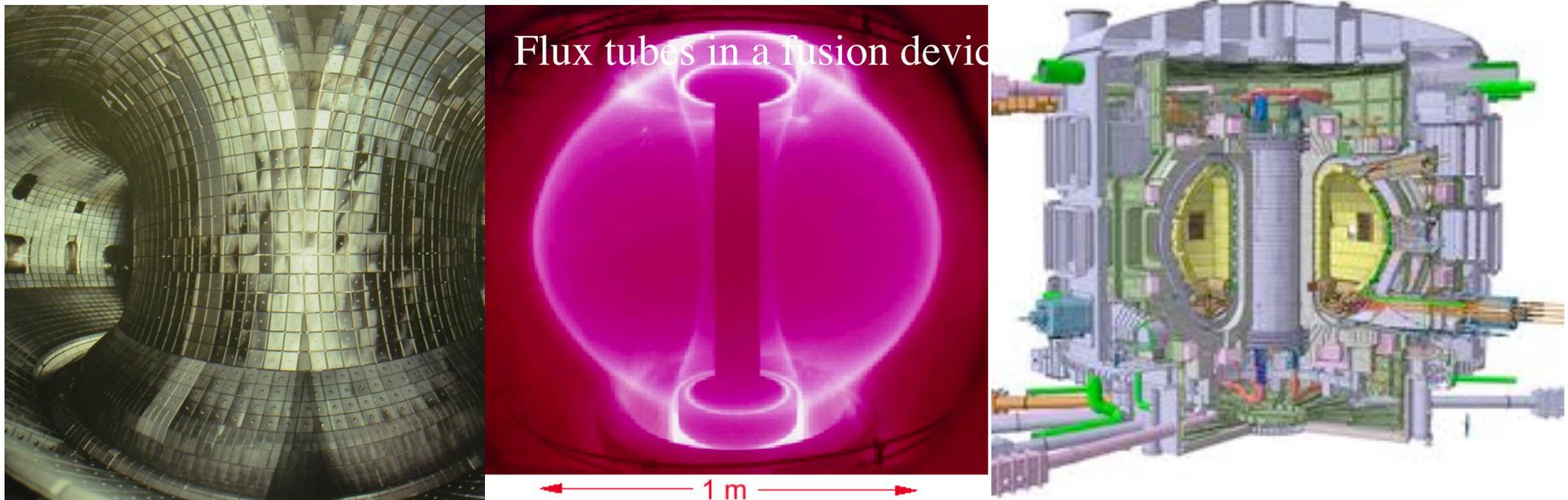
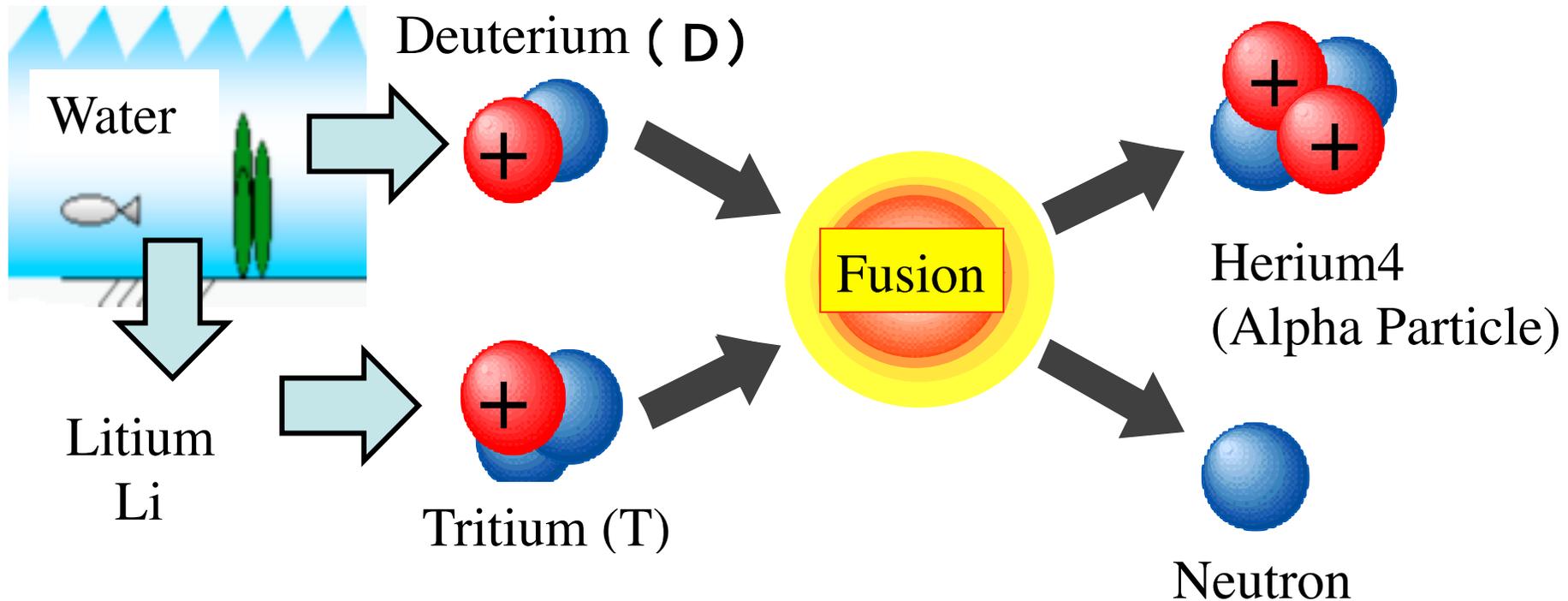


# Innovative Approaches to Economical DEMO Reactors

-- Y. Ono (University of Tokyo)



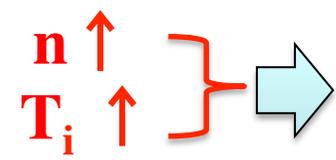
# D-T Fusion Reaction in the Natural/Artificial SUNs



- 1) The fusion energy is kinetic energies of neutrons and He4.
- 2) Each neutron has 14MeV (80%) → for heating water (heat engine)  
Each He4 (alpha particle) has 3,7MeV (20%) → for plasma heating

Gravitational Force

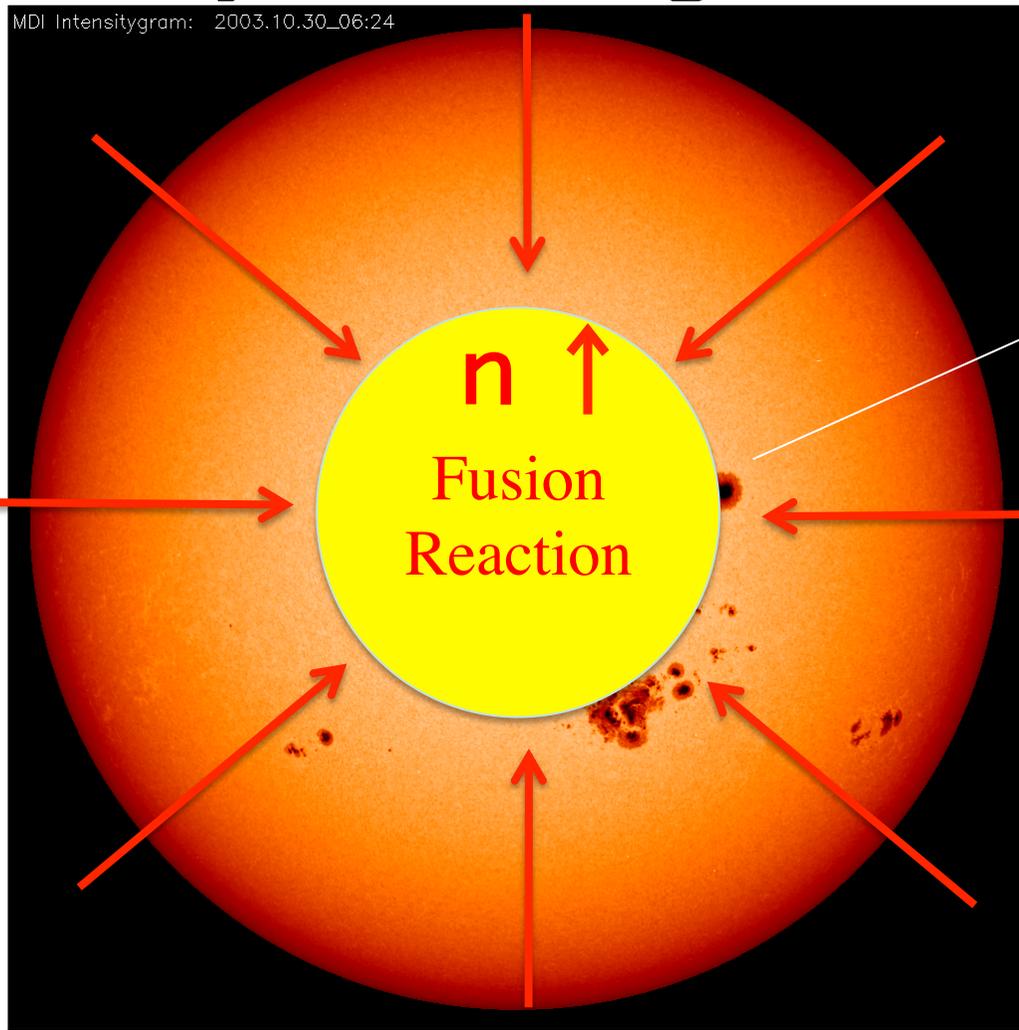
High Ion Temperature



Fusion Reaction

(D-T, D-D, D-He3 etc)

# SUN by visible light camera



Sun Spot

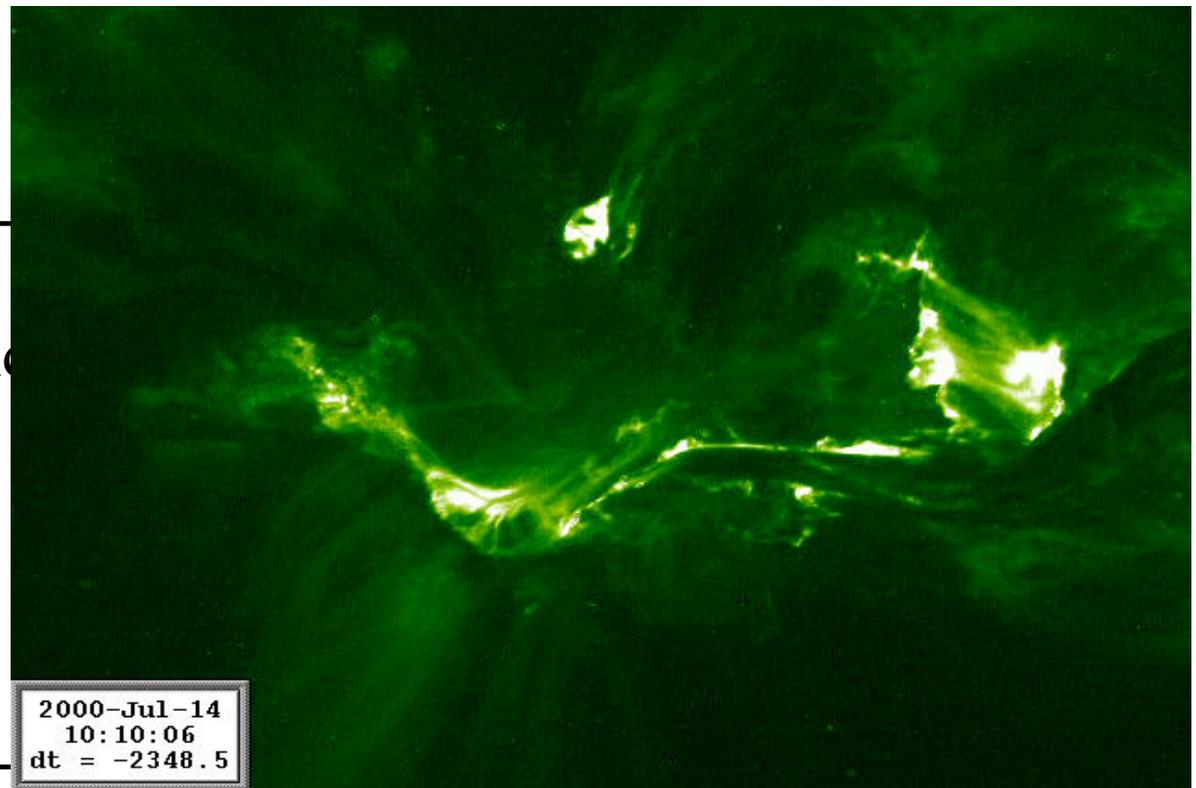
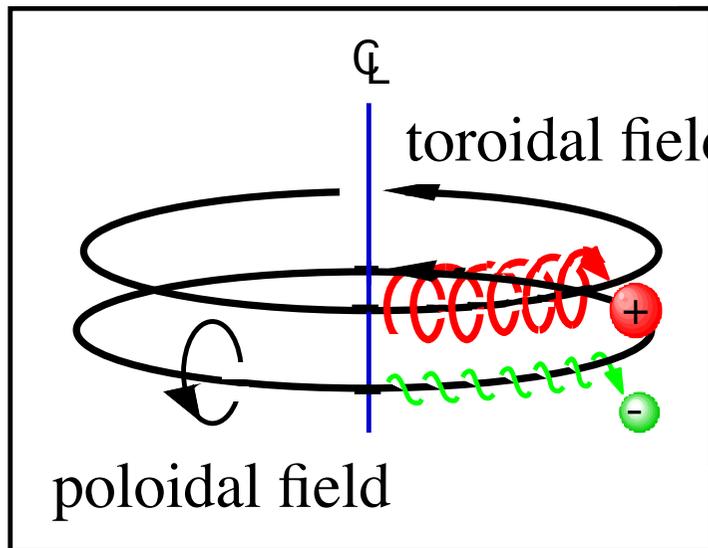
mg  
gravitational  
force

SOHO  
(NASA&ESA)

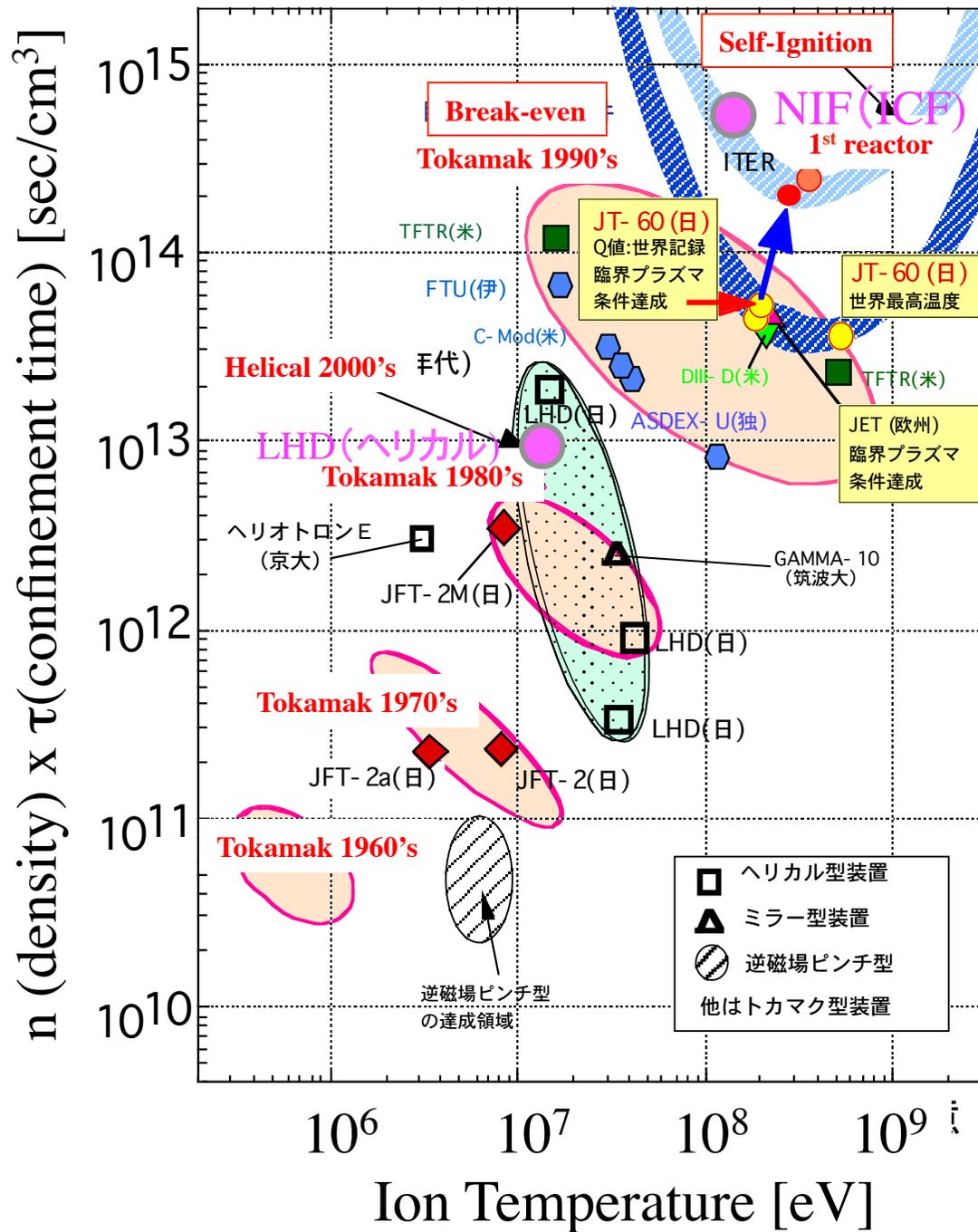
# Closed flux loops: solar coronas are “thermos bottles” for fusion plasmas

Solar coronas by X-ray camera have some similarities to tokamak plasmas.

Closed toroidal flux loop





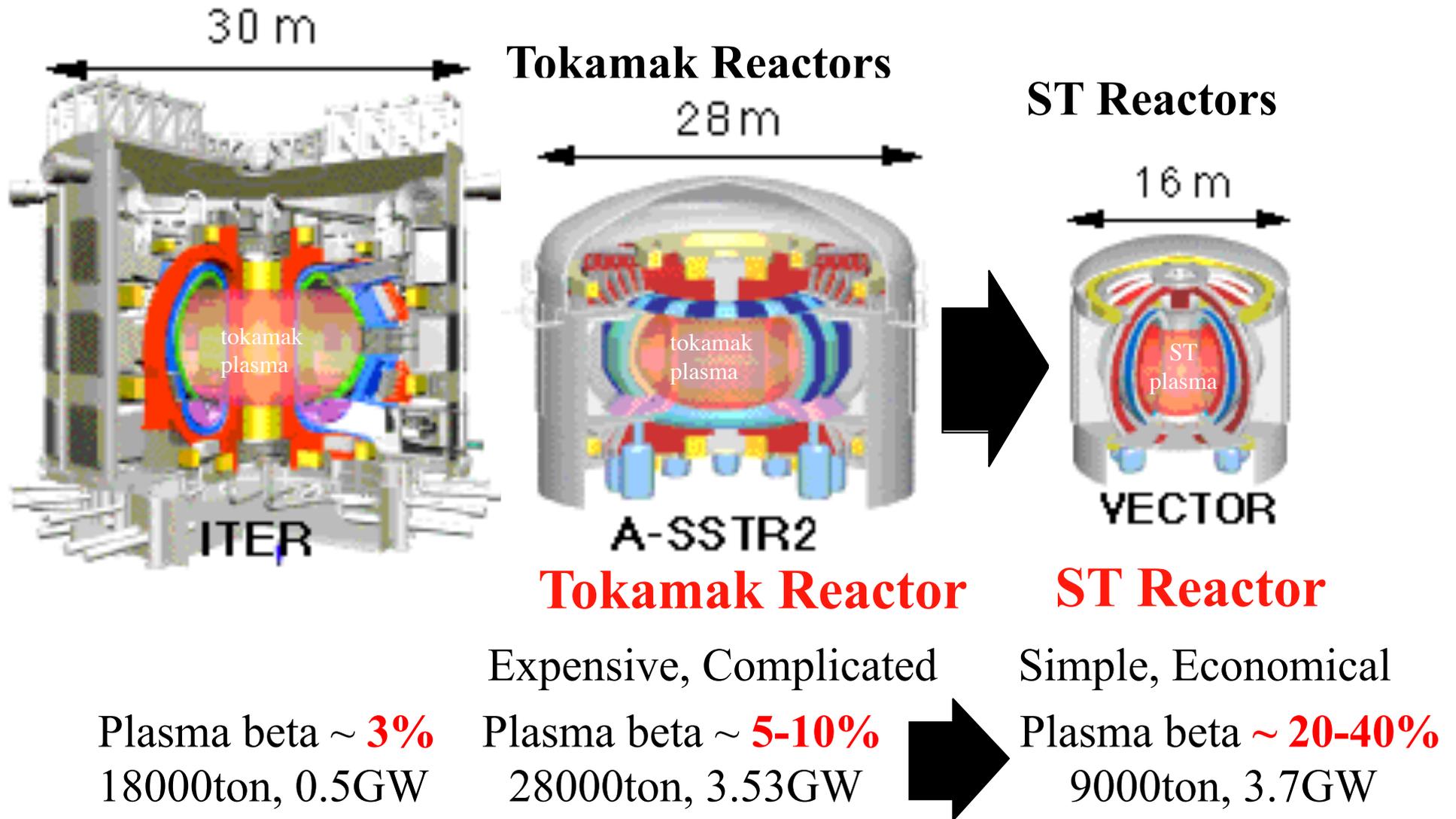


## Major Steps for Fusion Reactors

- ① Output Energy  $\sim$  Input Energy (realized in 1990's)
- ② Internal heating power > Heat loss = Small external heating  
ITER (US, J, EU, Russia, China, Korea, India)
- ③ Development of Low-Cost Demo

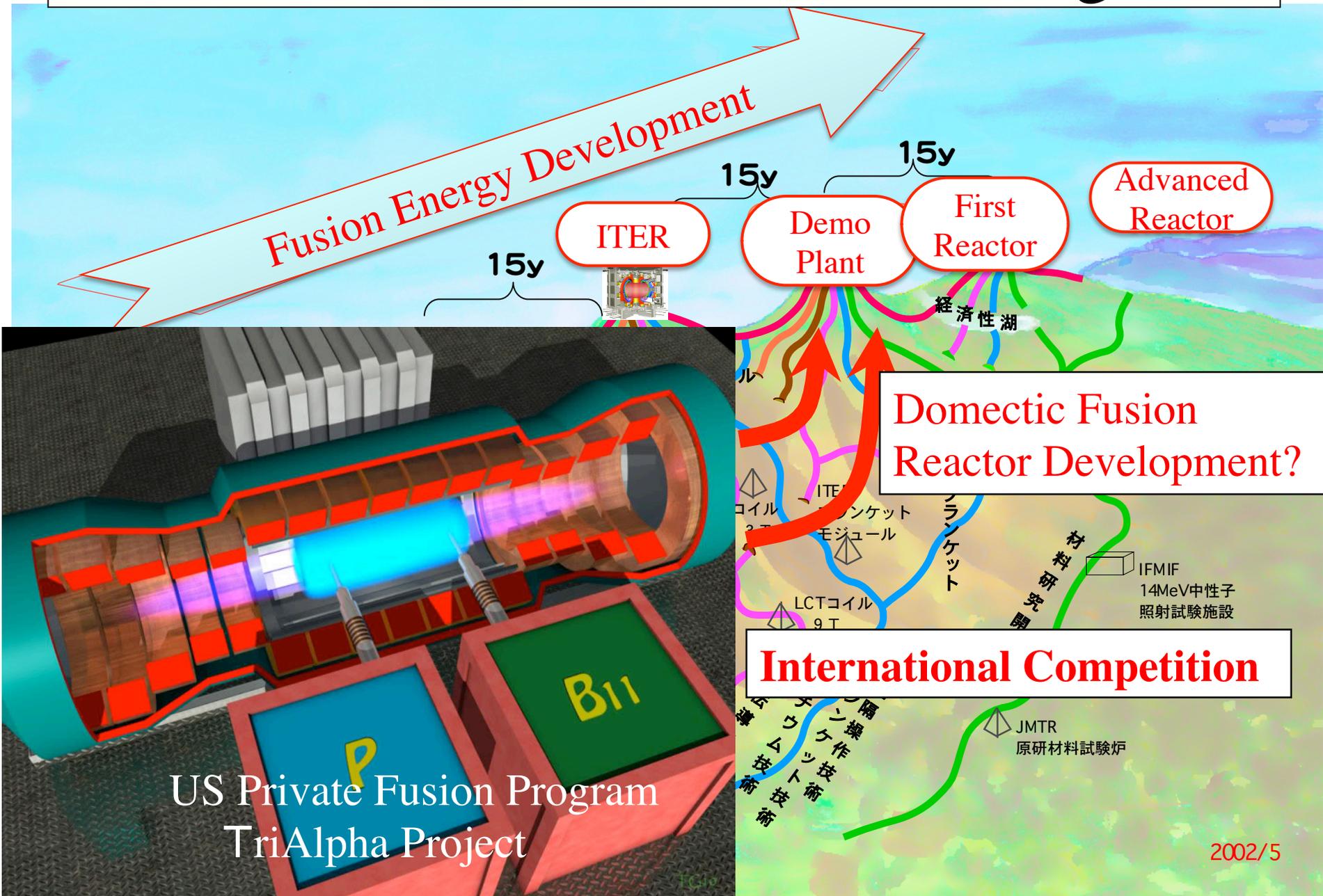


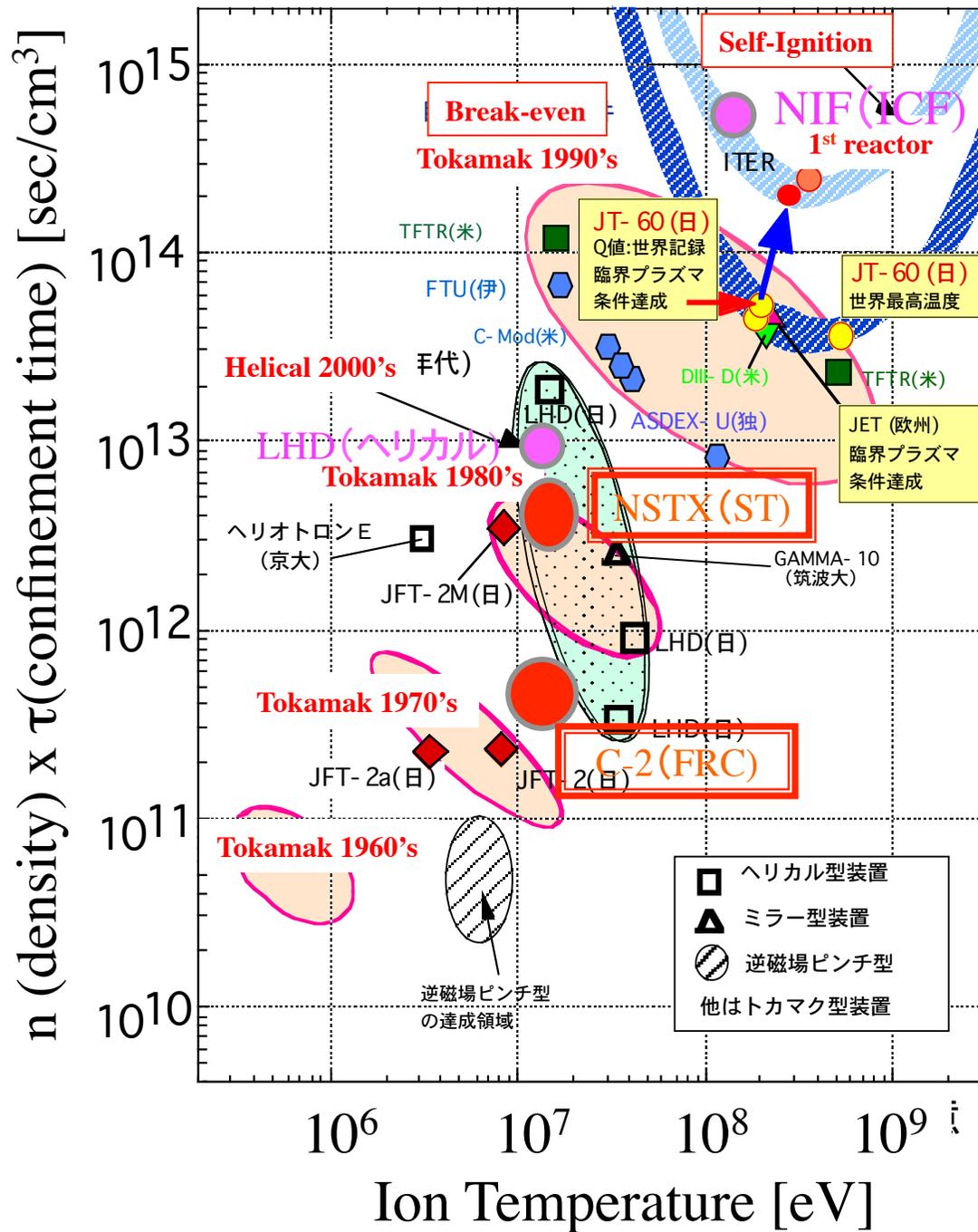
# Development of Economical Reactor Spherical Tokamak (ST) for DEMO after ITER



**Beta = thermal pressure/magnetic pressure ~ fusion output/reactor cost**

# - New Trend – Private Fusion Programs





## Major Steps for Fusion Reactors

- ① Output Energy  $\sim$  Input Energy (realized in 1990's)
- ② Internal heating power  $>$  Heat loss = Small external heating  
ITER (US, J, EU, Russia, China, Korea, India)
- ③ Development of Low-Cost Demo

## Summary

- Nuclear fusion energy has been developed mainly by large-scale tokamak programs for future safe and limitless energy.
- The International Thermonuclear Experimental Reactor (ITER) program will start its operation in 2025, demonstrating controlled large fusion gain and essential fusion reactor technologies.
- Development of the next stage experiment: DEMO needs innovations for economical fusion reactor.
- Various national projects and private companies are conducting R&D towards commercialization of economically viable nuclear fusion power plants beyond ITER program.
- In this session, we will present three innovative approaches to economical DEMO reactors and possible strategies for commercialization of fusion reactors.