

# Overview of Heavy Ion Research in Japan

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US-Japan Workshop on Heavy Ion Fusion  
and High Energy Density Physics

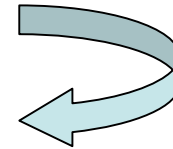
Utsunomiya University  
September 28-30, 2005

# Circumstances of Research in Japan

2001

M. of Education, Culture and Sports

M. of Science and Technology



M. of Education, Culture, Sports, Science and Technology

2004

National University



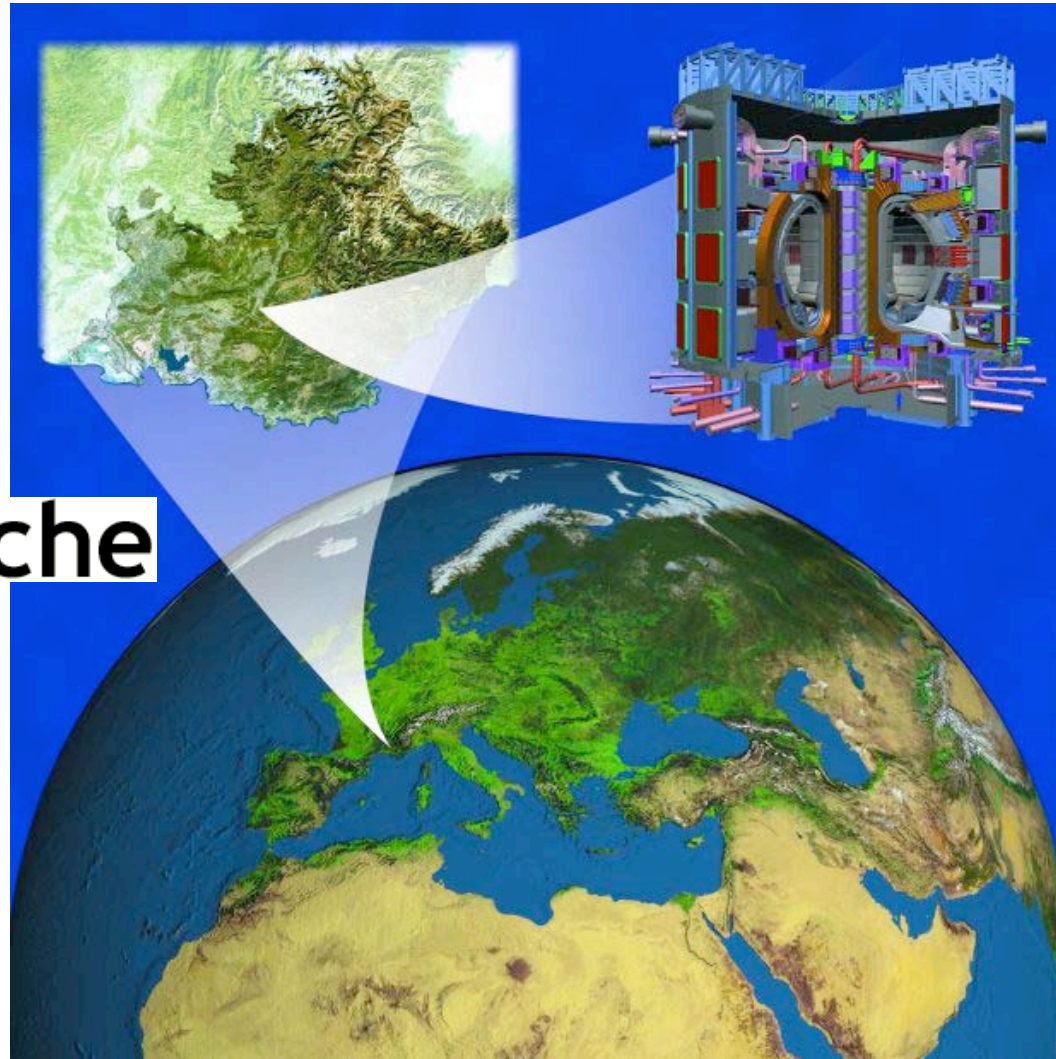
National University Cooperation

2005

ITER site decided

# ITER goes to France, not to Japan

**Cadarache**



# Research Activities 1

## Accelerator Physics

Induction Accelerator for All Species of Ions (KEK, TIT)

Laser-Plasma Accelerator toward HE Frontier (KEK)

Electron Acceleration by Laser (AIST)

Pulse Power Technology (TIT)

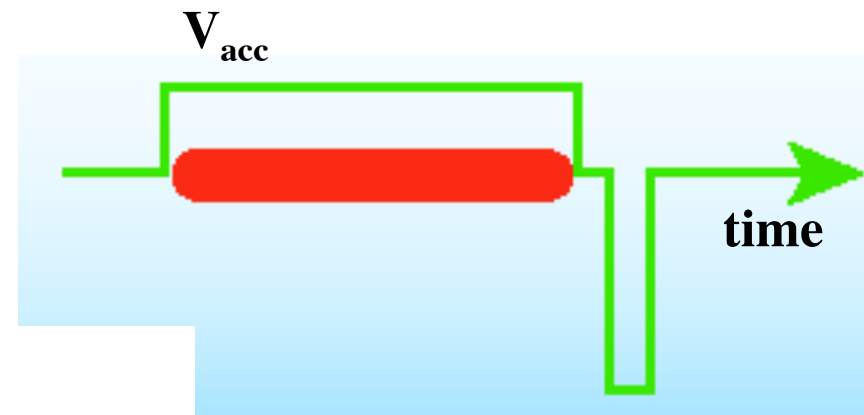
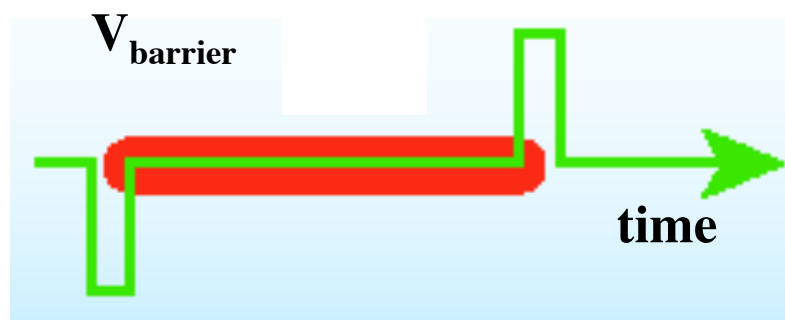
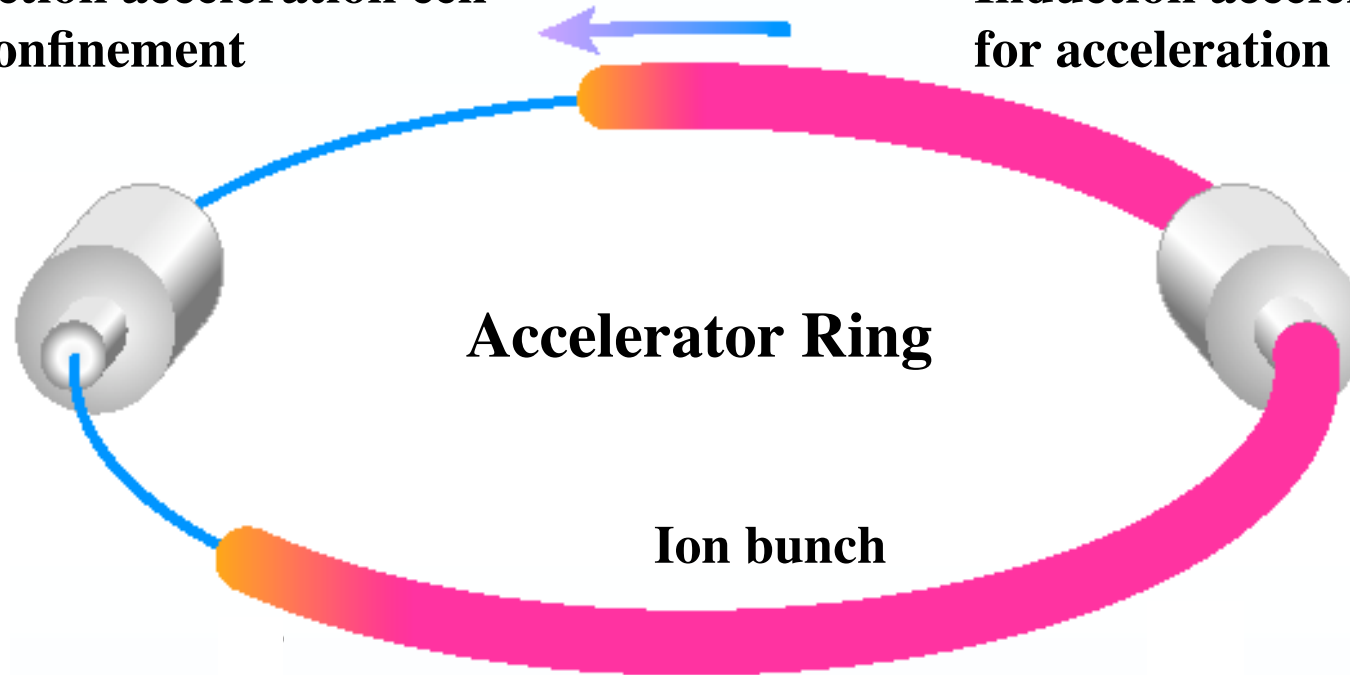
High-Current Beam Dynamics (UU)

MUSES at RIKEN cancelled in 2002

# Schematic View of Induction Synchrotron

Induction acceleration cell  
for confinement

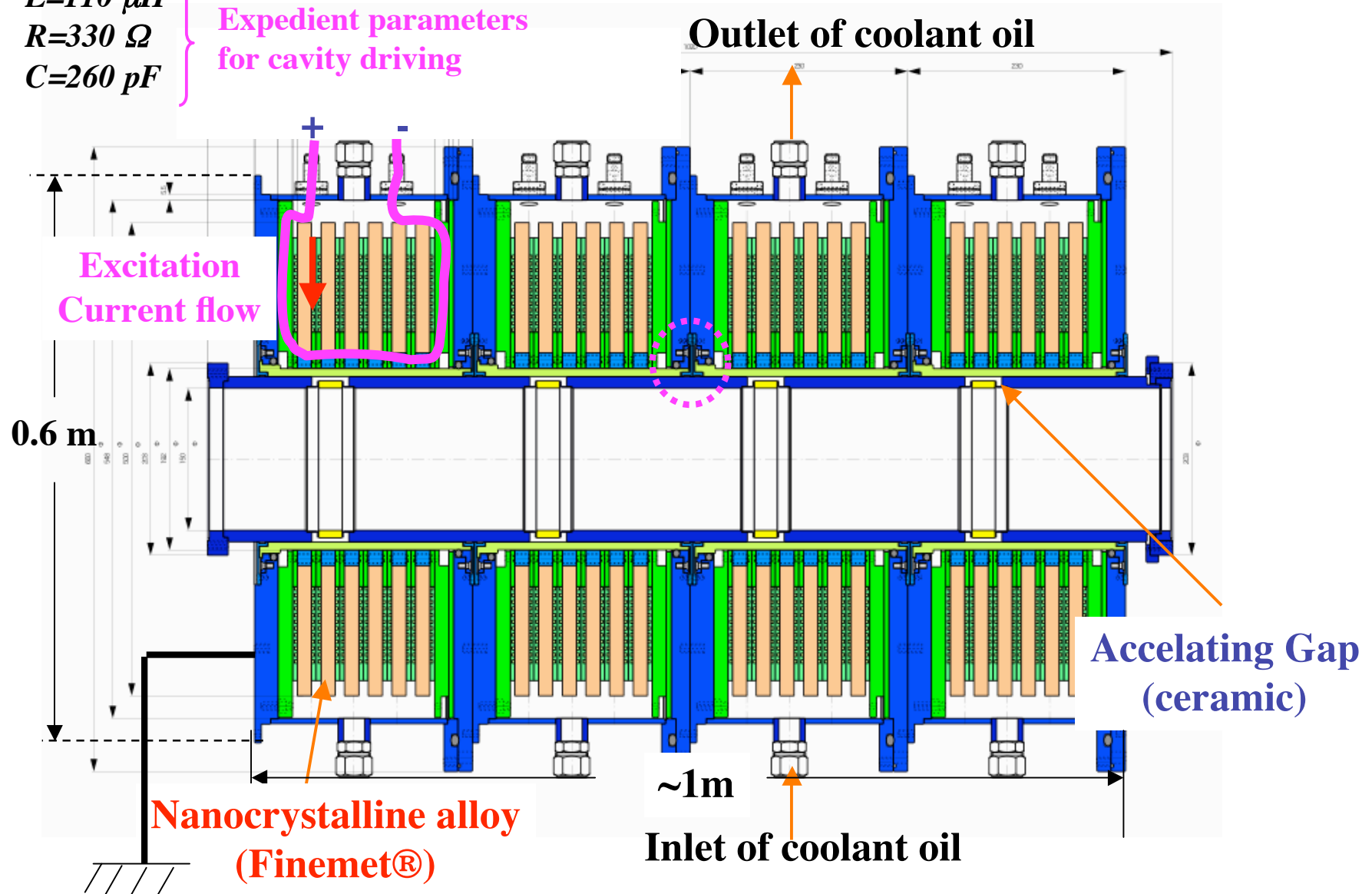
Induction acceleration cell  
for acceleration



# Induction Acceleration Cavity consisted of 4 Cells(2kV/cell) and a single inner chamber

$L=110 \mu H$   
 $R=330 \Omega$   
 $C=260 pF$

Expedient parameters  
for cavity driving



designed, assembled, measured, and installed by K.Torikai et al.

# Research Activities 2

## HED & WDM Physics

Strongly-coupled plasma & beam interaction (TIT)

EUV Source (EUVA)

WDM with Ultra-Short Pulse Lasers (UEC)

HED Science by Laser (ILE)

R-T Instability Control (ILE)

Impact Ignition (ILE)

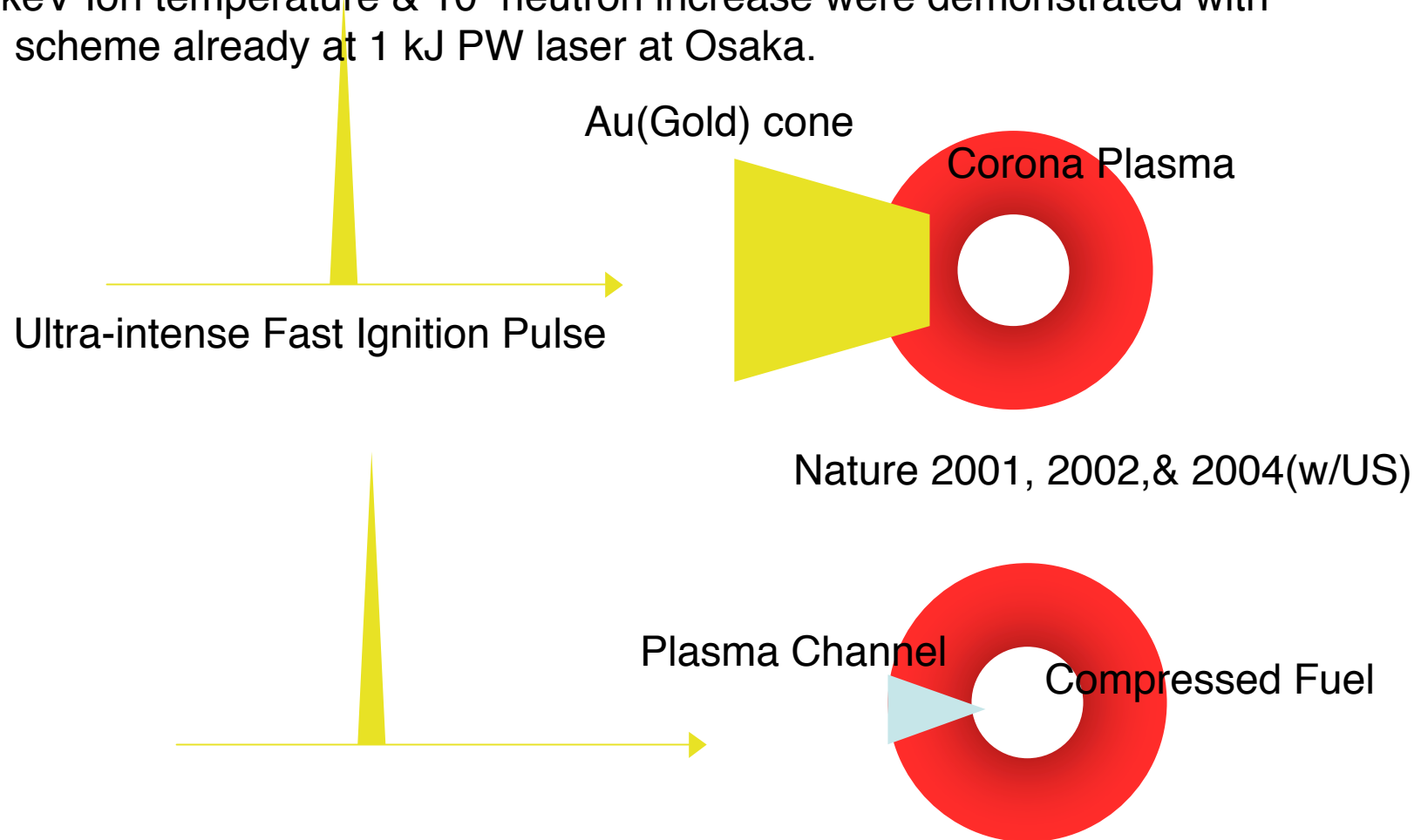
Pulse-particle interaction (Teikyo U)

K-alpha Radiation from High Density Plasma (TIT)

Fast Ignition may take several different schemes.

by K. Tanaka (ILE)

1 keV Ion temperature &  $10^3$  neutron increase were demonstrated with FI scheme already at 1 kJ PW laser at Osaka.

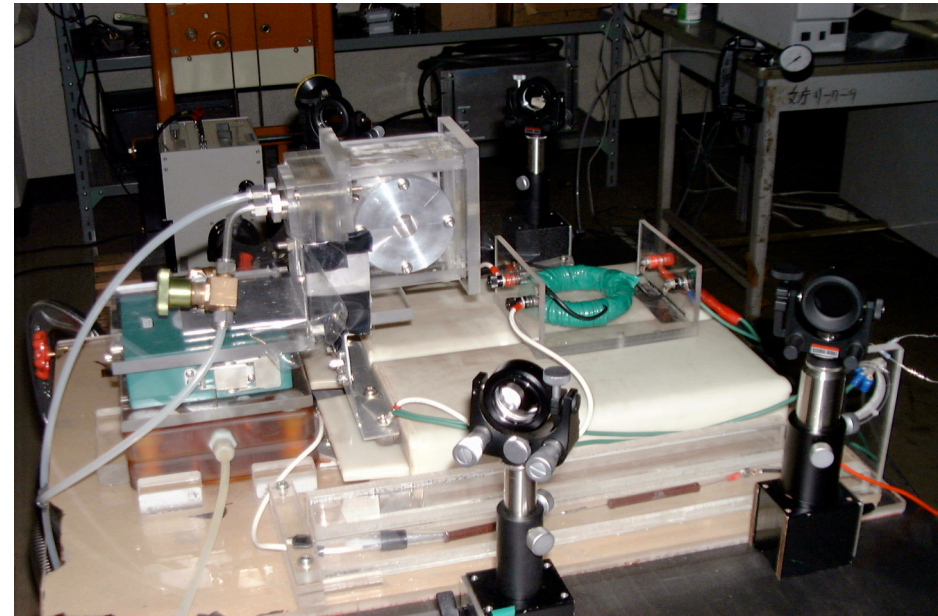
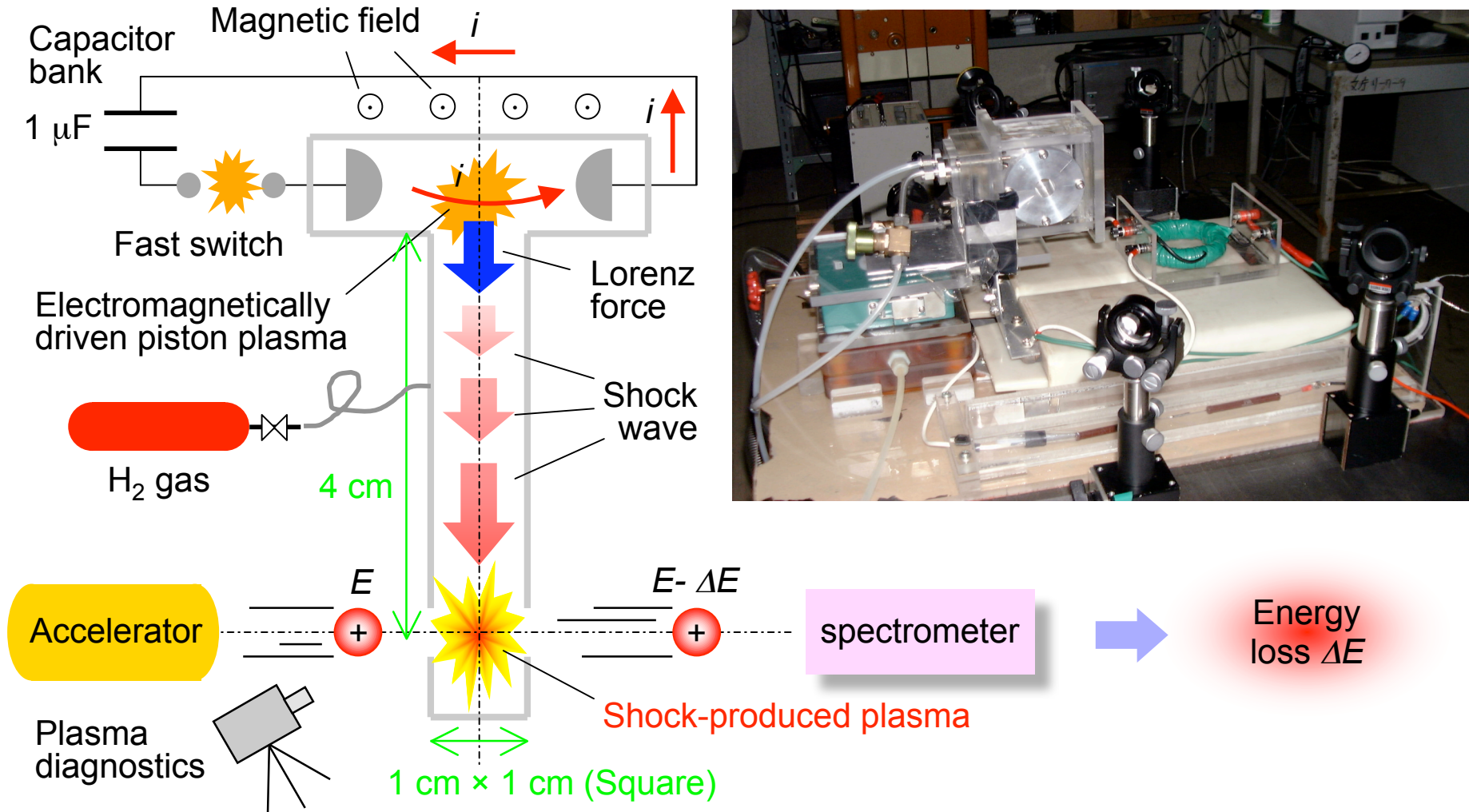




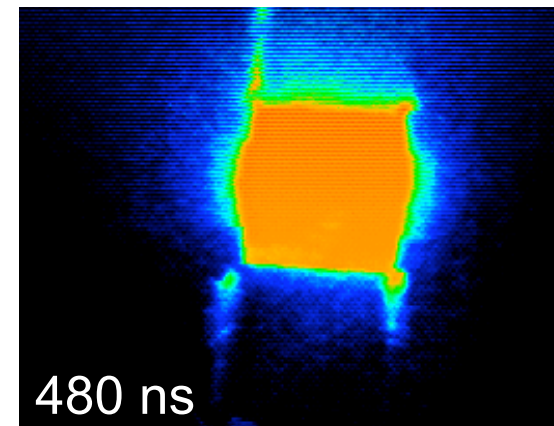
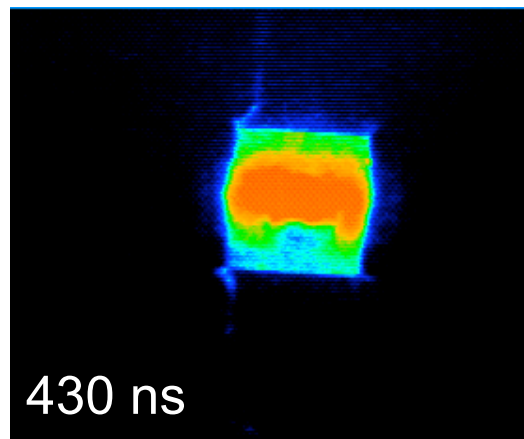
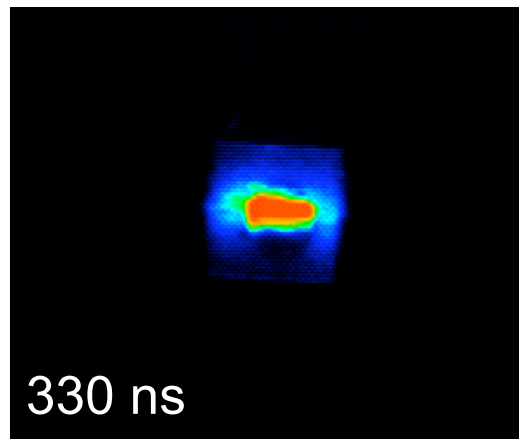
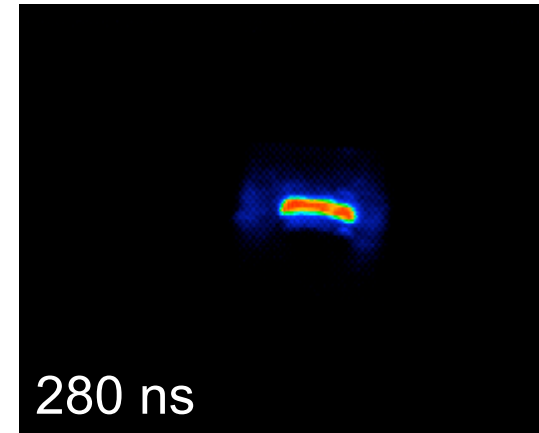
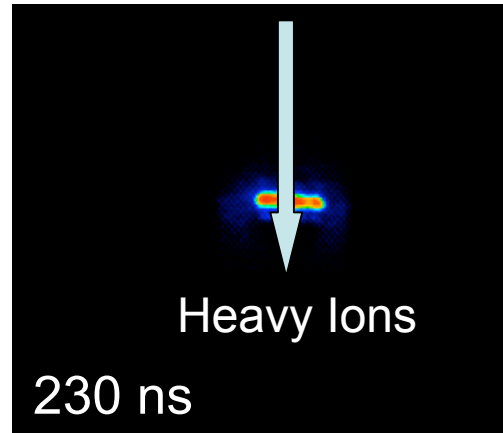
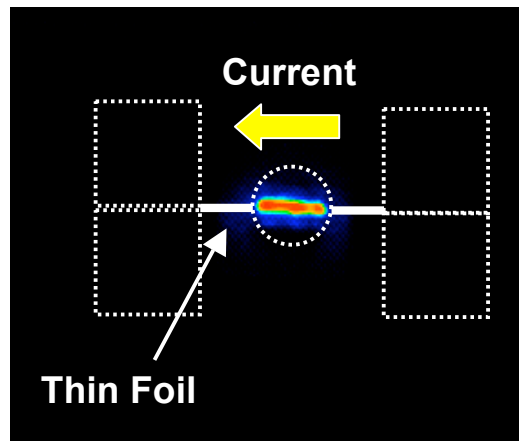


# An electromagnetically-driven shock tube is being developed to produce weakly-non-ideal plasma targets.

- Discharge energy  $\approx 0.1$  kJ during  $\approx 1$   $\mu$ s:



# Non-ideal Plasma Target Based on Foil Discharge



# High Energy Density Physics Promoted by Science Council

S.C. Report on 15 September 2005

提言： 高エネルギー密度状態の科学という広い物理分野が連携した新学術領域の推進を提案する。この新領域における我が国の競争力を高めることは基礎科学の振興だけでなく、学術の応用研究の将来性を含めて重要である。本研究分野推進のため関連する物理分野の専門家が緊密に連携できる共同研究体制の構築を提案する。

IFE by Laser + High Power Laser



Metallic Hydrogen, Interior of Jupiter,,,

# Budget for All National University Cooperation

	2004	2005
Total	12,415 X 10 <sup>12</sup> ¥ 12.415 B\$	12,317 X 10 <sup>12</sup> ¥ 12.317 B\$
Special Programs for Education and Research	741 X 10 <sup>12</sup> ¥ 741 M\$	786 X 10 <sup>12</sup> ¥ 786 M\$
Annual Reduction of University Support		1%
Ceiling of National Budget		3%

# Funding for University Members

- 1 Grant-in-Aid for Scientific Research via JSPS

1 to 50 M¥/proposal  
individual funding

- 2 Special Programs for Education and Research

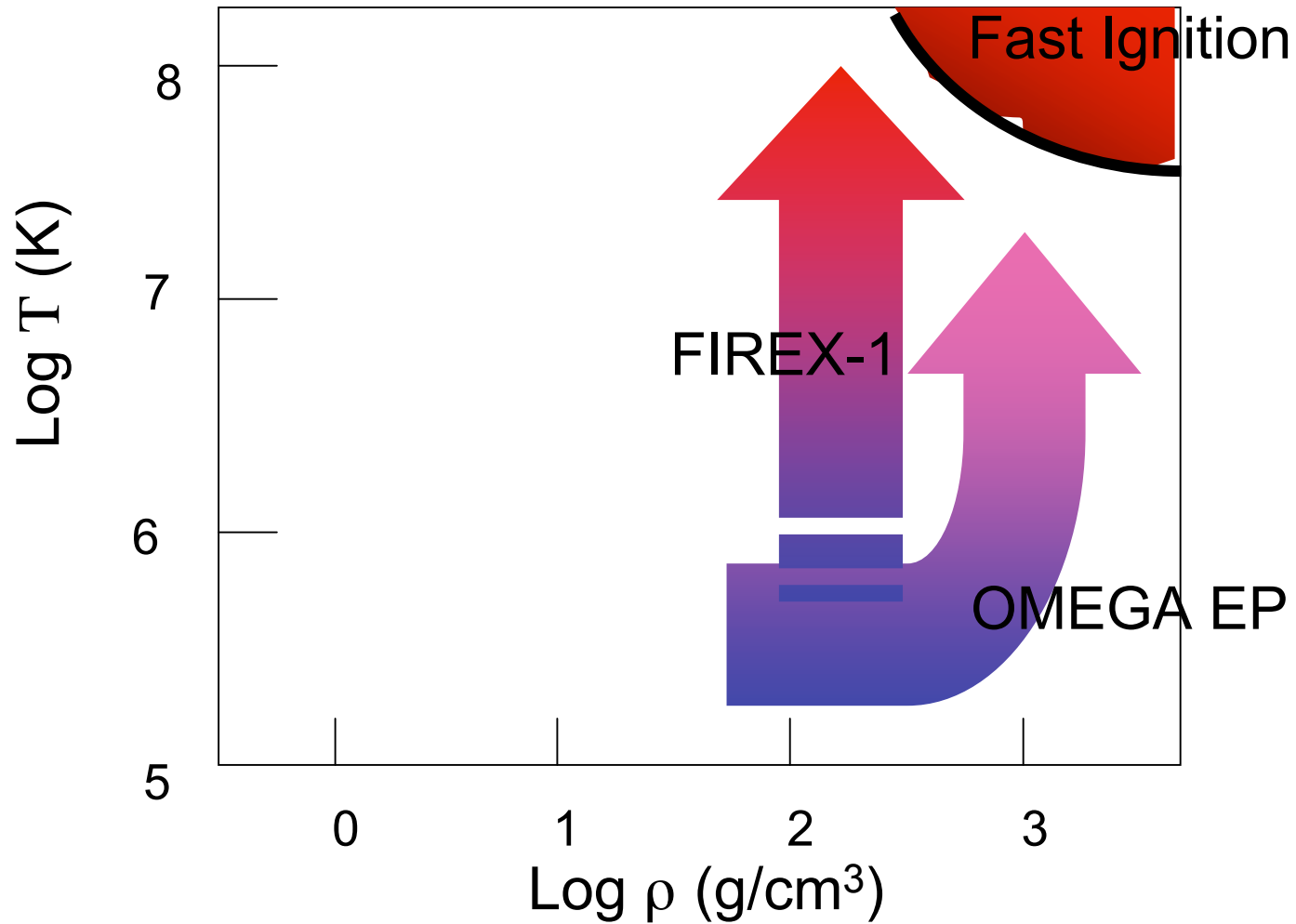
funding via organization  
KEK collaboration with universities

- 3 US-Japan collaboration for fusion study

~ 1 M\$/y for 5 years (decision in Jan. 2006)

Japan-US can collaborate to prepare the fast ignition.

by K. Tanaka (ILE)



# Other Big Funding

Innovative Nuclear Power by JST

2005 to 2009

~  $100 \times 10^8$  ¥/y

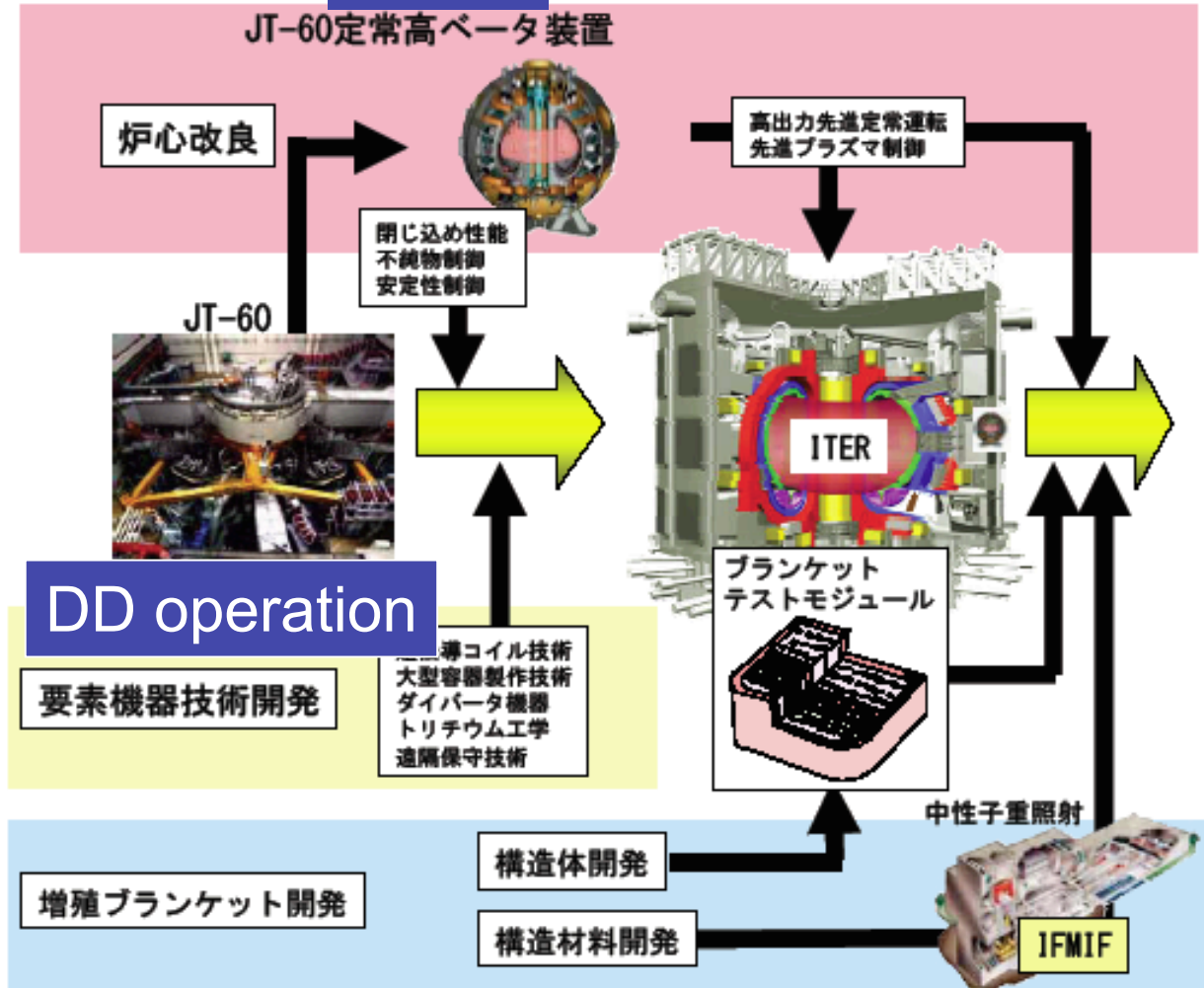
~ 100 M\$/y

ITER Project by MEXT

# Broad Approach to Fusion Energy

IFE is not included!

High  $\beta$



- ・ 原型炉で核融合炉の技術的成立性を実証（開発段階完了）
- ・ 技術的には2030年代に核融合発電の実現ができると考えら

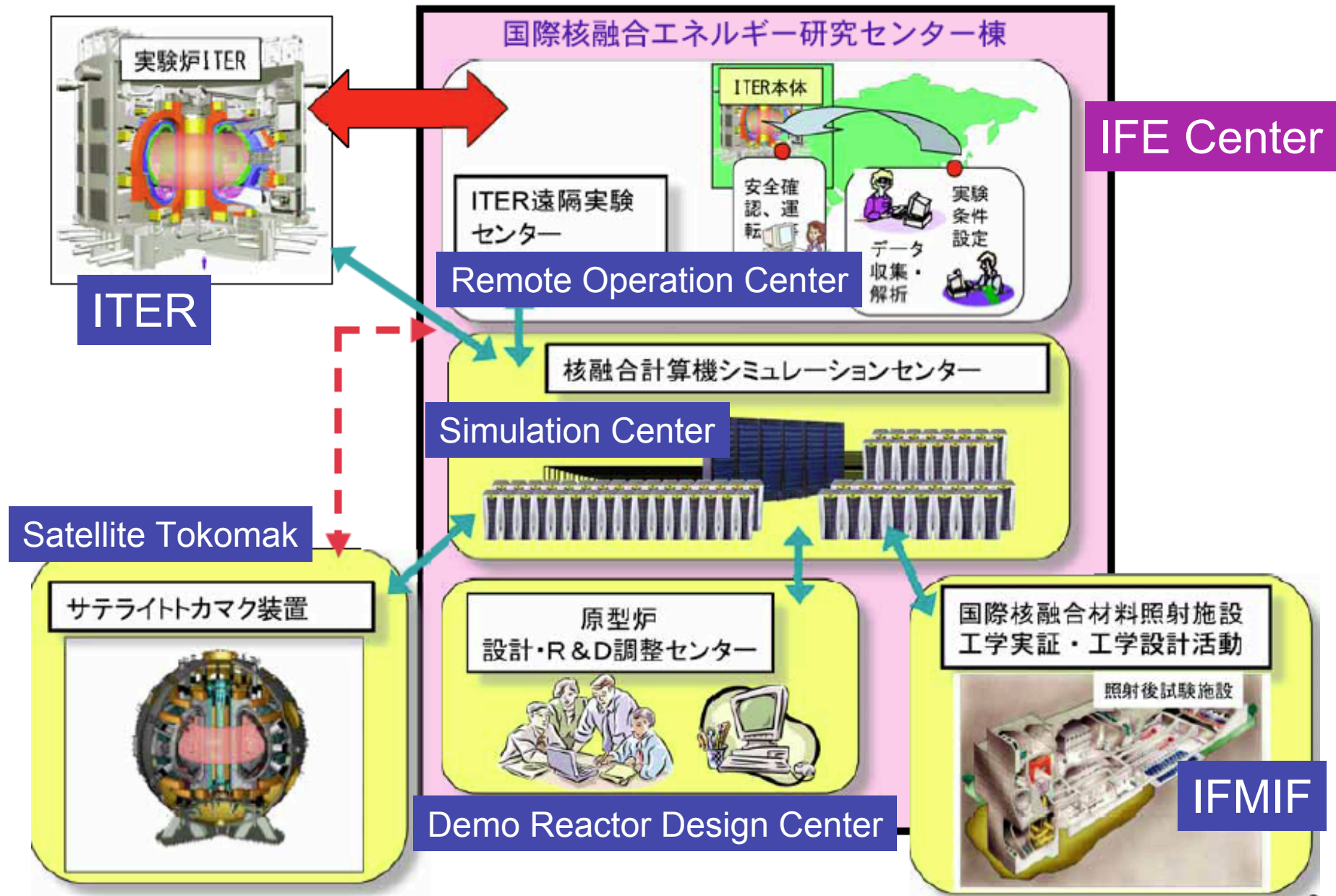
Demo Reactor



ITER：原型炉に向けた我が国独自の高出力先進定常運転法及び増殖ブランケット開発のテストベット



# International Fusion Energy Center



# Financial Crisis of Japan

Deficit (National + Local)

$1014 \times 10^{12}$  ¥

$10.14 \times 10^{12}$  \$

increasing  $\sim 2 \times 10^6$  ¥/s

$\sim 2 \times 10^4$  \$/s