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Uses of Radiation for Development and Welfare

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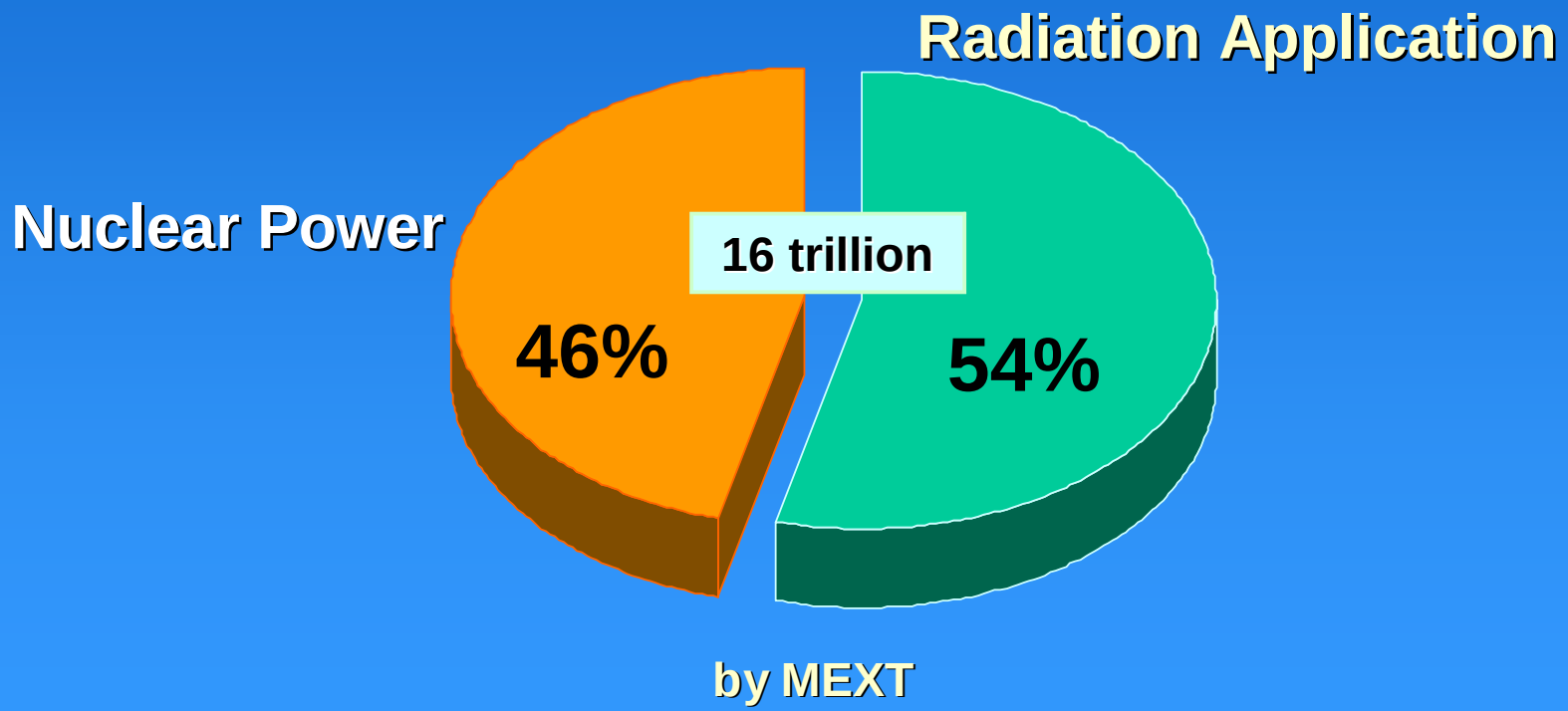
Commissioner, AEC, Japan

Major Points of Discussion

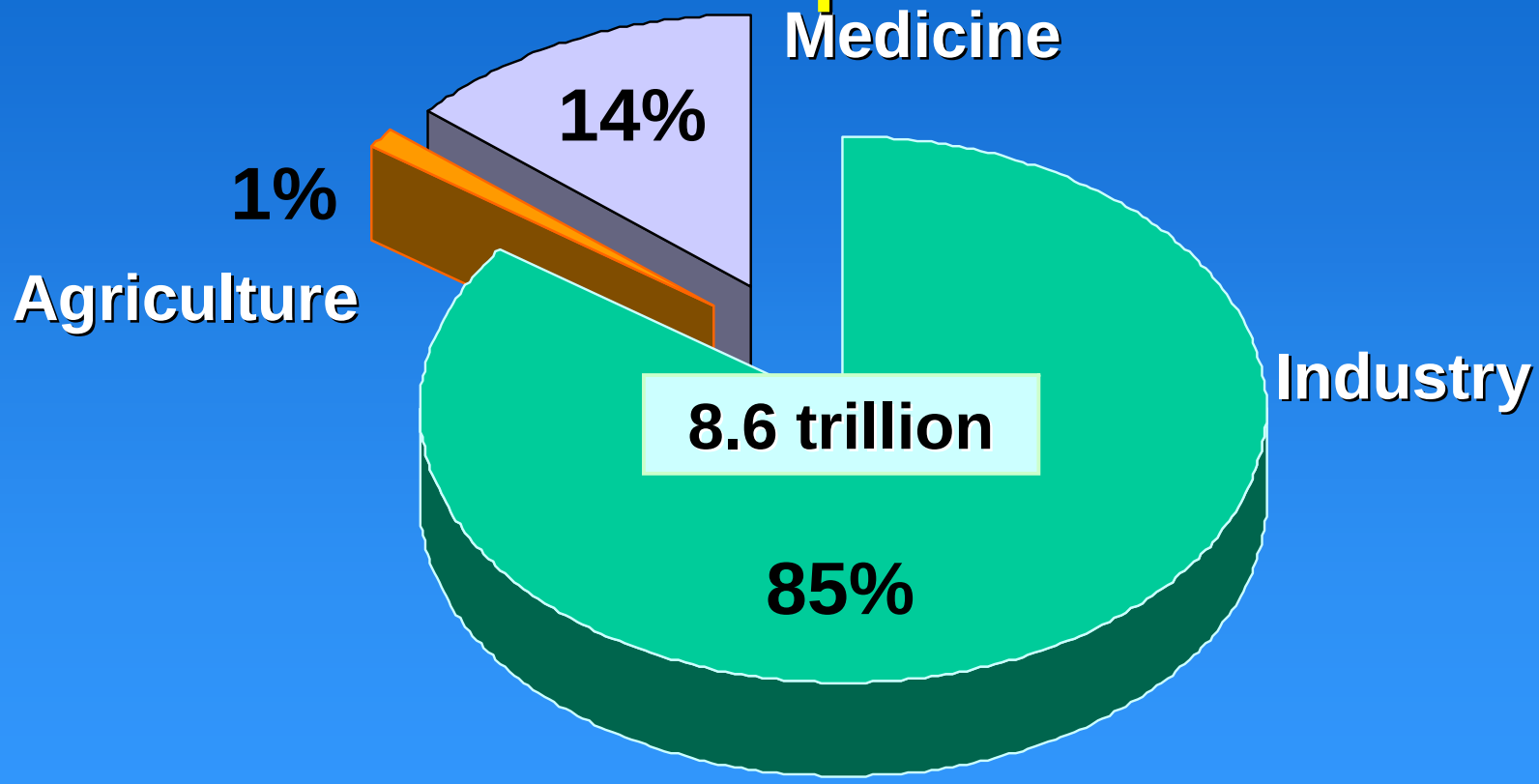
- Improved industry ---High quality products
- Cleaning environment ---Removing pollutants
- Food --- Productive agriculture and food safety
- Better health care ---Combating cancer

Economic Scale of Nuclear Power and Radiation Technology in Japan (1997)

3.2% of the GDP 494 trillion (10^{12}) JPY en

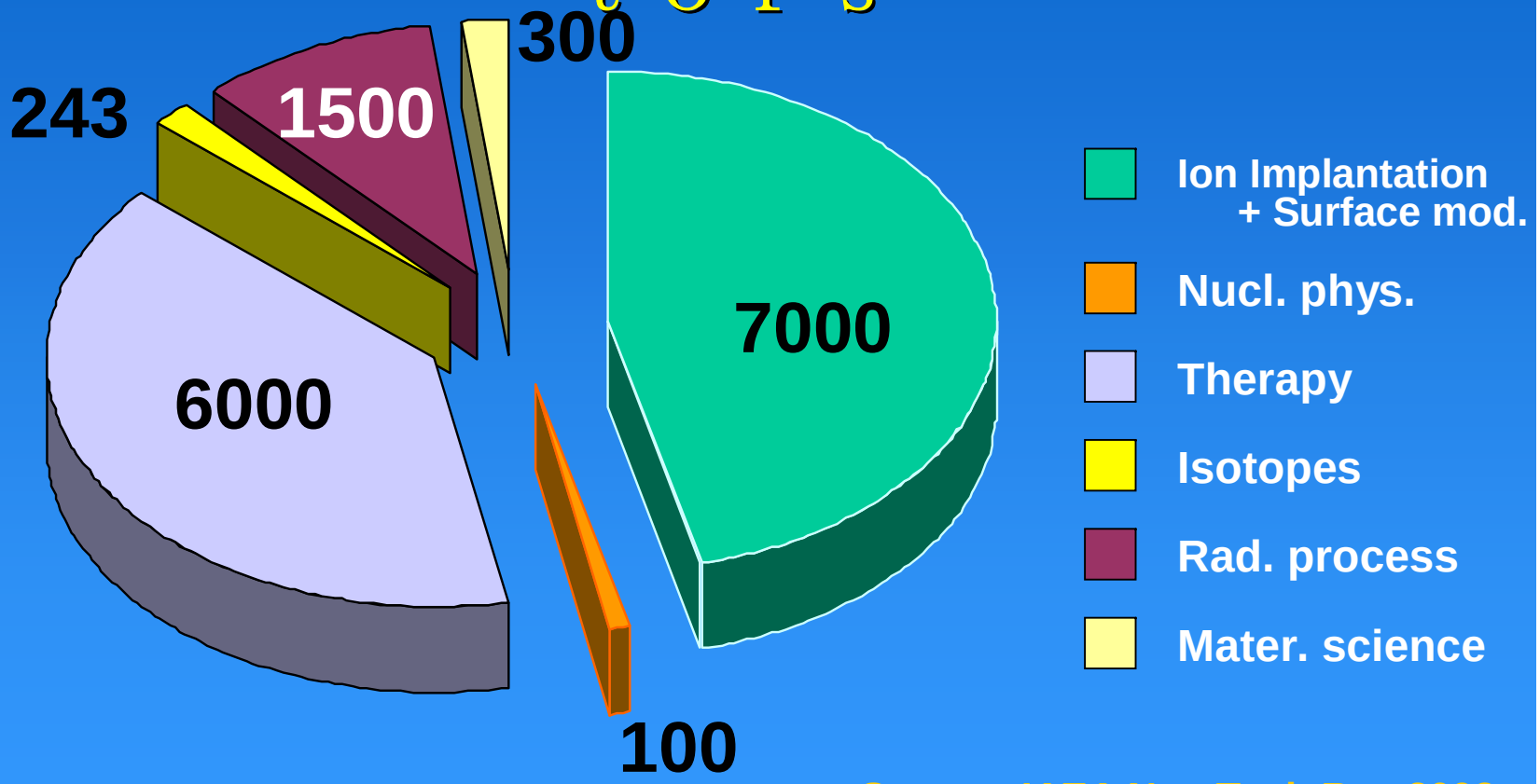


Breakdown of Economic Scafe of Radiation Application in Japan



Radiation Sources – Worldwide -1

Particle Accelerators



Source: IAEA Nuc.Tech.Rev.2002

Radiation Sources – Worldwide -2

Industrial Scale Co-60 Gamma Irradiator

- – 160 units
- Large penetration range
- Developing countries :65 unit
- Larger then 1MCi: more than 32 units

Major applications

- Sterilization of medical products
- Food irradiation

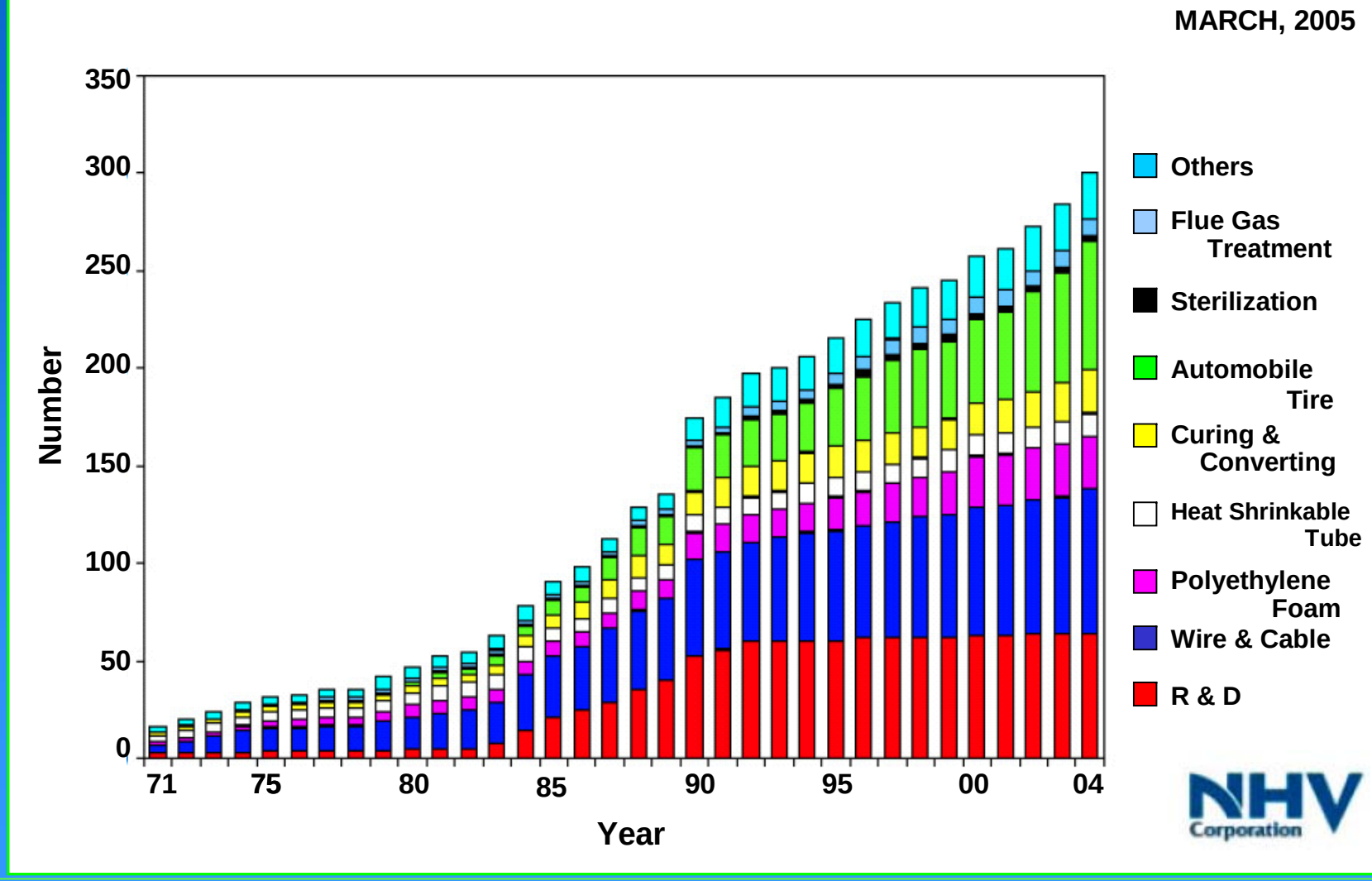
Commercially produced cross-linked or grafted polymers by radiation processing – 1

Products	Applications
Cross-linked polyethylene and PVC	Wire insulation resistant to heat and chemicals, pipes for heating systems
Cross-linked foamed polyethylene	Insulation, packing, floating materials
Heat shrinkable tubings and sheets	Food packaging, insulation, protection against corrosion
Cross-linked rubber sheets	Automobile tires (high quality),
AA grafted PE film	Battery separator
Cross-linked polyurethane	Cable insulation for antilock brake sensor

Commercially produced cross-linked or grafted polymers by radiation processing – 2

Products	Applications
Cross-linked nylon	Automobile parts resistant to heat and chemicals
Super heat resistant SiC fiber	Metal and ceramic composites,
Vulcanized natural rubber latex	Medical gloves, Fingerstall
Cross-linked hydrogel	Wound dressing
Curing of paints and inks	Surface coating and printing
Grafted PE fiber	Deodorant

Number of Electron Accelerator for Industry by Application



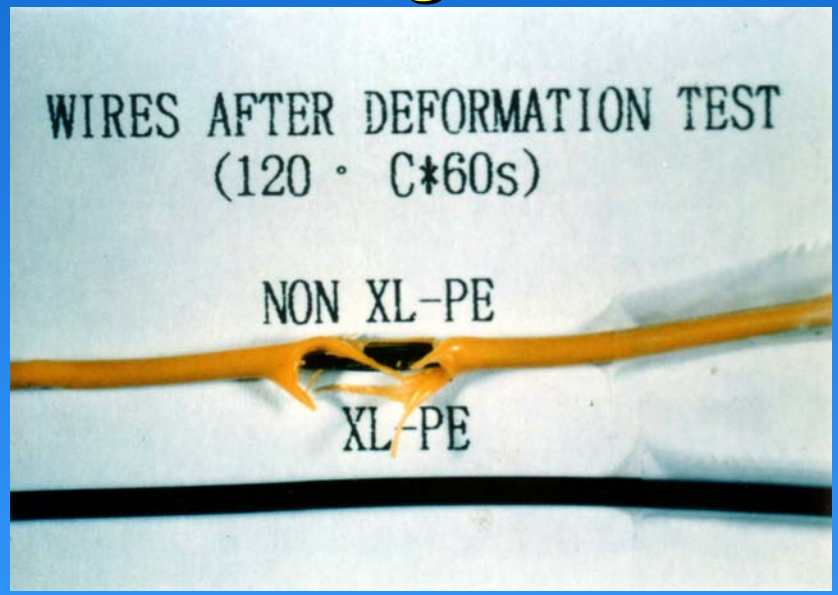
Electron Beam Processing for Wires

Electron Accelerator with tube handling device
3MeV (MINT, Malaysia)

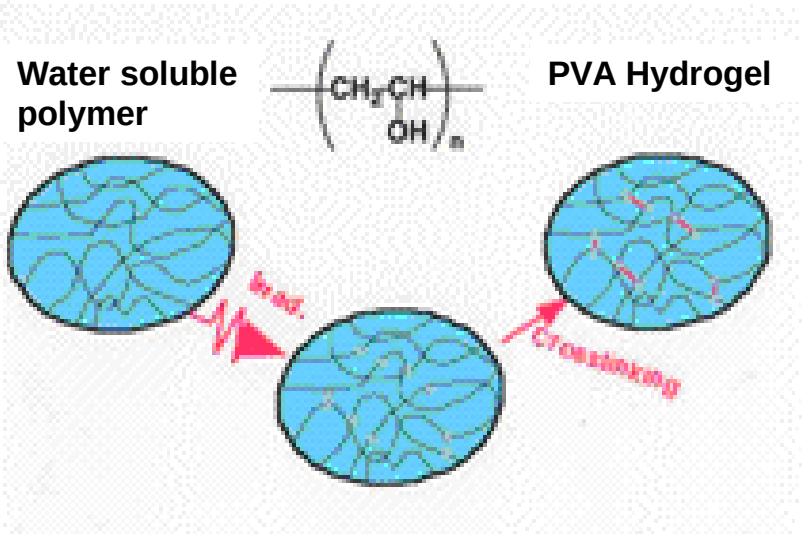
Radiation Crosslinking Improves Thermal, Mechanical, Chemical Properties

Merits of Radiation Processing

- ✓ Solid state reaction
- ✓ Free from chemicals
- ✓ Simple and high speed
- ✓ Room temp. process



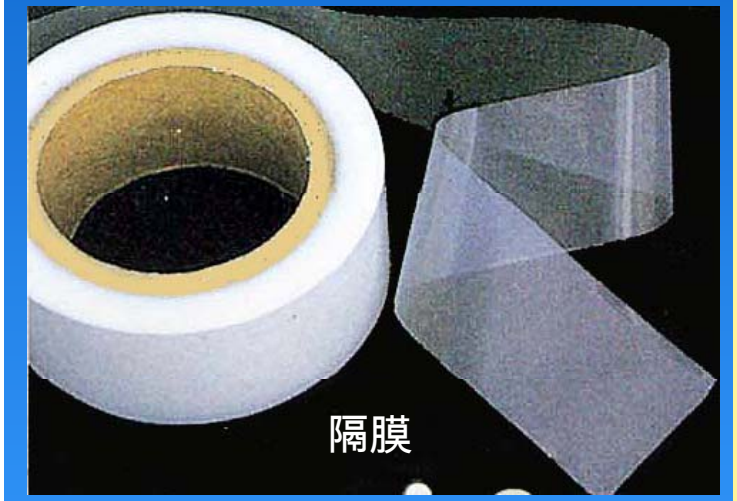
Hydrogel Wound Dressing



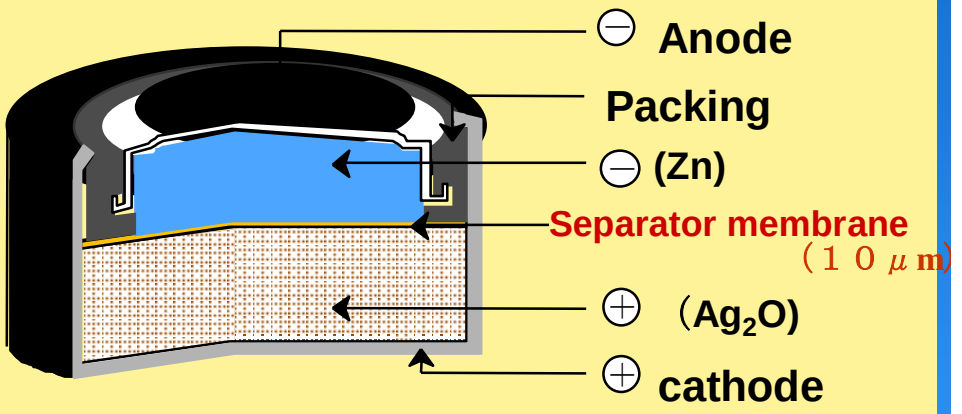
ADVANTAGES

1. Healing is faster
2. Changing the dressing without pain
3. Transparency

Longlived Battery Separator



Separator membrane



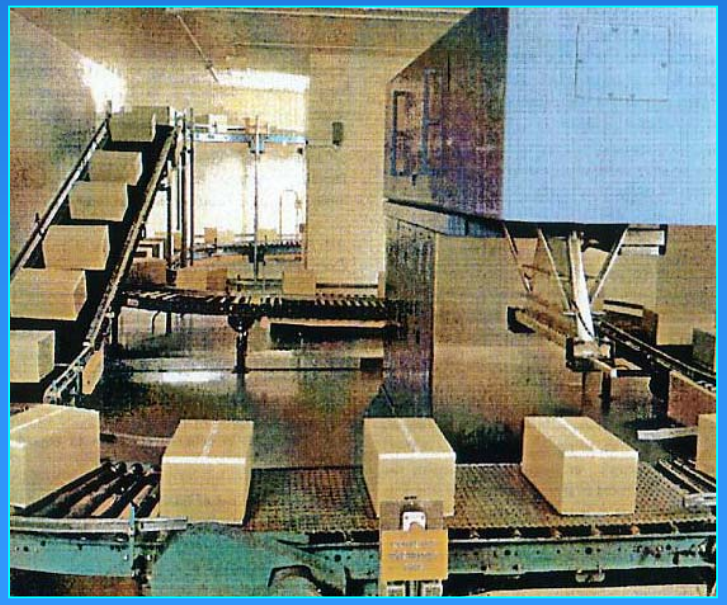
Silver oxide battery

Radiation grafting of AAc onto PE

Efficient Sterilization of Medical Supplies by High Energy (5 - 10 MeV) Accelerator

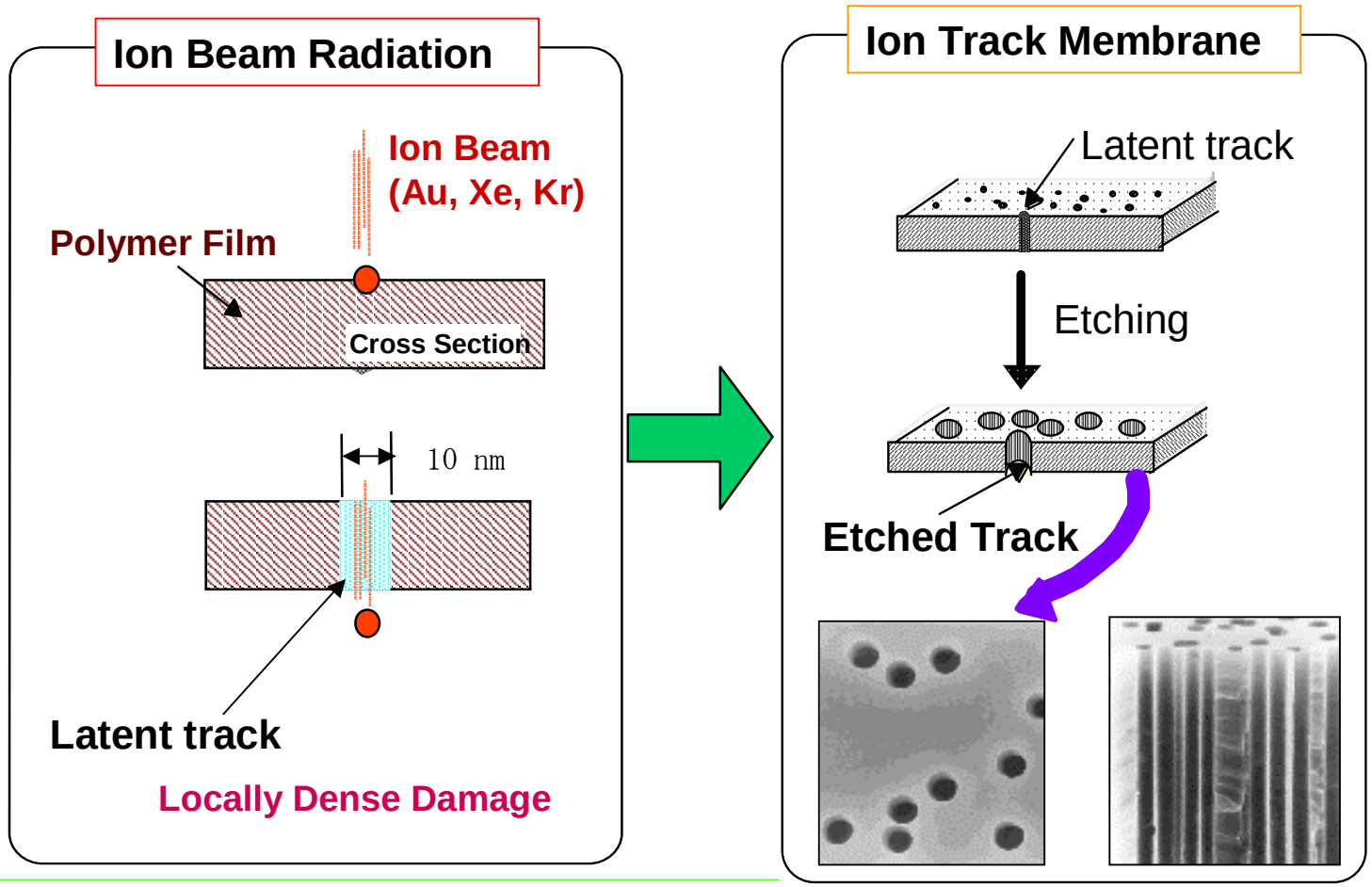
50% of medical supplies sterilized by EB

- High speed processing
- Larger capacity
- No replenishment of radiation source



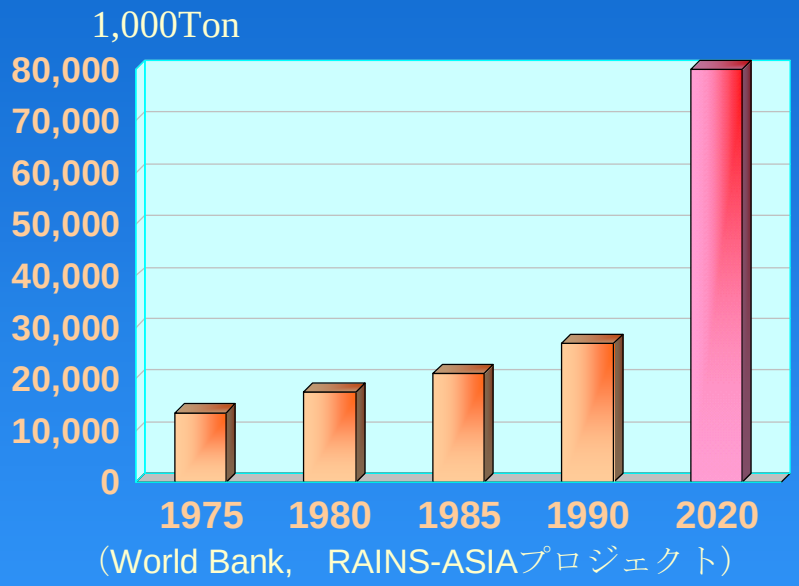
Radiation Processing for Nano-technology

Membrane with Nano-scale Pores by Heavy Ion Beams



Global Environment is Degrading

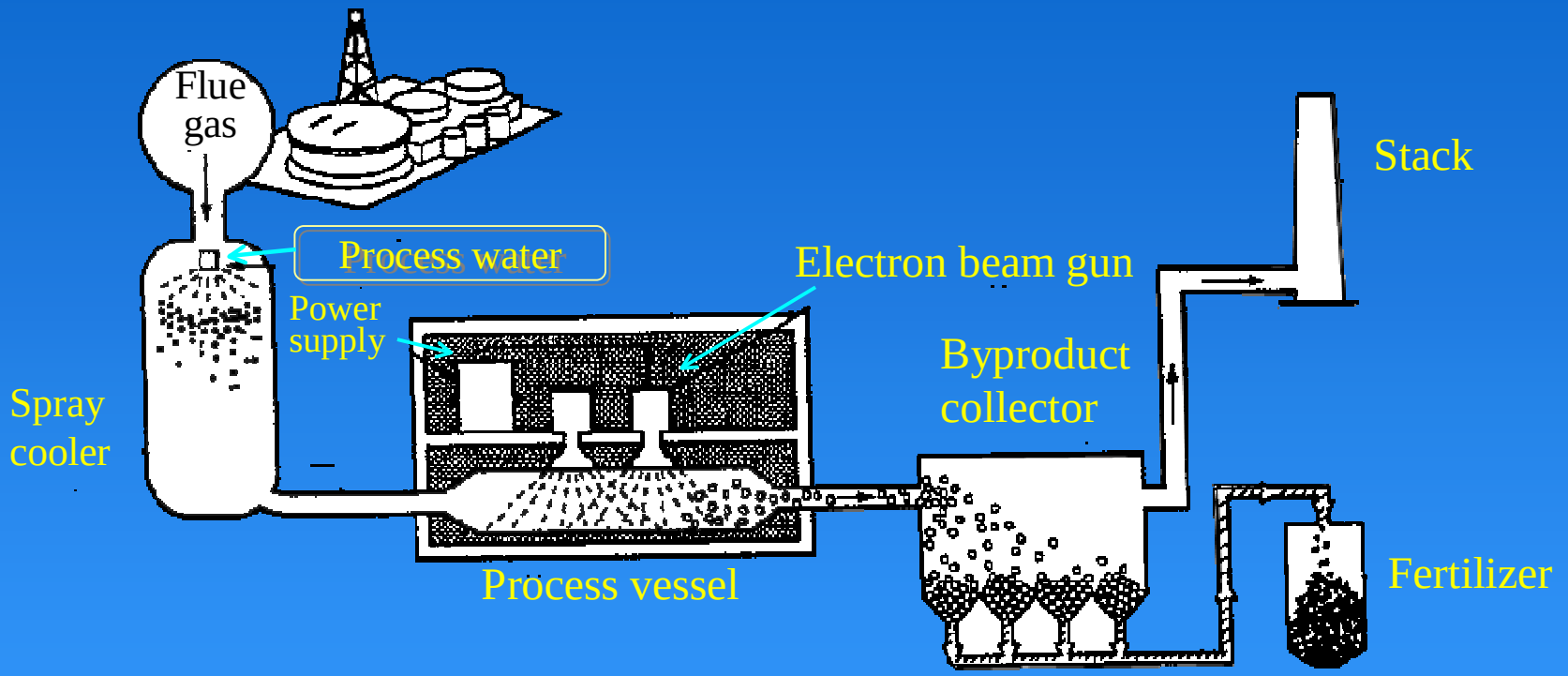
Increasing Emission of SO_2



（World Bank,　RAINS-ASIAプロジェクト）

Damage of Forests by Acid Rain in East Europe

Innovative Technology for Cleaning Flue Gases by Electron Beams

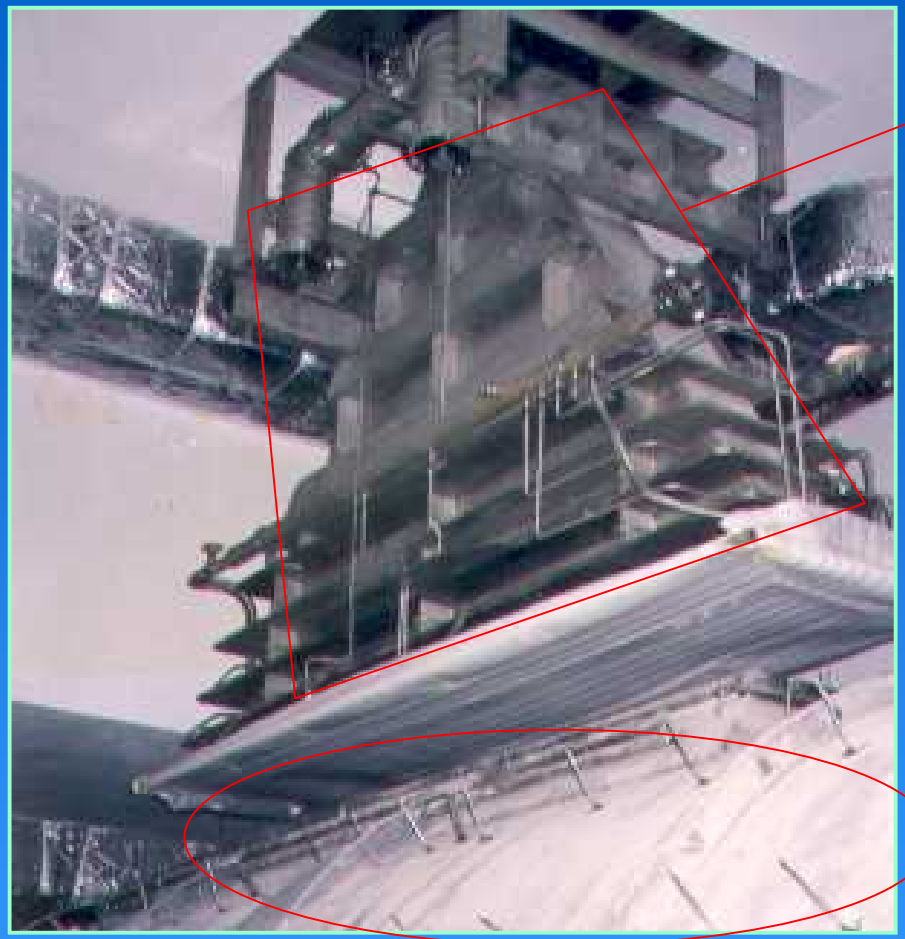


Removal efficiency: SO_2 90% Absorbed dose: 5~10kGy

Temp: 65~70℃ No_X 30~80%

Industrial and Pilot Plants of Cleaning Flue Gases from Power Stations by Electron Beam

		m^3/hour	Fuel	
China	1	300,000	coal	in operation
	2	300,000	coal	in operation
	3	300,000	coal	under construction
Poland		270,000	coal	in operation
Bulgaria		10,000	coal	in operation



Accelerator

Accelerator:
300kW×4 heads
Capacity:
270,000m^3 /hour
Accelerator and Process Chamber

SO_2 removal 90~95%

NOx removal 70~80%

Total dose: 10kGy

Process Chamber

Cleaning Flue Gas from Coal Burning Power Station by Electron Beams. Industrial Scale Demonstration Plant in Poland (October, 2000) : IAEA TC Projrct

Process vessel of Polish demonstration plant

The Flue Gas Cleaning Plant in Changdu, China

Coal burning power plant of 100MWe

Capacity: 300,000 m^3/hour

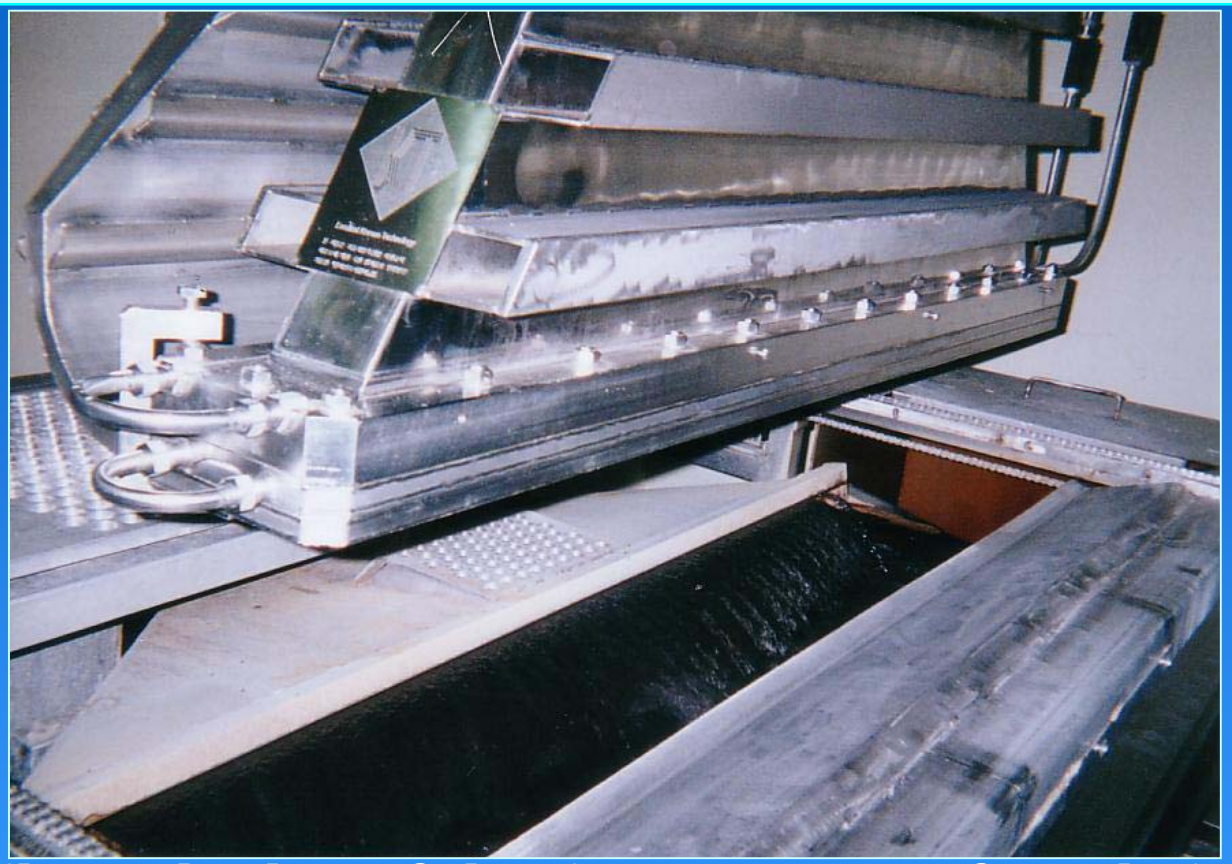
SO_2 removal 90%
NO_x removal 30%

Total dose 5kGy

ADVANTAGES OF ELECTRON BEAM TECHNOLOGY FOR CLEANING FLUE GASES

- Simultaneous removals of SO_2 and NOx
- Applicable to high SO_2 content flue gases
- By-product is usable as agriculture fertilizer
- Amount of water needed is much less than that of conventional process

Electron Beam Treatment of Waste Water



Pilot-scale plant of cleaning waste water from dyeing factories in Korea
(treatment capacity 1,000m^3/day EBM:1MeV, 40kW)
Demonstration Plant of 10,000m^3/day is under construction

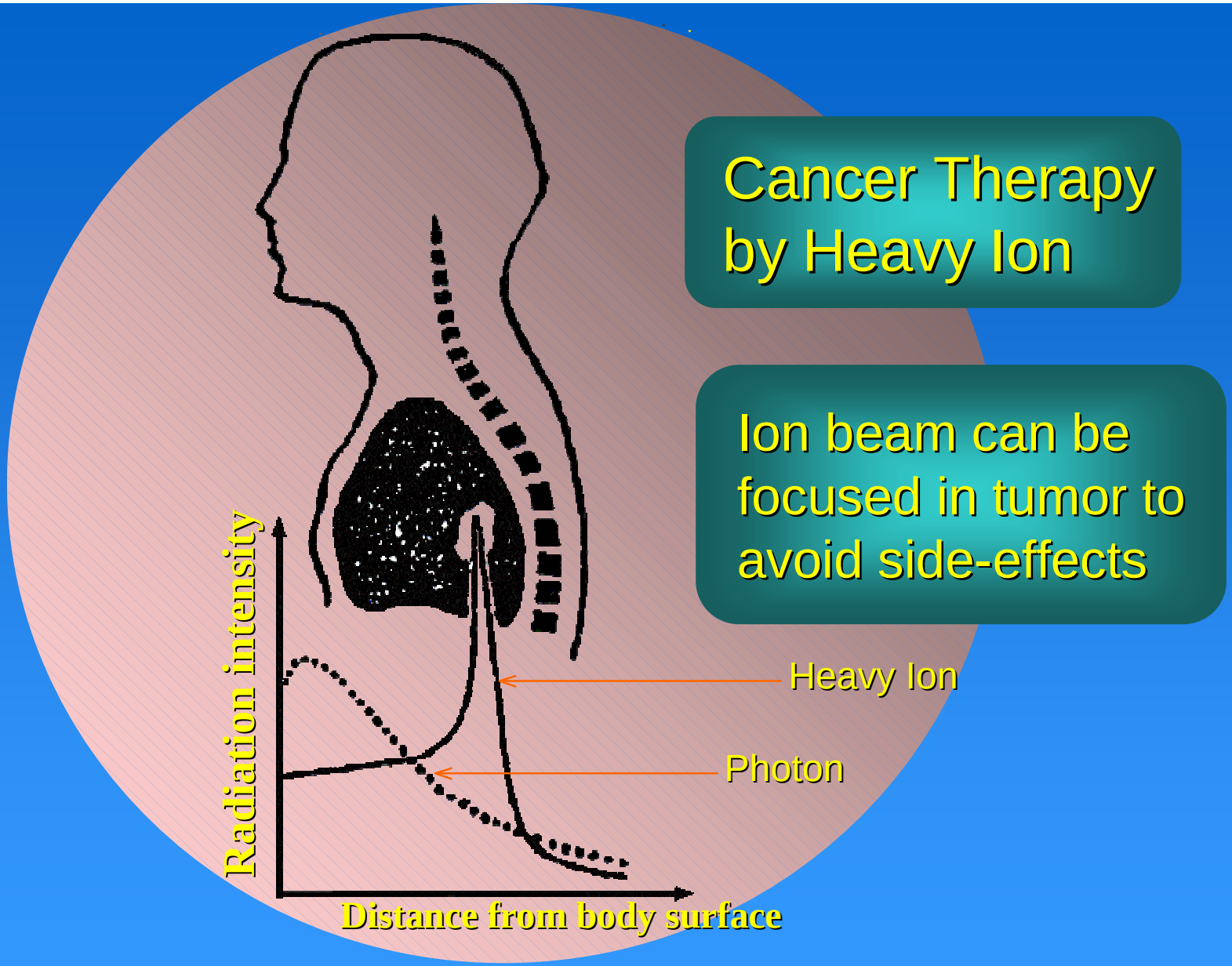
Environmentally Friendly and More Productive Agriculture By Radiation

- Sterile insect technique to reduce insecticides
  Fruit fly, tsetse fly, NW screw worm fly
- Mutation breeding to reduce chemicals
  2000 mutant varieties
- Food irradiation to replace chemical fumigation
- Biofertilizer to replace chemical fertilizer

Demonstration of Bio-fertilizer for peanut in Vietnam

Cancer Therapy by Heavy Ion

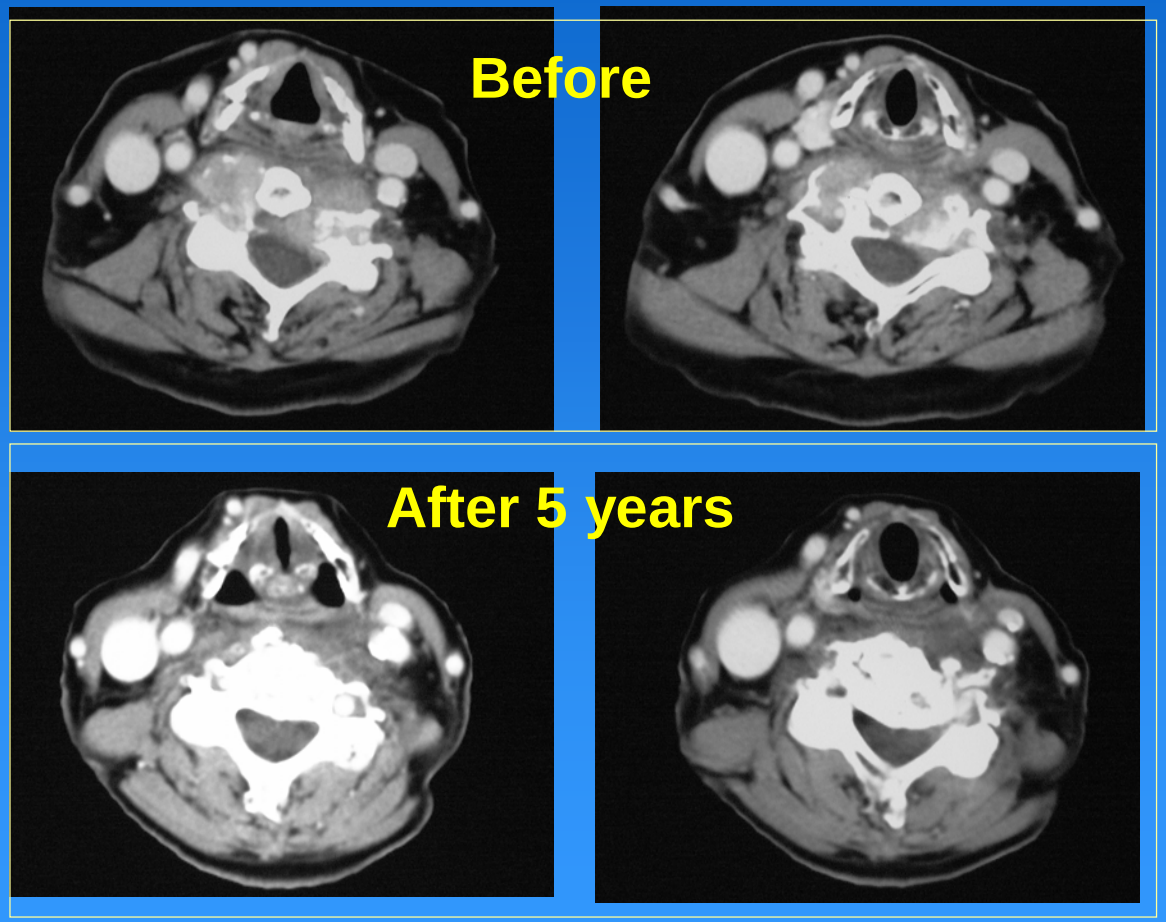
Ion beam can be focused in tumor to avoid side-effects



Heavy Ion Beam Therapy Facility of NIRS of Japan

Radiation Therapy by Heavy Ion (Carbon) Beams

Osteosarcoma of the 5th cervical spine



New Accelerator-Based Large Spallation Neutron Sources under Construction

County		Institute	Proton	Commissioning
USA	SNS	ONL	1.4MW	2006
UK	ISIS	Rutherford -Appleton	240kW	2007
Japan	JSNS	JAERI-KEK	1MW	2008

Major Fields of Research

- Material Science
- Life & Biological Sciences
- Particle Physics

Conclusion - 1

1. **Radiation technology largely contributes to the sustainable development in the field of industry, agriculture and health care.**

2. **Radiation source technology is well developed. In particular, electron accelerators with large capacity. High energy and high reliability are available at reasonable price.**

3. **Ion beam accelerators with high energy are used for medical application and material science.**

Conclusion - 2

4. New polymer products have been developed using electron accelerators to penetrating into new market.
5. Food irradiation is efficient technology to enhance food safety, and the amount of irradiated food is growing worldwide.
6. IAEA's TC Program and CRP achieve to promote radiation application in Member States.