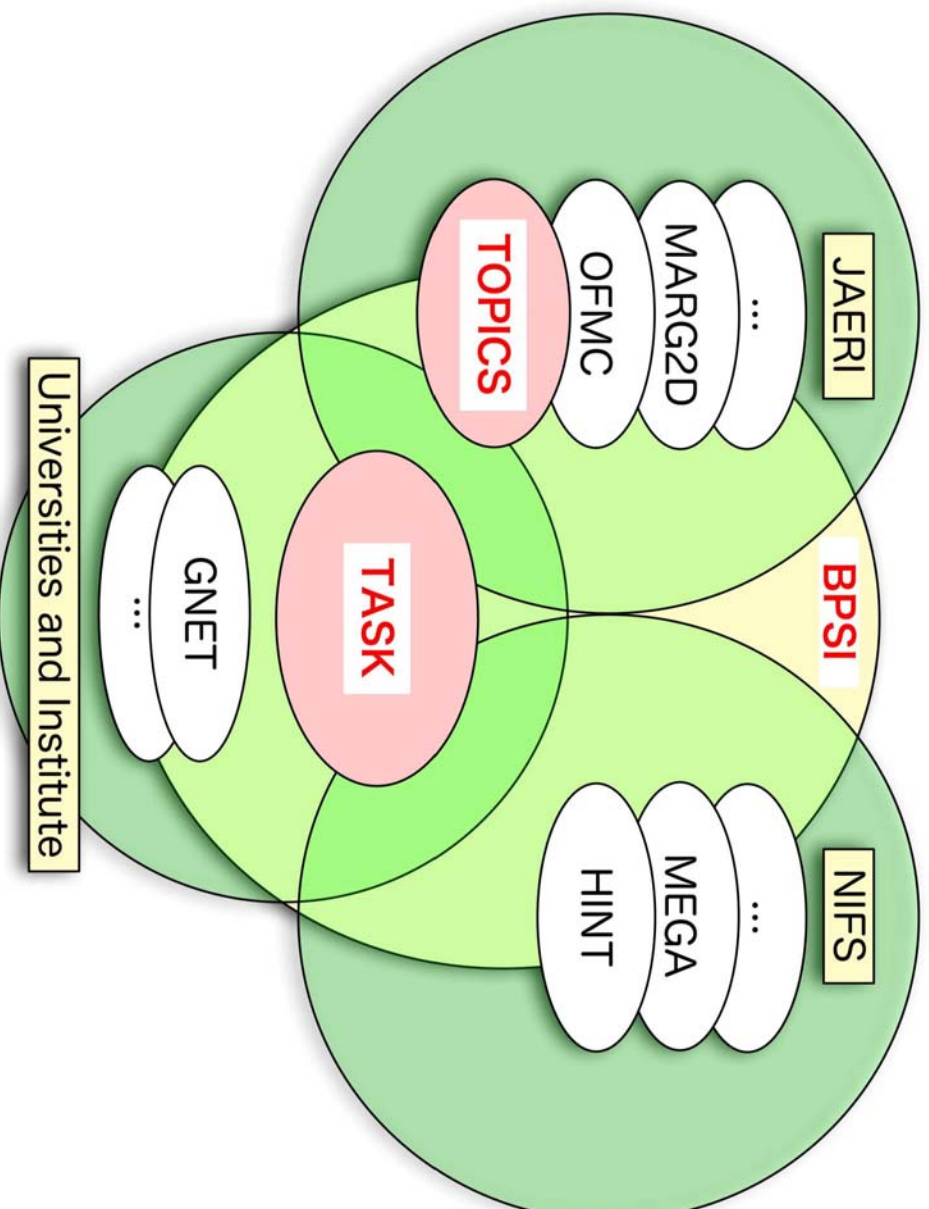
- Grant-in-Aid from JSPS (M. Yagi, Kyushu U)
- Part of Grant-in-Aid from MEXT (S.-I. Itoh, Kyushu U)
- Research collaboration of RIAM, Kyushu U (M. Yagi, Kyushu U)
- Research collaboration of NIFS (Y. Nakamura Kyoto U)
- Research collaboration of JAERI (A. Fukuyama, Kyoto U)
- US-Japan JIFT Workshop from JSPS (A. Fukuyama, Kyoto U)
- **Only for meeting support at present**

# Structure of BPSI

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**TASK:** Core code of BPSI for ITER, JT-60, LHD, and small machines

**TOPICS:** Transport Analysis and Predictive Simulation for JT-60



# Status of BPSI

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- **1st Stage**
  - Development of standard dataset and module interface
  - **Integrated simulation of multi-physics**
  - Validation of modules with **experimental results**
  - Transport simulation in **3D helical configuration**
- **2nd Stage**
  - **Integration of existing and newly-developed modules**
  - **Global integrated simulation** (Core+Edge, Transport+RF+MHD,...)
  - Validation of modules with **direct numerical simulation**
  - Integrated simulation in **3D helical configuration**
- **3rd Stage**
  - **Integrated simulation including startup and termination**
  - **Full integrated simulation of burning plasmas**