

Workshop SERPENT

Presentation of the Reactor Physics Group

The IN2P3 Context

IN2P3 is one of the 10 Institutes of the CNRS

- Created and operated as an Institute since 1971
- Some numbers
 - 2500 permanent staffs + 400 PhD students and 300 Postdocs
 - 900 researchers and 1600 Technical staff (strong technical support)
 - Annual Budget
 - 190 M€, 20 M€ external resources (8.5 from Technology Transfer)

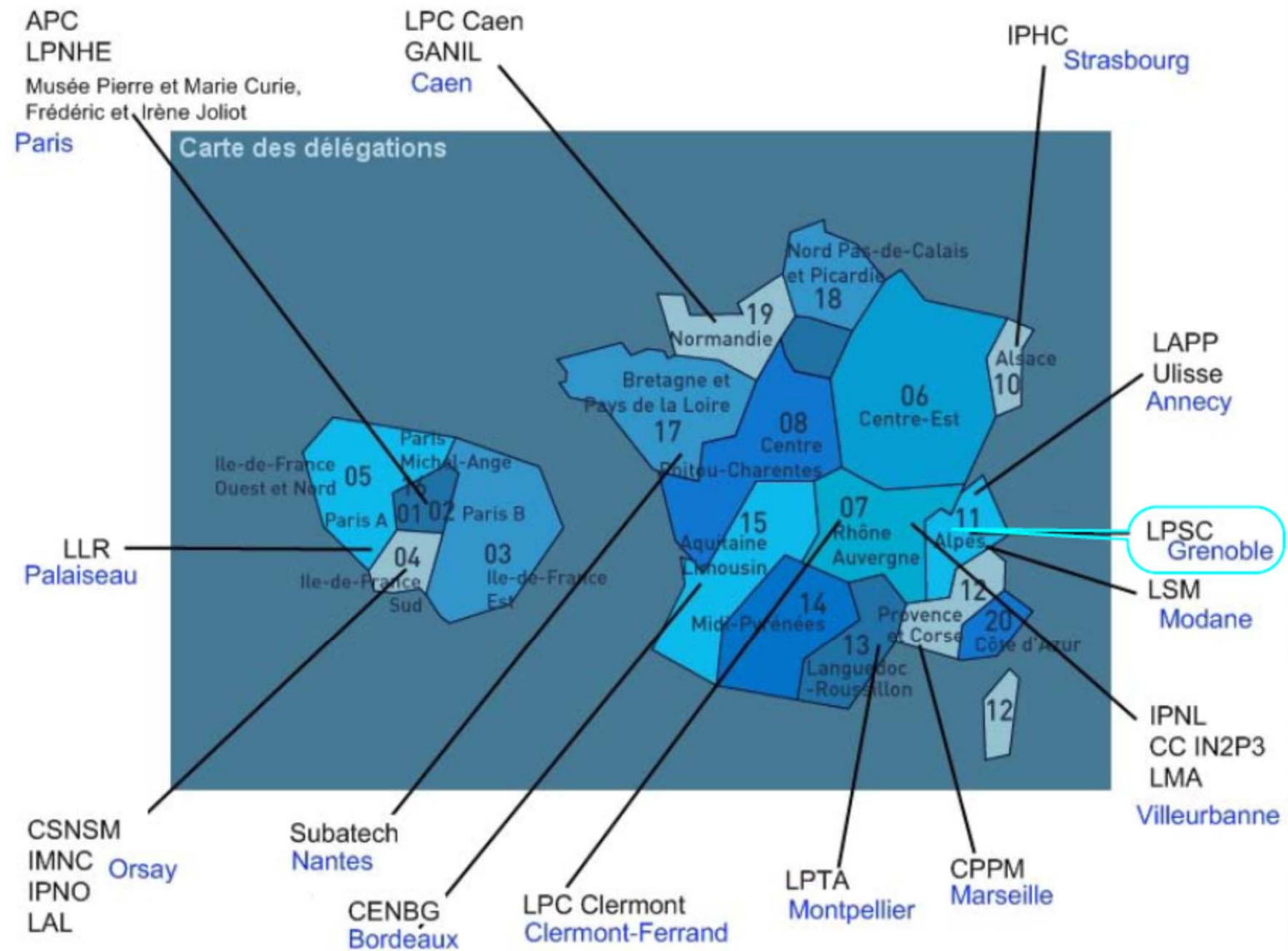
Mission

- Basic research in nuclear physics, particle physics and astroparticle physics
 - Coordinates programs in these fields for the French academic world (CNRS, Universities), in partnership with the CEA (Atomic Energy Agency)
 - Coordination of 2 Europe Research Areas-NETs : ASPERA and NUPNET

Organization

- 25 laboratories (most of them operated jointly by CNRS and Universities) and platforms organized in a national network
- 9 associated international laboratories (in particular with Asia)
- 1 “GIP” (semi-public) : microelectronics and Microsystems for industry
- Active/leader in 40 active international projects

IN2P3 laboratories in France



The location



The LPSC : generalities

The laboratory

- Operating agencies : CNRS and Universities of Grenoble (UJF, INPG)
 - LPSC part of the network of laboratories of IN2P3
- About 225 people
 - 70 Physicists, 100 Technical staffs, 35 PhD students, 20 Postdoc, ...
 - More than 60 students trained in research each year
- Budget 3-4 M€/year (not including salaries)
 - 2-3 M€ for the scientific projects
 - $\approx 75\%$ from CNRS/IN2P3
- About 25 projects underway (experiments, theory, and technology)
 - ANR, Europe (FP6&7) and International
 - World level collaborations

The site

- 5 hectares of land, 9 buildings (total surface 20,000 m²)
- Several assembly Halls and facilities
 - Accelerator, Tier 3, Molten salt loop ...
- Platforms for research and academic training
 - Nuclear energy, plasma and ion beams, ...

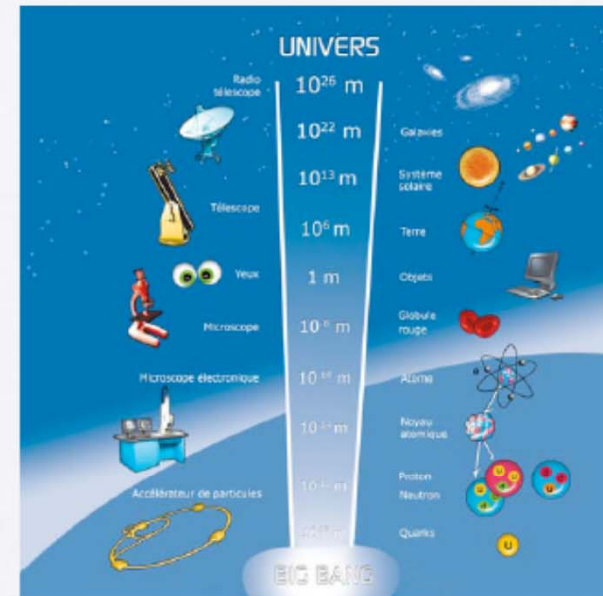


Research at the LPSC

Physics of the 2 infinities (IN2P3) :
 infinitely small to infinitely large
 ... as well as cross-disciplinary and spin off

Physics cases

- 1 - Quarks, leptons
and fundamental interactions
- 2 - Astroparticles and cosmology
- 3 - Hadronic and nuclear Physics
- 4 - Theory and phenomenology
- 5 - Physics of nuclear reactors
- 6 - Accelerator and Ion Sources
- 7 - Interdisciplinary : Medical and Plasma



Teaching and Training, Technology Transfer and
 Scientific Information

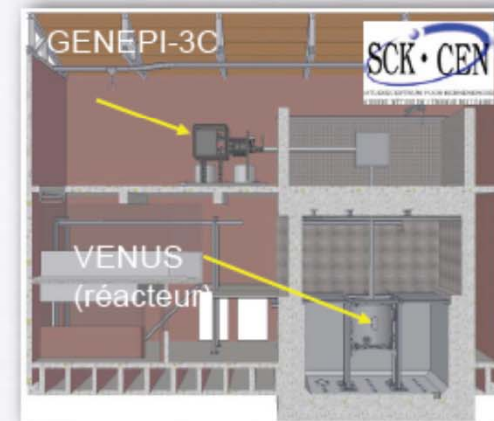
Scientific goals

- Innovative reactors for energy production with reduced waste production and optimization of the resources (Th/U cycle)
- Burning of minor actinides; accelerators driven subcritical reactors (ADS)



The tools and concepts

- GUINEVERE project (at Mol, Belgium)
 - Research reactor (VENUS)
 - External source of neutrons from accelerator (GENEPI-3C, Grenoble)
- Neutron facilities (PEREN, GELINA, ILL)
 - Key cross section measurements
- Molten salt concept (FFFER, Grenoble loop)
- Simulations and scenarios



Reactor Physics Group

- The Reactor Physics Group was created in 1994
- **Group manager:** A. Billebaud
- **Group members**

9 university researchers:

A.Bidaud (MCF INPG)
N.Capellan(MCF INPG)
G.Kessedjian(MCF INPG)
E.Liatard (PR UJF)
O.Méplan (MCF UJF)
E.Merle-Lucotte (PR INPG)
A.Nuttin (MCF INPG)
P.Rubiolo (PR INPG)
C.Sage (MCF INPG)

4 CNRS researchers:

A.Billebaud (DR)
S.Chabod (CR)
V.Ghetta (CR)
D.Heuer (DR)

1 Post-doc:

M. Aufiero

2 PhD students:

A. Chebboubi (3A)
A. Laureau (3A)

1 External collaborator:

M.Allibert

Reactor Physics Group: research teams

Modeling, Analysis and Scenario (MAP): P. Rubiolo

- *Development of multi-physics / multi-scale tools for reactor physics studies*
- *Analysis of advanced reactor systems and the associated energy scenario*
- *Evaluation of nuclear perspectives including economics aspects*

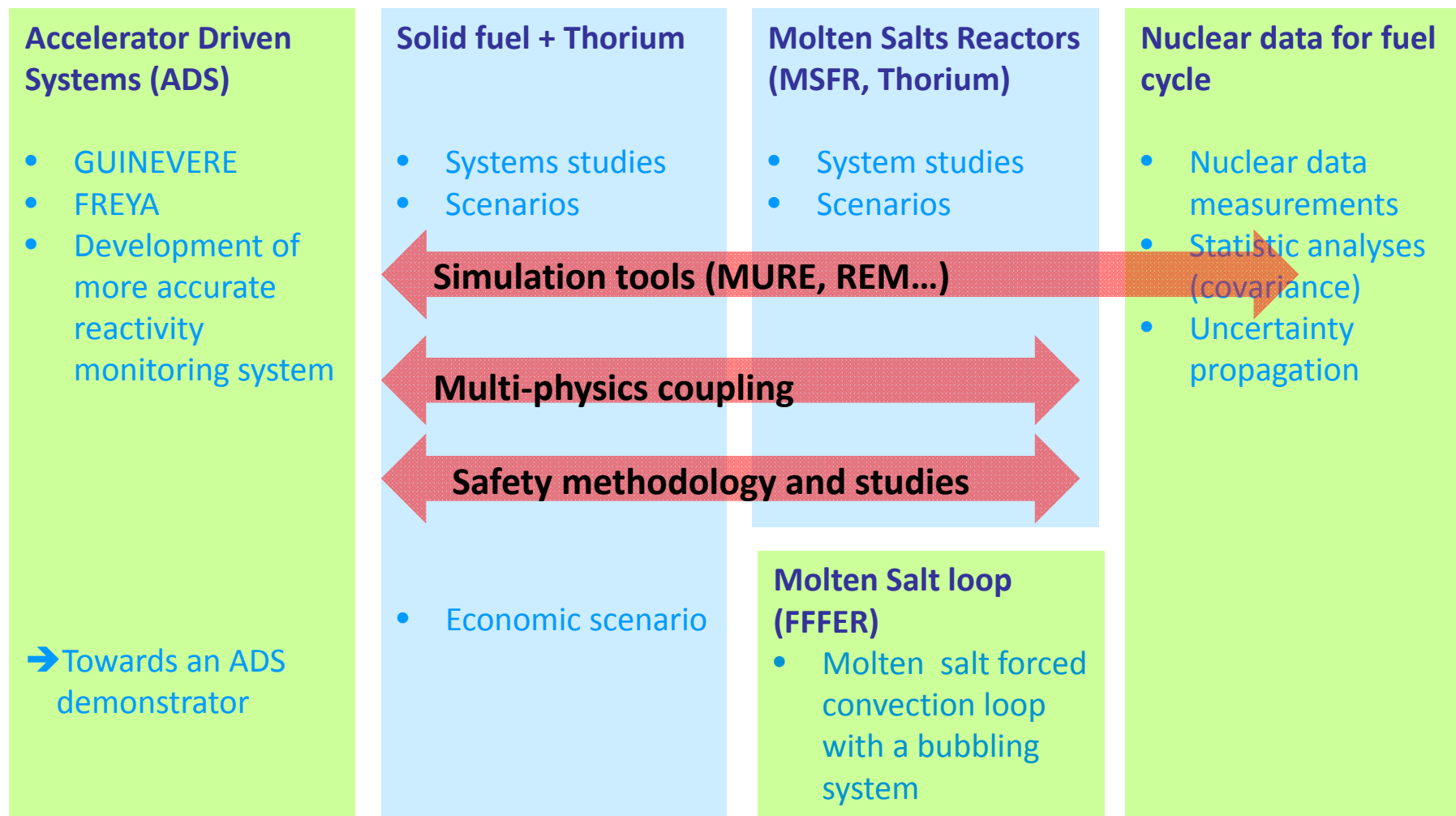
Experiments for Reactor pour les Réacteurs: G. Kessedjian

- *Nuclear data for nuclear fuel cycle*
- *Reactor experiments*
- *High temperature fluids*

MSFR system: E. Merle-Lucotte

- *Physical studies for reactor design*
- *Development of safety methods for liquid nuclear fuel reactors*
- *Development of the MSFR reactor concept*

Reactor Physics Group: research areas



Recent R&D projects/results

Solid fuel / Thorium / Scenarios

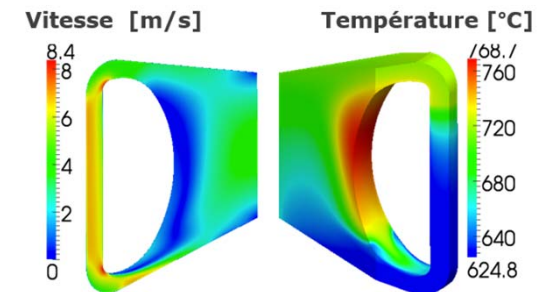
- Thorium fuel performance (heavy/light water reactors):
- Energy scenario studies (tools: CLASS & MURE, collaboration with IN2P3, economists)

Molten Salt Fast Reactor (MSFR)

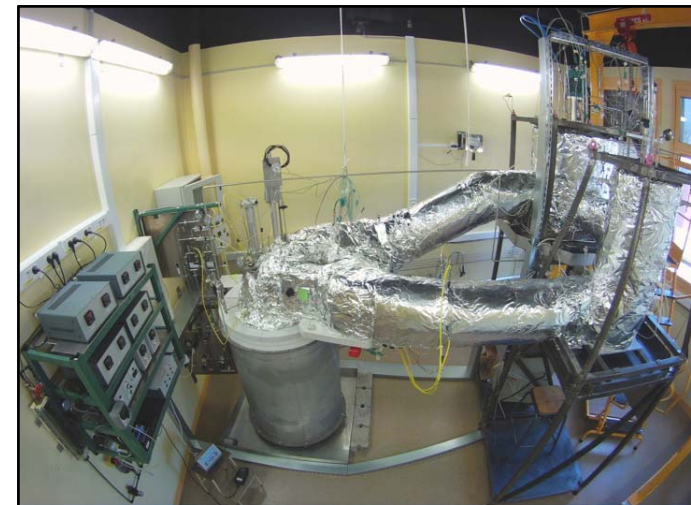
- Design and safety studies: system code
- Safety methodology
- Multi-physics coupling
- Projects : EVOL/CLEF/ SAMOFAR
- Molten Salt loop (FFFER)

Nuclear data for fuel cycle

- Fission products yields measurements at ILL
- Lohengrin experiment: magnetic spectrometer
- Sensitivity studies to nuclear data uncertainties
- Uncertainties propagation (SERPENT)



Thèse Axel Laureau



Workshop SERPENT

Grenoble INP – Grenoble Institute of Technology

Nuclear Education and Training at Grenoble



Grenoble INP is a federation of 6 engineering schools

Phelma: "Physics, Applied Physics, Electronics and Materials Science"

Ense3: "Energy, Water and Environmental Sciences"

Ensimag: "Information Management Sciences"

Esisar: "Advanced Systems and Networks"

Génie Industriel: "Industrial Engineering"

Pagora: "Paper science, Print Media and Biomaterials"

+ 35 research laboratories

Students are admitted two years after their high school graduation via competitive exams for entry to Grandes Ecoles, via University's degrees, or an in-house Preparatory Course

5000 students/year among them 3500 future engineers

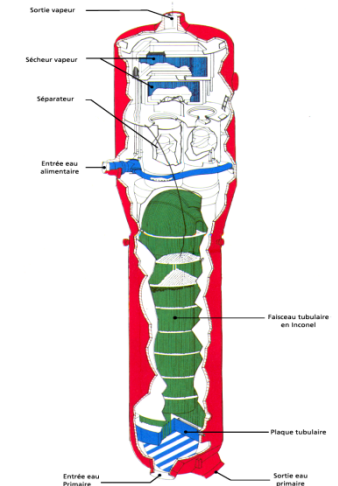
Around 1600 diplomas delivered per year

Nuclear Education and Training at Grenoble

- Two Engineering Programs:

- ✓ **Reactor Physics and Nuclear Engineering (GEN - PHELMA):** ~50 students per year (physics and microscopic sciences, neutronics, materials, thermal-hydraulics, nuclear reactors, safety, simulations)

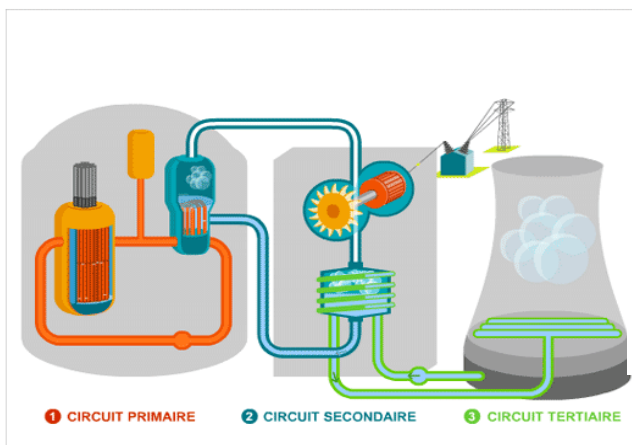
- ✓ **Nuclear Energy Engineering (IEN – ENSE3):** ~25 students per year (thermal-hydraulics, electrical engineering, automation, nuclear sciences)



- Two Masters of Science (PHELMA):

- ✓ Master « **Material Sciences for Nuclear Energy** » (15-25 students – in English)

- ✓ Master « **Energy Physics** » (15-25 students – in French)



- **PhD programs** + Leader of the PhD Track “Sustainable Nuclear & Converging Energies” of the KIC InnoEnergy

- **International bachelor in Nuclear Energy (PHELMA)** – 10-20 students per year from North China Electric Power University

Nuclear Education and Training at Grenoble

- **Nuclear Instrumentation - PLATIN**
(Radiation detection, nuclear electronics)

α spectroscopy based on Si junction, γ spectroscopy based on Ge junction, Ionization and proportional chamber, Neutron detection, γ - γ coincidences, Neutronic activation, Detection statistics and analysis



- Practice of PC-based **simulator for PWR**
(PHELMA – UJF / based at LPSC)



- Access to a **Full Scale Simulator** (for the training of power plants EdF operators)

Reactor Physics Group

Welcome to Grenoble !

