

# MoMaS Research Program

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[www.gdrmommas.org](http://www.gdrmommas.org)

# MoMaS in a nutshell

- ▶ **Mathematical Modeling and Simulations for Radioactive Waste Management**
- ▶ Program exists since 2002, current program spans 2008–2011
- ▶ member of, and funded by, the PACEN program of CNRS



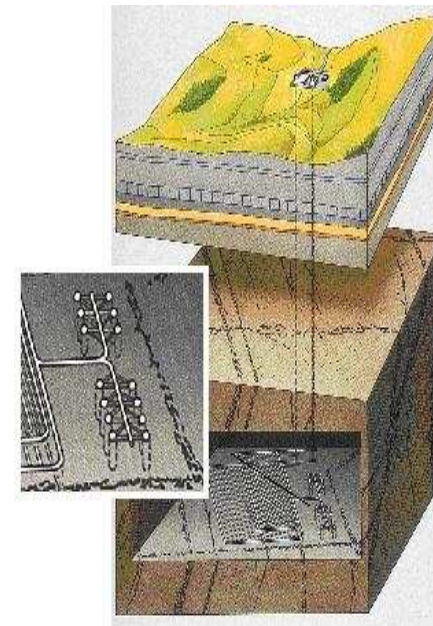
[Programme pour l'Aval du Cycle Electro-Nucléaire]

- ▶ co-sponsored by 5 other institutions



# MoMaS in a nutshell

- ▶ **National Law 2006–739 of 28 June 2006**
  - ▶ National Program of Radioactive Material and Waste Management
  - ▶ underground storage of high-activity long-life ( $\geq 1\text{My}$ ) waste
  - ▶ investigated site at Bure in **Meuse Haute-Marne** ( $-500\text{m}$ )
  - ▶ national and parliamentary debates scheduled 2012–2014
  - ▶ construction of storage facility assessed in 2015
  - ▶ possible opening in 2025



# MoMaS in a nutshell

- ▶ task force  $\approx$  25 persons.year
- ▶ budget  $\approx$  250kE/year
- ▶ MoMaS serves both regulators and implementors
- ▶ research must be neutral
- ▶ MoMaS provides a national communication link

# MoMaS in a nutshell

## MoMaS activities

- ▶ 15 research projects spanning 2 years
- ▶ benchmarks
- ▶ workshops and short courses

## Program organization

- ▶ activities reviewed by a Scientific Committee (18 members)
- ▶ management
  - ▶ main coordinator : AE
  - ▶ vice coordinator : Michel Kern (INRIA)
  - ▶ chair of Scientific Committee : Grégoire Allaire (E. Polytechnique)

# Research projects

- ▶ **Scientific output since 2002**

- ▶  $\approx$  100 refereed papers
- ▶  $\approx$  20 related PhD theses

- ▶ **Basic goals of undergoing research**

- ▶ strengthen foundations of existing models by mathematical analysis
- ▶ derive new models in particular by upscaling and homogenization
- ▶ develop robust and efficient simulation schemes along with suitable implementation
- ▶ quantify and reduce uncertainties in models and simulations

# Research projects

## 4 key research directions in 2008–2009

- ▶ multiphase flows
- ▶ models and coupling
- ▶ numerical methods
- ▶ error analysis and uncertainties

# Research projects

## Multiphase flows

- ▶ hydrogen production by radiolysis and metallic corrosion
- ▶ process modelling
  - ▶ phase diagrams for H<sub>2</sub>/H<sub>2</sub>O system
  - ▶ capillary pressure non-equilibrium
  - ▶ high-mobility asymptotic models
- ▶ process simulation
  - ▶ numerical schemes for two-phase flows
  - ▶ challenges : heterogeneities, phase (dis)appearance, initial conditions
  - ▶ ANDRA Benchmark 'Couplex-Gaz'
  - ▶ simpler benchmarks are currently being designed
- ▶ participation in Euratom Project FORGE



# Research projects

## Models and coupling

- ▶ modeling of excavation damaged zone
- ▶ upscaling of source terms (in space and in time)
- ▶ upscaling of cement degradation models
- ▶ effective dispersion models and coupling with fractures
- ▶ transport models based on fractional derivatives

# Research projects

## Numerical methods

- ▶ numerical methods for anisotropic and heterogeneous problems
  - ▶ Benchmark presented at Aussois, June 08
- ▶ particle methods
- ▶ solvers for far field simulations
- ▶ algorithms for coupling transport and chemistry
  - ▶ Benchmark presented at Strasbourg, January 08

# Research projects

## Error analysis and uncertainties

- ▶ parameter estimation by multiscale inverse methods
- ▶ assessment of uncertainty propagation with chaos polynomials
- ▶ robust and guaranteed a posteriori error estimates