



Overview of education and training in the nuclear field realized by the INSTN

By Pascale ROMANETTI
CEA-INSTN Cadarache
International Contact of INSTN
Pascale.romanetti@cea.fr



French Atomic Energy Agency (CEA)



« Commissariat à l'Énergie Atomique »
(CEA) means French Atomic Energy Agency

The CEA is the French government-funded technological research organization whose two main objectives are:

- to become the leading technological research organization in Europe
- to ensure that the nuclear deterrent remains effective in the future.



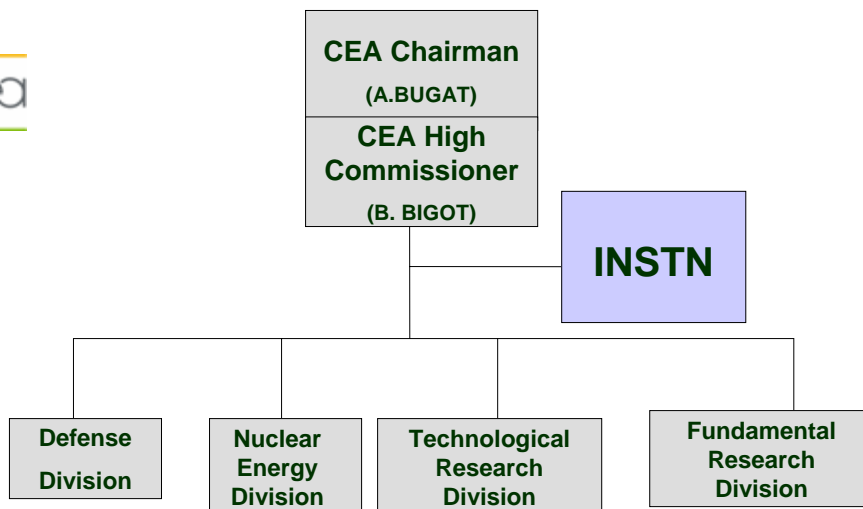


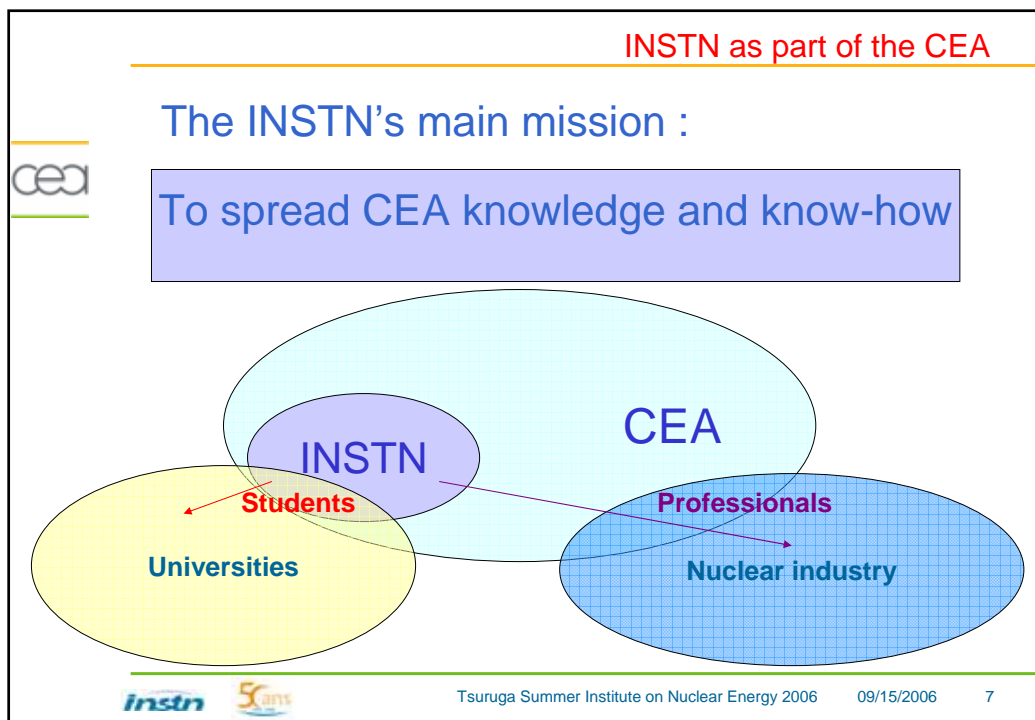
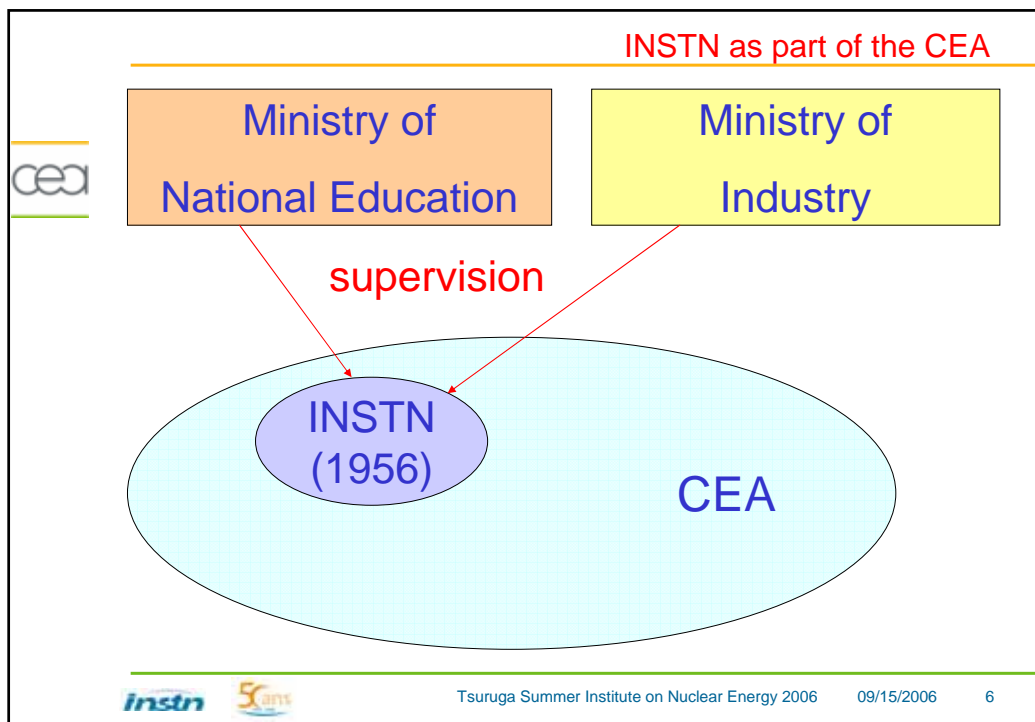
INSTN = National Institute for Nuclear Sciences and Techniques

The only nuclear-related educational institute in France devoted to

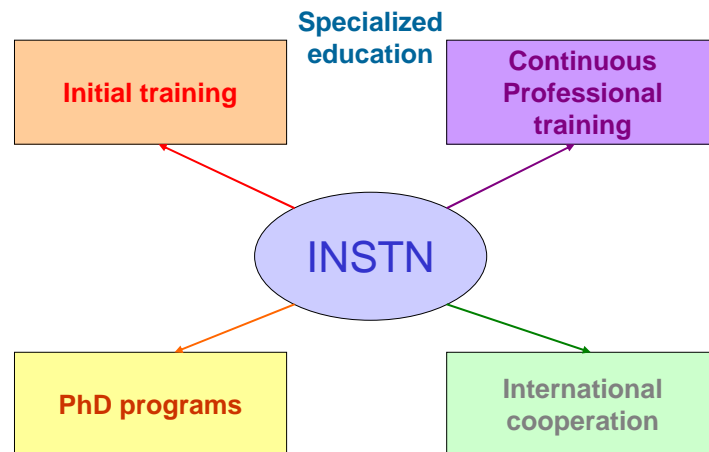
- post-graduate education
- professional training

in nuclear science and technology within the CEA





The INSTN's activities :



The INSTN's ASSETS:

- Network of specialists
- Interface among Research, the University and Industry
- Know-how and experience in pedagogical engineering and organization
- Adaptability to evolutions in sciences and technologies

INSTN's resources: Locations and Staff

5 locations, associated with main CEA sites

Staff : 115



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INSTN's resources ~ 1000 Teachers

- Mostly CEA researchers and experts,
- French and foreign University teachers,
- French and foreign engineers and experts from
 - the field of industry
 - the medical sector
 - regulatory agencies.

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INSTN's resources: INSTN's pedagogical facilities



• Nuclear training reactor: Ulysse

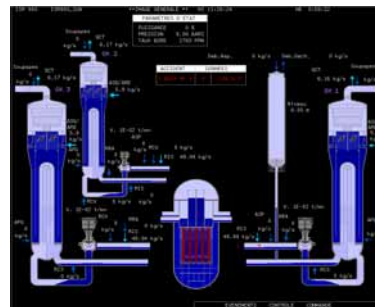


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INSTN's resources: Lab. Work : INSTN's facilities



- Reactor simulators for normal and accidental operating conditions
- Computers and Industry codes



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INSTN's resources: Lab. Work : INSTN's facilities



- Physics and chemistry active laboratories

- Radiation protection training facilities



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INSTN's resources: Lab. Work : INSTN's facilities



- Electronic microscopes

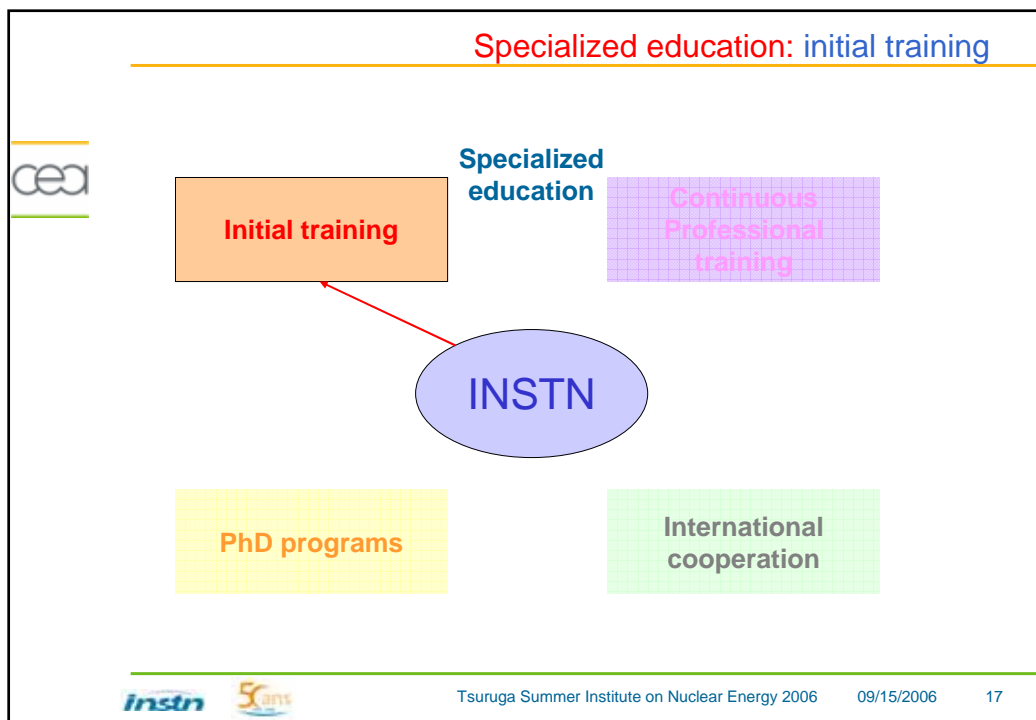
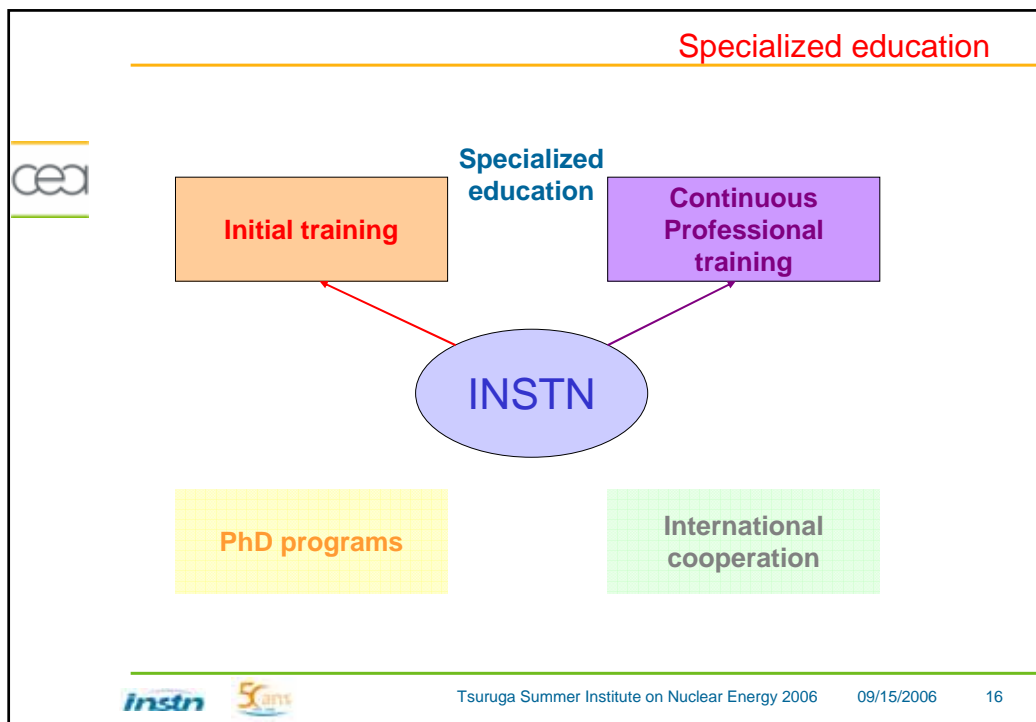
- Van de Graaff accelerator...

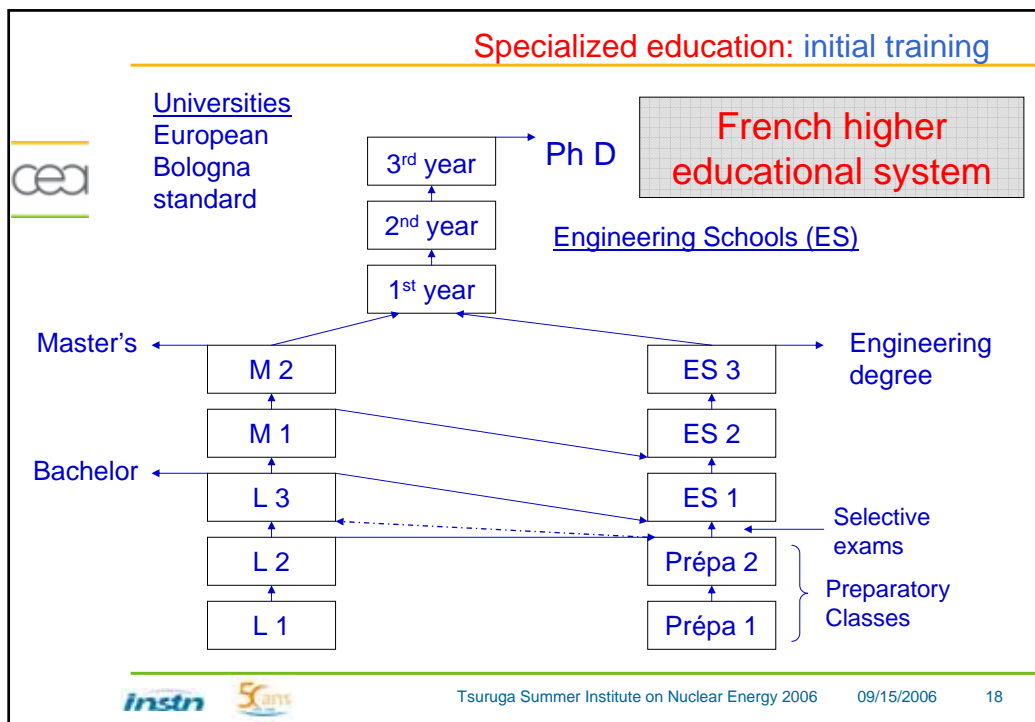


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Specialized education: initial training

At post graduate level:

- Nuclear engineering degree, delivered by the INSTN
- Masters degree in cooperation with Universities or Engineering schools
- Nuclear physicist degree, delivered by the INSTN
- Specialities for medical doctors and pharmacists

At undergraduate level :

professional “licence”, technician degrees (radiation protection)

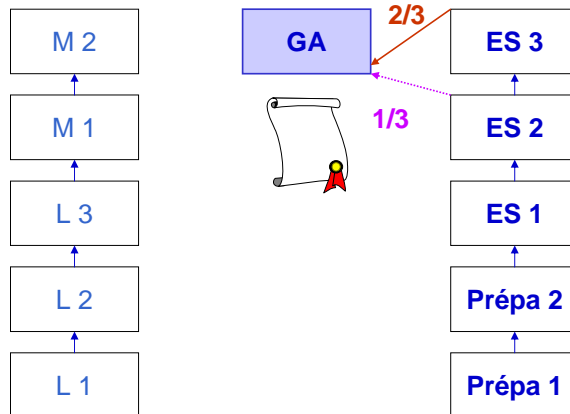
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Initial training - "Atomic Engineering" degree



one year specialization course



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Initial training - "Atomic Engineering" degree



Three locations /
One Syllabus

Cherbourg-EAMEA
17 students

Paris-Saclay
26 students

Aix en Pce-Cadarache
23 students



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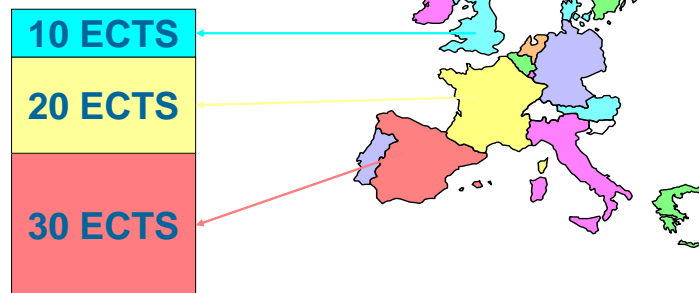
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ECTS = European Credit Transfer System



European System: 1 year = 60 ECTS
1 ECTS ~ 10 Hours



- 7 months : courses, conferences, visits, exercises, laboratory sessions (> 550 hours)

→ 55 ECTS

- 5 months : Master thesis internships in research centers, universities, industry..

→ 25 ECTS

Initial training - "Atomic Engineering" degree

Main courses and European Credit Transfer System associated



□ Applied Nuclear Physics	108 h	11 ECTS
□ Thermal Hydraulics	57 h	6 ECTS
□ Materials for Nuclear Applications	30 h	3 ECTS
□ Structural Mechanics in Nuclear Technology	18 h	2 ECTS
□ Instrumentation for nuclear applications	18 h	2 ECTS
□ Radiation protection	42 h	4 ECTS
□ Nuclear Fuel cycle	18 h	2 ECTS
□ PWR Dynamics and Control	96 h	10 ECTS
□ Power reactor safety	18 h	2 ECTS
□ Nuclear reactor systems	24 h	3 ECTS
□ Nuclear Energy Economics and policies	36 h	3 ECTS
□ Use of computer codes in nuclear engineering	18 h	2 ECTS



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Initial training - "Atomic Engineering" degree

Master Thesis internship 5 to 6 months (April → September)



☺ in France :



- EDF : R&D, engineering centres, NPP
- AREVA : Framatome, Technicatome, SGN...
- IRSN,
- CEA - DEN ...

☺ abroad...

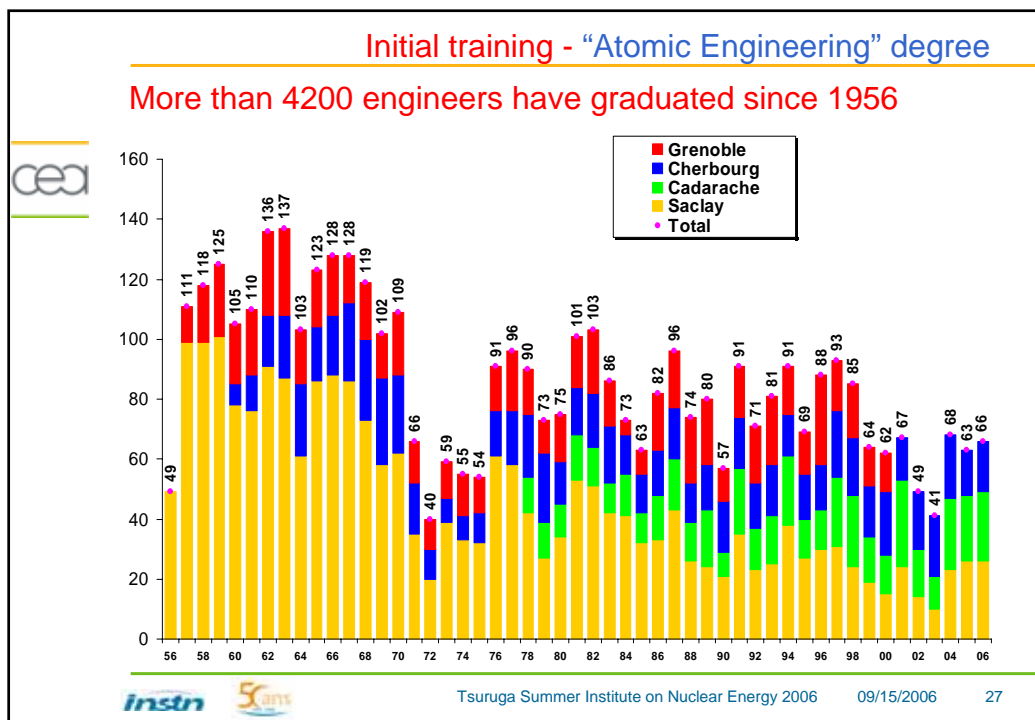
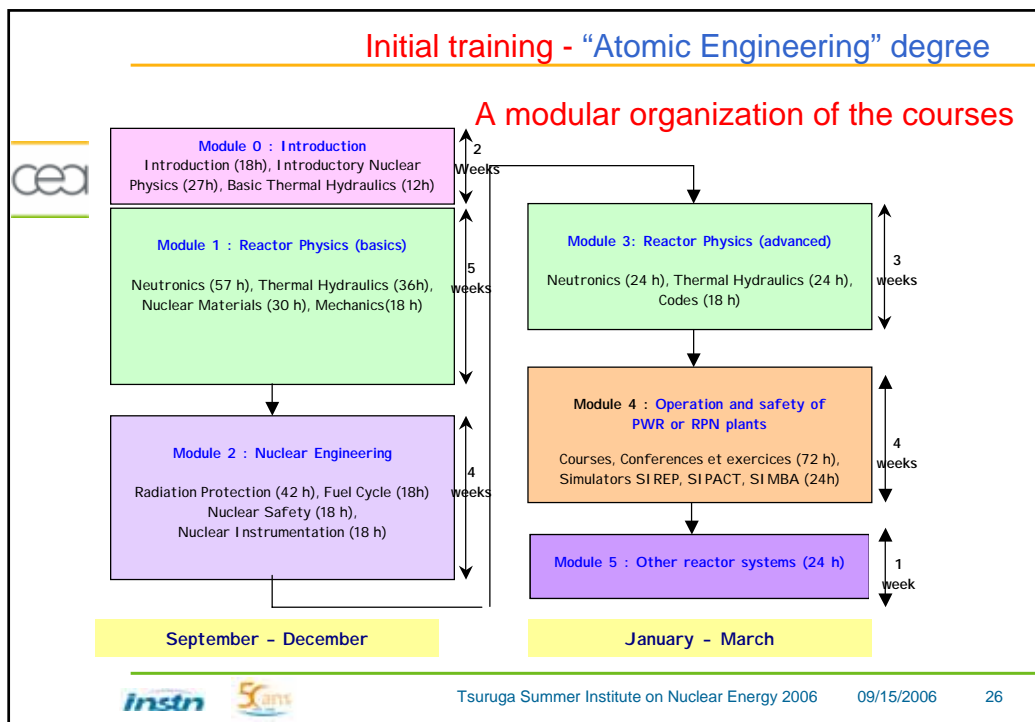
- 🌐 M.I.T. – Boston
- 🌐 Argonne National Laboratory – Chicago
- 🌐 École Polytechnique de Montréal
- 🌐 Oakridge National Laboratory
- 🌐 Penn State University - Pennsylvanie,
- 🌐 Texas A&M
- 🌐 Berkeley ...



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Initial training - "Atomic Engineering" degree

GA courses – Reference books in Nuclear Engineering (1)



Neutron Physics
Paul Reuss



Nuclear Materials
Clément Lemaignan



Nuclear Fuel Cycle
Louis Patarin



Nuclear Economics
Evelyne Bertel &
Gilbert Naudet



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Initial training - "Atomic Engineering" degree

GA courses – Reference books in Nuclear Engineering (2)



Neutronics : Exercises



Pressurized Water Reactors



Radiation protection for
nuclear engineering

www.edpsciences.com



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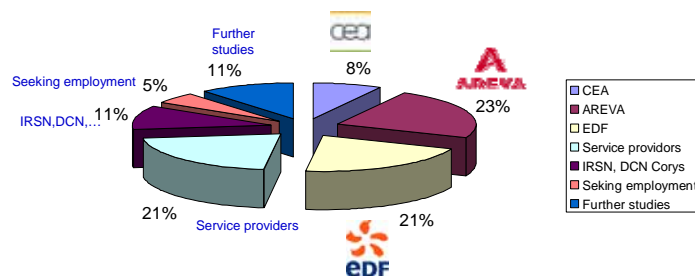
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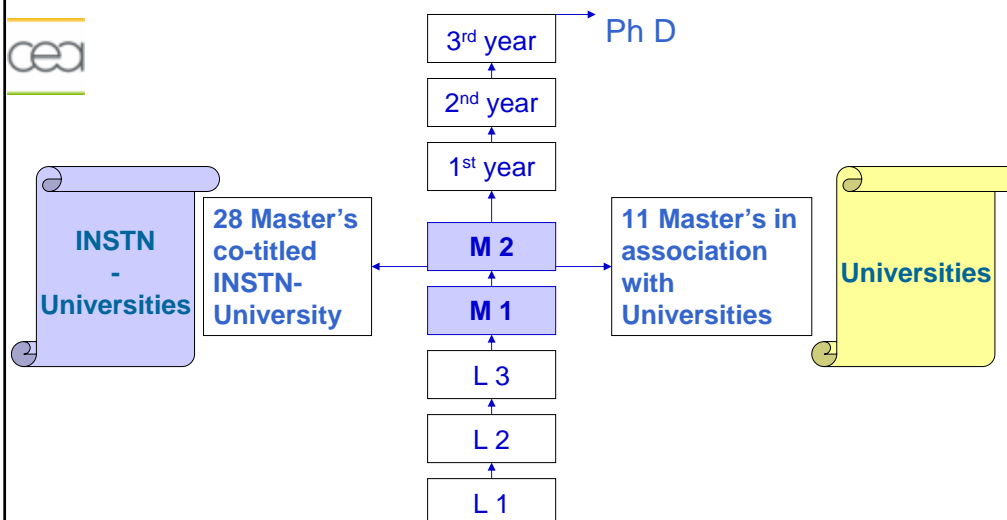
Initial training - "Atomic Engineering" degree

Status of GA graduates (Saclay & Cadarache)

- Average salary (1st employment) : 33.5 k€
- Contract : 81% of permanent job
- Average delay before 1st job : 3 weeks



Initial training – Master's degree





INSTN
-
Universities

28 Master's degrees co-titled INSTN-University:

- Physics and applications (3-one of which is: **"Sciences of Fusion"**)
- Chemistry and applications (5)
- Materials (2)
- Mathematics and applications (1)
- Waste management, clean-up and dismantling (2)
- Sciences of the environment (1)
- Biology, health (2)
- Medical physics (4)
- Data systems (3)
- Economy and management (5)



Universities

11 Master's degree in association with Universities

- Physics and applications (6)
- Chemistry and applications (1)
- Materials (1)
- Biology, health (1)
- Nuclear risk evaluation (1)
- Nano sciences (1)



Initial training – Master's degree in reactor physics



Paris XI Orsay
University

INSTN

Master's degree in reactor physics

Mandatory courses

3 optional courses:

- Modeling and instrumentation in physics
- Reactor Physics
- New technologies for energy production



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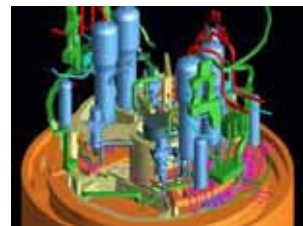
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Initial training – Master's degree in reactor physics



Six modules : 50 hours each

- Interactions of radiation with matter
- Modeling and simulation
- Reactor Physics
- Signal analysis and particle detection
- Neutronics
- Applied neutronics



*Beginning in September 2007, a new masters degree in Nuclear Reactor Technology **in English**, oriented R&D, will be offered*



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• **Subjects:**

- Nuclear medicine
- Radio pharmacy and Radiobiology
- radiological and medical physics

• **Partnership :**

- Over 20 universities in France
- 14 coordinators



Diagnostic

➤ Nuclear medicine

- prescription
- interpretation

DES

➤ Radio pharmacy

- quality control of products

DESC

➤ Nuclear medicine for technician

- Examination accomplishment

TMN

Therapy

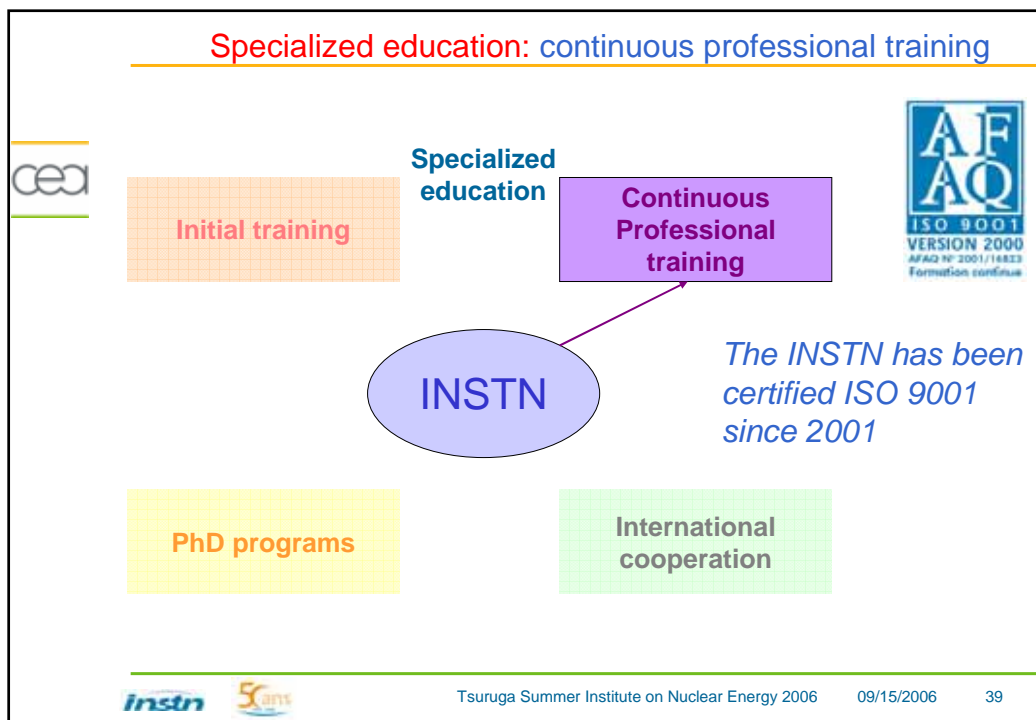
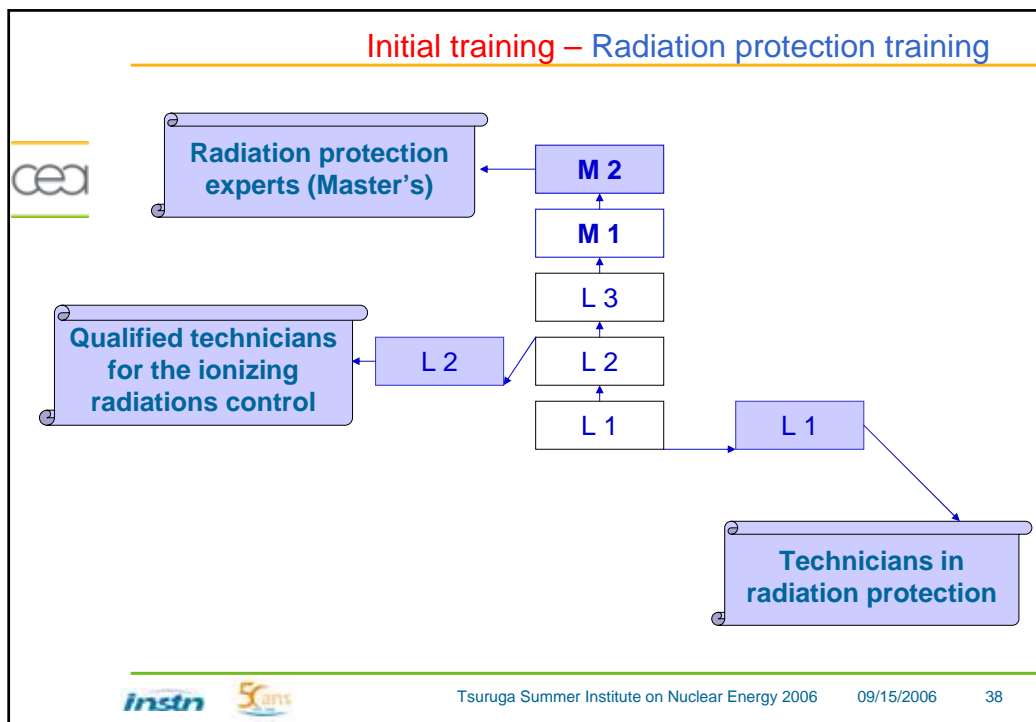
➤ Radiotherapist physicist

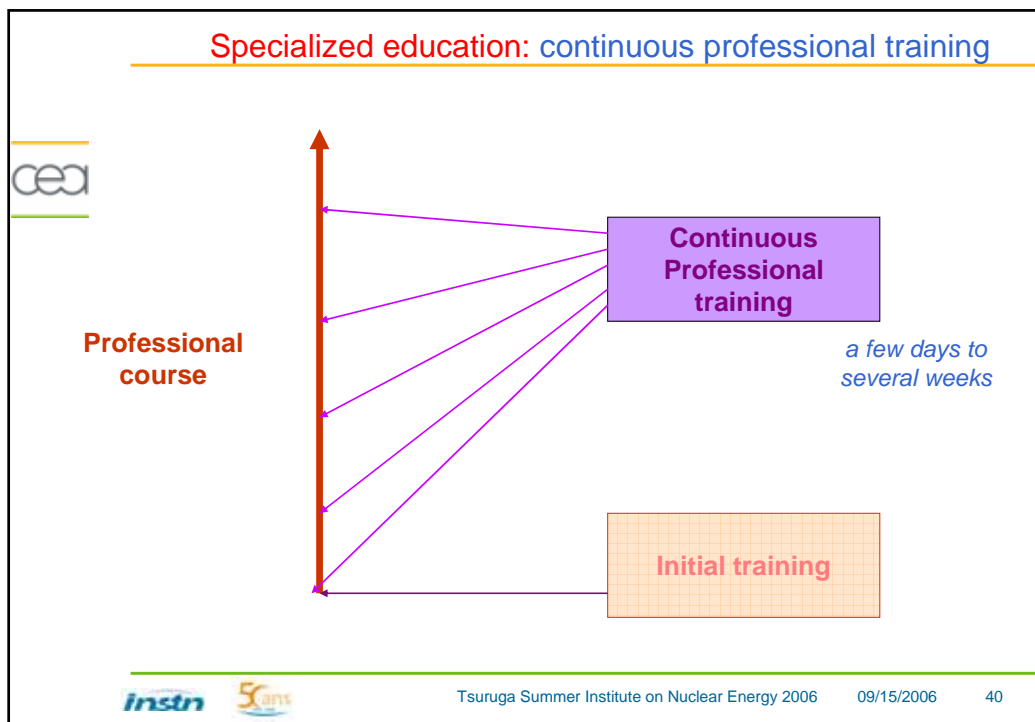
- Treatment prescription

➤ Medical Physicist


- Dose evaluation
- Radiotherapy materials
- Quality assurance

DQPRM





Specialized education: continuous professional training




- **Scientific and technical training courses**
- **On-the- job training at the CEA**
 - Safety, radio-protection
 - project management, communication, ...

Last year:

- 700 training sessions
- 2,900 days (~ 4 days / session)
- 7,800 trainees (~ 11 trainees / session)





Logos:  

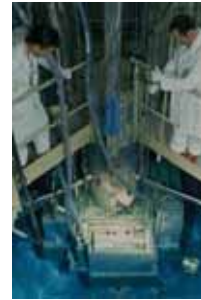
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Specialized education: continuous professional training



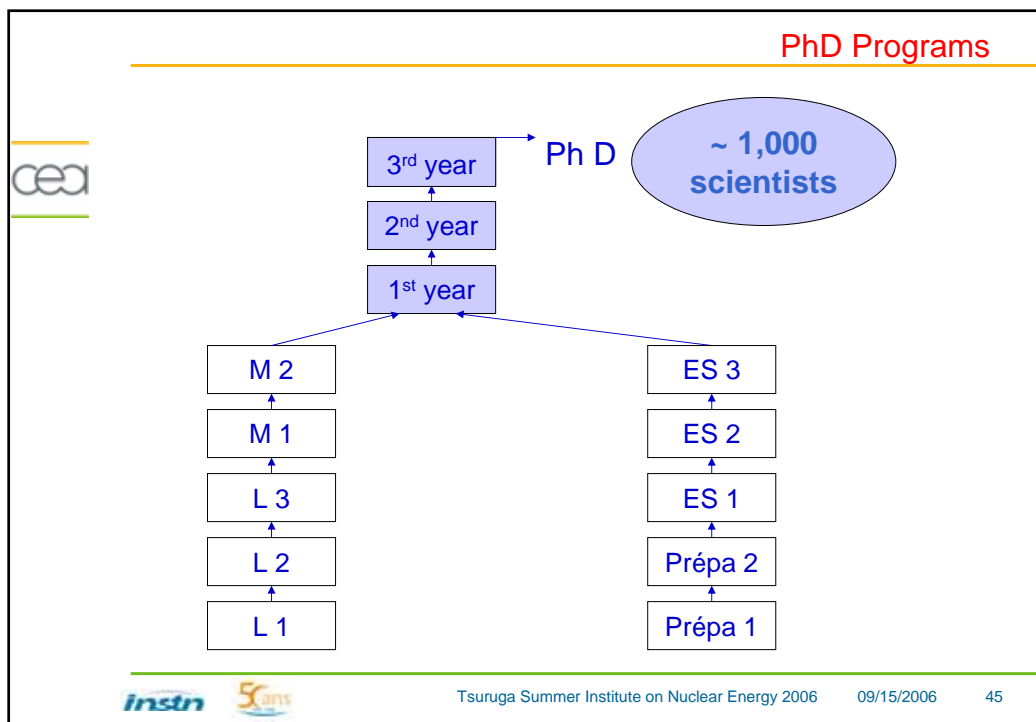
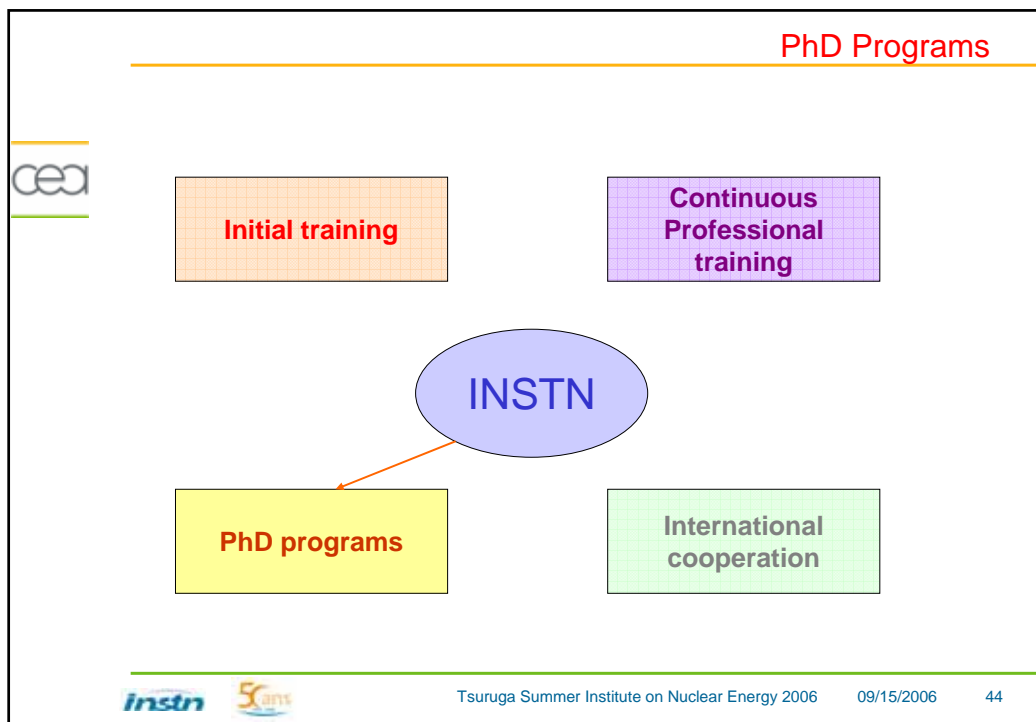
Mainly in technical, but some non-technical areas:

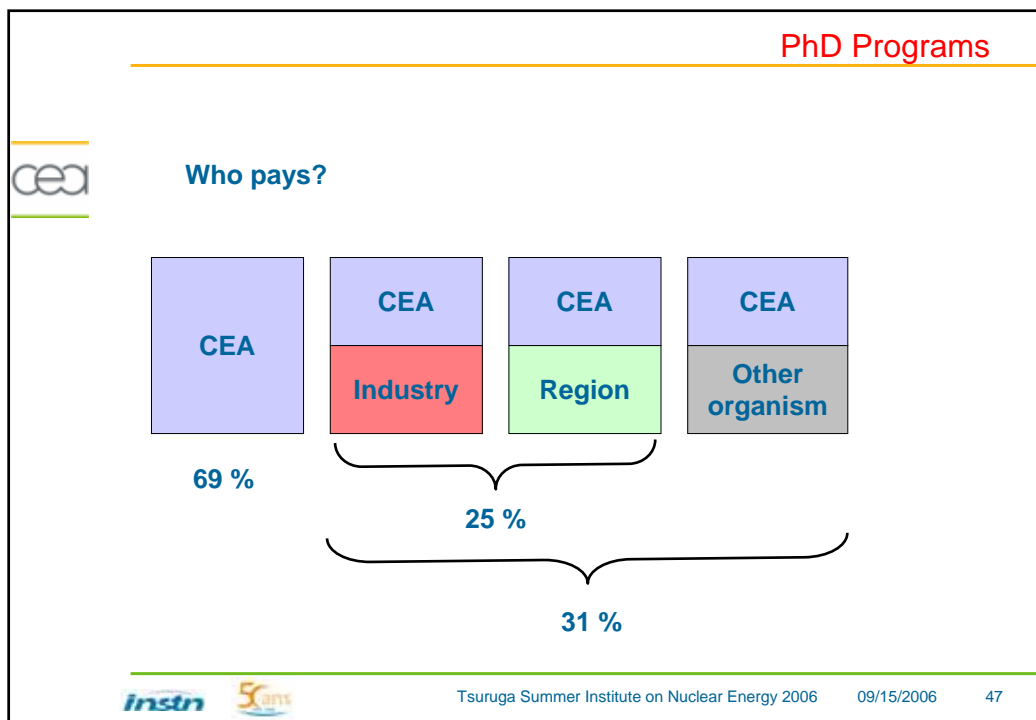
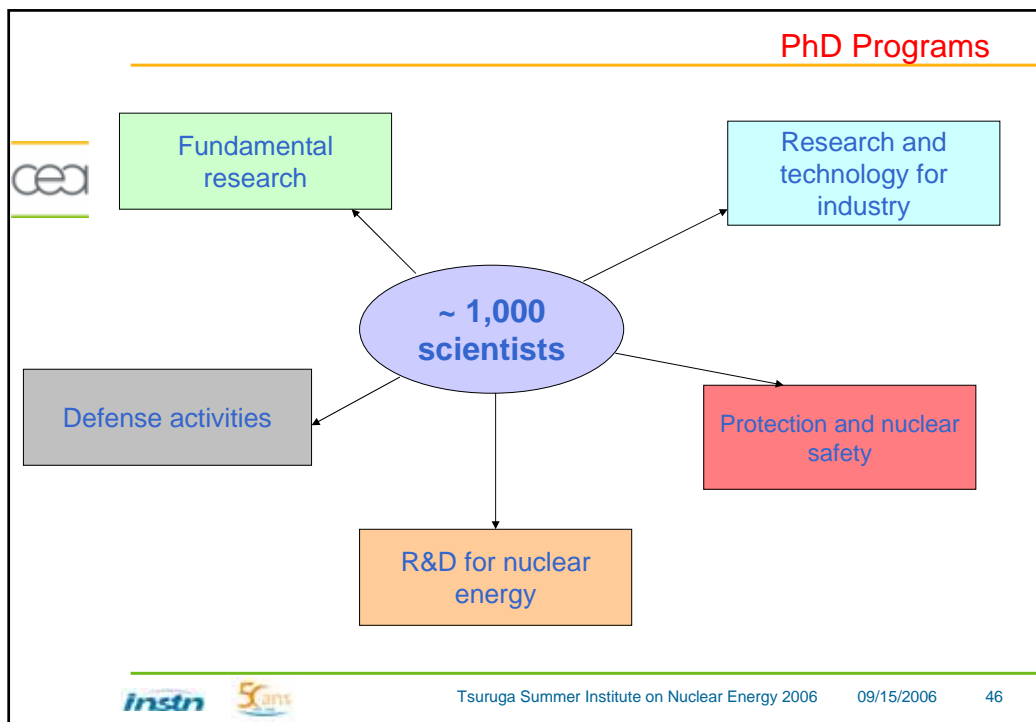
- ✓ nuclear power plants,
- ✓ materials, nuclear fuel cycle,
- ✓ environment, health physics,
- ✓ conventional and nuclear safety,
- ✓ radioisotopes use in biology, molecular biology,
- ✓ chemistry, radiochemistry, chemical analysis,
- ✓ radioactivity, nuclear measurements,
- ✓ project management,
- ✓ other topics, including new energy technologies or initiation to nuclear energy for grammar school teachers...

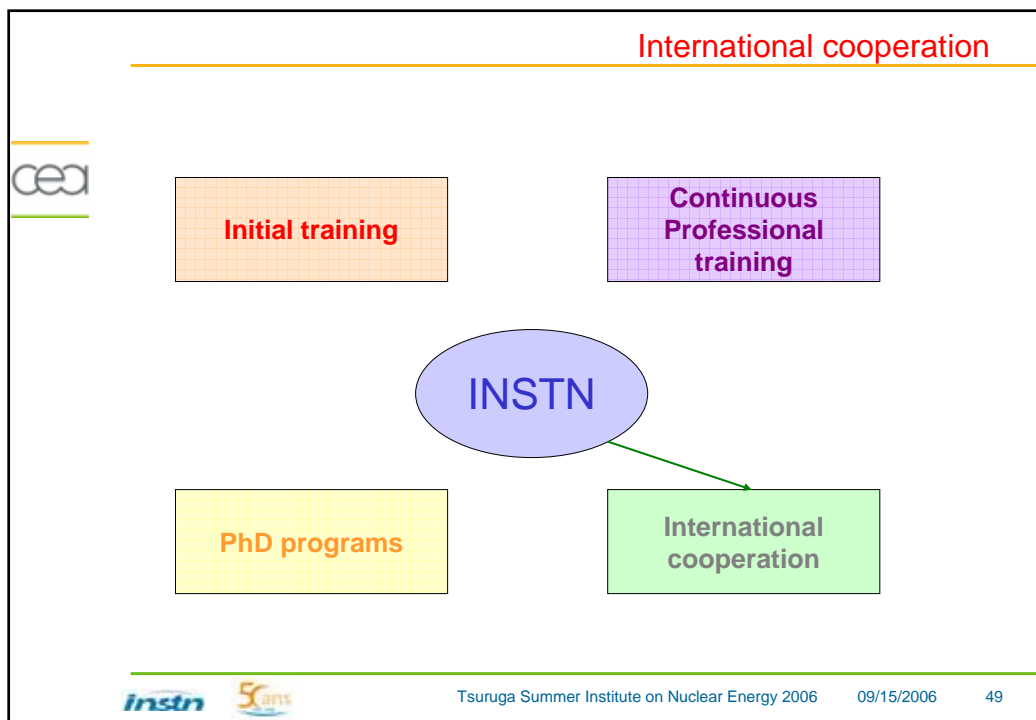
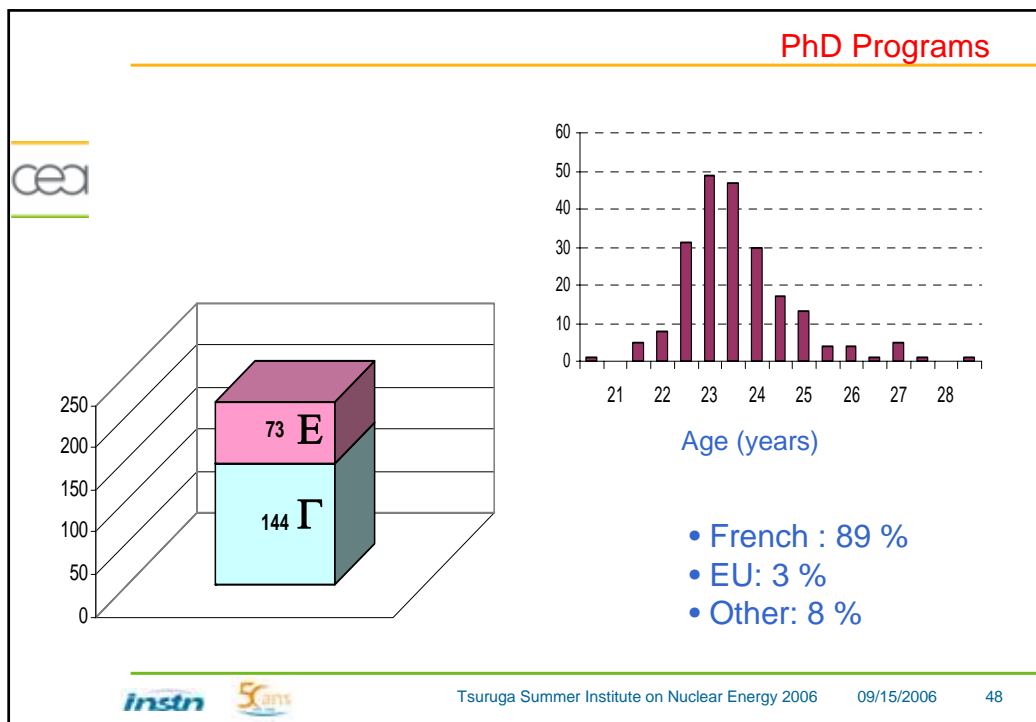


Specialized education: continuous professional training









International cooperation: initial and professional training



- Every year: ~ **100 students**
- Over 1,500 trainees since 1976
- Technical cooperation IAEA
- In Europe: “European Nuclear Education Network Association”



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International cooperation: professional training



Examples of trainings organized upon request of the IAEA



- Regional Post-Graduate Educational Course on Radiation Protection and on the Safe Use of Radiation Sources
- Basic professional training course on nuclear safety
- Training needs assessment, Networking and materials for training courses in nuclear safety
- Train the trainers course in nuclear safety



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International cooperation: European projects



- Radioprotection Master's
- EMIL (European Master's in Molecular Imaging) project
- ENEN (European Nuclear Engineering Network) project
- NEPTUNO (Nuclear European Platform of Training and University Organizations)



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International cooperation: European projects



European Molecular Imaging Laboratories



« The aim of the training activities is to reinforce and spread **excellence** throughout Europe in the **teaching of molecular imaging** »

EMIL courses

Master Molecular Imaging

Summer School



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The European Nuclear Education Network Association

<http://www.enen-assoc.org>

MISSION : the preservation and further development of higher nuclear education and expertise

