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TOSHIBA
Leading Innovation >>>

Technology Development of Superconducting Magnet

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December 3, 2013
Monaco ITER International Fusion Energy Days
Magnet session

TOSHIBA eco style
Toshiba Group contributes to the sustainable future of planet Earth.

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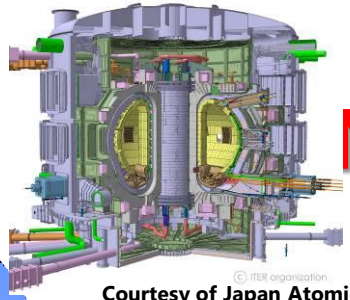
Toshiba's Nuclear Activities

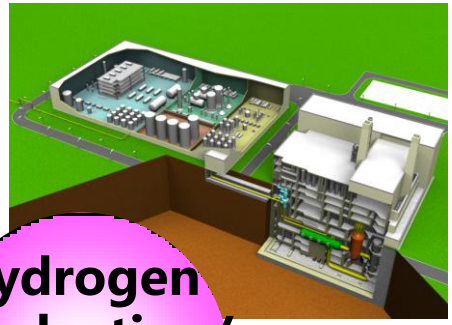
Uranium/ Fuel Manufacturing

Nuclear Plants Construction

Courtesy of Tokyo Electric Power Company


Courtesy of Japan Atomic Energy Agency and ITER Organization

Nuclear Fusion


Courtesy of Japan Atomic Energy Agency

Hydrogen Production/ Accelerator applications

Fast Reactor / Next Generation Reactor

Maintenance & Services

Nuclear Fuel Cycle

Developing Fusion as Energy System in Future

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SC Magnet for Fusion

- **CS Model Coil**
  Conductor Nb3Sn
  Max. Field 13T
  Stored Energy 640MJ

- **LHD Poloidal Coil**
  Conductor NbTi
  Outer Dia. 11m (OV coil)
  Stored Energy 251MJ

- **R&D for ITER TF coil**
  Full scale Radial Plate
  1/3 scale Double Pancake
  Coil Case segment

Images: Courtesy of Japan Atomic Energy Agency and National Institute for Fusion Science

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SC Magnet for Accelerator

- **ATLAS Central Solenoid**

Inner Dia./Length	2.5m/5.3m
Field (at axis)	2T
Conductor	NbTi/Cu/Al

- **MQX**

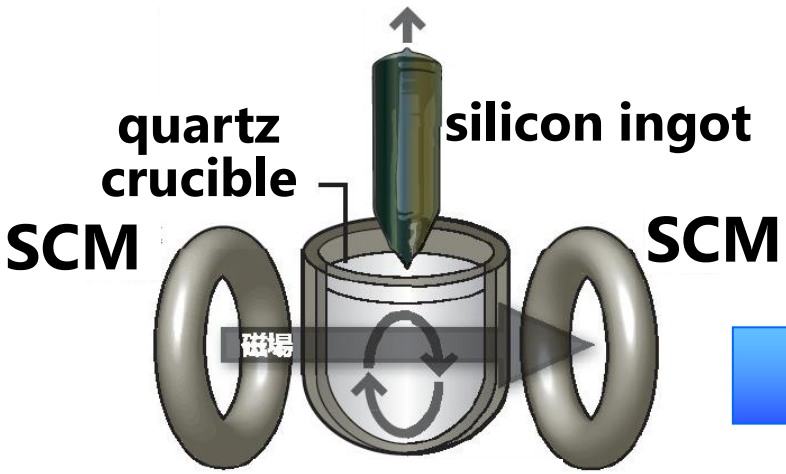
Inner Dia./Length	70mm/6.6m
Max. Field	8.6T
Conductor	NbTi
Error field	$<10^{-4}$

Images: Courtesy of High Energy Accelerator Research Organization (KEK)

SC Magnet for Industry Application

- **Magnets for single crystal silicon production**

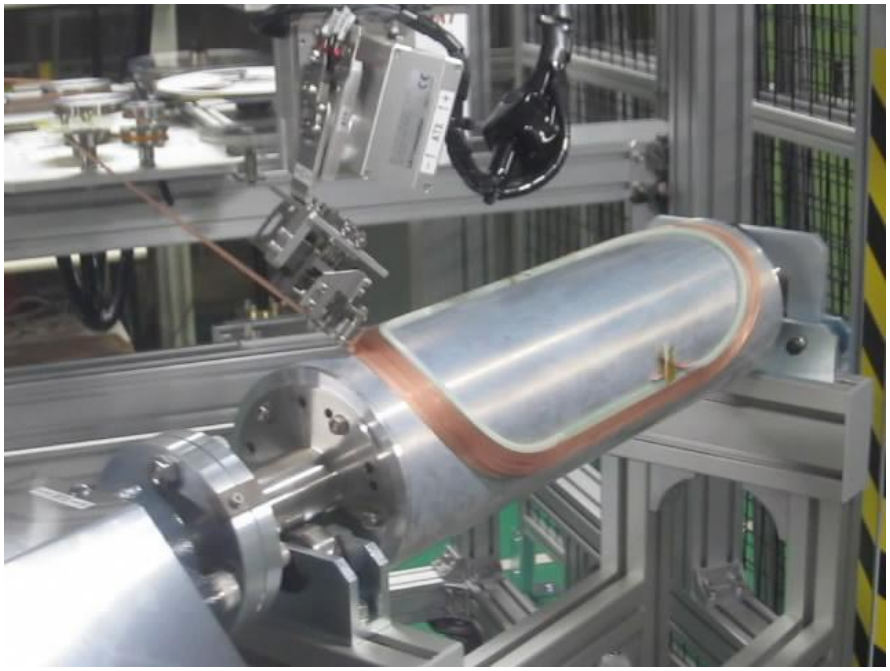
Field (at furnace center)	**0.4-0.5 T**
Conductor	**NbTi**



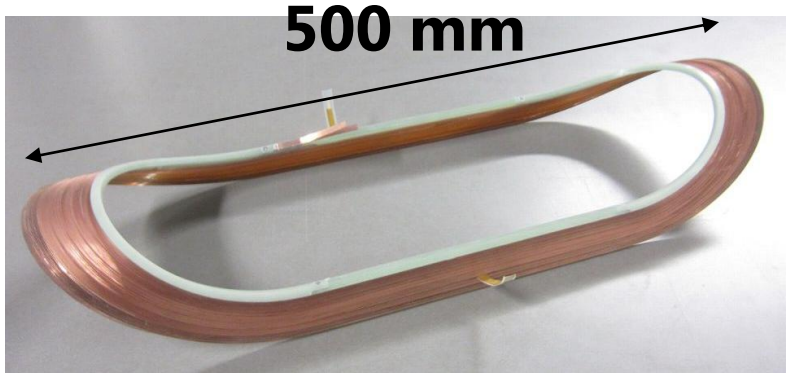
Crystal pulling furnace

Developing HTSC technology

- **Manufacturing Technology for YBCO coil TOSHIBA has developed an auto-winding technology for 3D shape YBCO coil with high accuracy of winding position (<0.1mm)**



Numerically controlled winding machine



Saddle-shaped YBCO coil for bending magnet of heavy ion radiotherapy

Issues in skill development & transfer

- **Based On the real Job Training.**
  -Continuing development is desirable
  -Fusion project is like a pulse load
  -Looking for various opportunities including accelerator, government R&D project, in-house R&D, etc.

- **Superconducting magnet system is comprehensive technology.**
  -variety of skillsets are necessary; mechanical, electrical, material, cryogenic, …

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Thank you!

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