

## Properties of atomic nuclei



# PARIS

## PHOTON ARRAY FOR STUDIES WITH RADIOACTIVE IONS AND STABLE BEAMS

Detecting high-energy gamma radiation emitted in nuclear reactions

© PARIS Collaboration

- **Scientific leader:** Iolanda Matea Macovei (IJCLab) \*
- **Laboratories involved:** GANIL (Caen), IJCLab (Orsay), IPHC (Strasbourg), IP2I (Lyon)
- **Nature:** research instrument
- **Status:** international research project in operation involving research teams from Bulgaria, France, Germany, India, Italy, Poland, Romania, Russia, Turkey and the United Kingdom
- **Website:** <http://paris.ifj.edu.pl/>

### SCIENTIFIC OBJECTIVES

PARIS is a calorimeter dedicated to the detection of gamma radiation emitted in nuclear fusion-evaporation, fusion-fission, deep inelastic or transfer reactions. It will be particularly well-suited to the detection of gamma rays characterised by a wide range of energies and multiplicities. It will be used to study Jacobi phase transitions, shape transitions, giant dipole resonances in hot nuclei and reaction mechanisms. PARIS will also be used in various facilities: GANIL, ALTO, IFJ PAN (Krakow, Poland), LNL-INFN (Legano, Italy), TIFR (Mumbai, India).

### RESOURCES DEPLOYED

The basic element of the PARIS calorimeter, the "phoswich", consists of two bonded crystals read by a photomultiplier. The first crystal, based on a new generation scintillator - LaBr<sub>3</sub>:Ce, LaBr<sub>3</sub>:Ce+Sr or CeBr<sub>3</sub>, is cubic in shape with sides of 2.5 cm. These new materials have significantly improved the energy resolution of inorganic scintillators while maintaining very good time resolution. The second crystal, based on a NaI:Tl scintillator, is used to increase the detection efficiency of high energy (>10 MeV) gamma radiation. In its 4π version, PARIS will be composed of about 220 phoswiches that can be assembled in different geometries.

**40** laboratories involved

**< 1** nanosecond resolution

**15** participating countries

**220** elements assembled in 4π configuration

**40%** photoelectric efficiency at 1 MeV

### IN2P3 CONTRIBUTIONS

- Definition of the chemical composition of the basic element of PARIS, the "phoswich".
- Manufacture of LaBr<sub>3</sub>:Ce crystals.
- Assembly of the 2 types of crystals.
- Encapsulation.

### OTHER FRENCH LABORATORIES INVOLVED

Irfu (CEA Saclay)

**2011 - 2012**  
Prototype phase

**2012**  
Demonstrator goes into production

**2018**  
Use of PARIS in partial configuration in experiments

**2022**  
2Pi detector with 12 clusters

**2025**  
Objective to reach a 4Pi detector with 24 clusters