

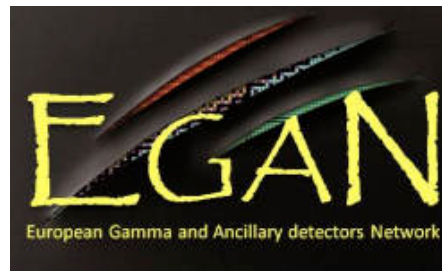
# Overview of the PARIS Project

**I. Matea**

- IPN Orsay -

on behalf of the PARIS collaboration

(<http://paris.ifj.edu.pl>)



## The PARIS project:

→ Part of the SPIRAL2 Instrumentation Project



**Title: High-energy  $\gamma$ -rays as a probe of hot nuclei and reaction mechanisms**

Spokesperson(s) (max. 3 names, laboratory, e-mail - please underline among them one corresponding spokesperson):

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Jean-Pierre Wieleczko, GANIL, [wieleczko@ganil.fr](mailto:wieleczko@ganil.fr)

## PARIS design concepts:

Design and build high efficiency detector  
consisting of 2 shells (or 1 shell)  
for medium resolution spectroscopy  
and calorimetry of  $\gamma$ -rays in large energy range

→ Based on state of the art scintillators

→ Compatible with other SPIRAL2 (and more) instruments: EXOGAM2, AGATA, NEDA, GASPARD

## Design based on Physics cases and Theory Background WG report

LoI physics cases + Coulex below the barrier + Nuclear astrophysics

- ~ 0 <  $\beta$  < 10%**
- $E_\gamma$  up to 40MeV with  $\Delta E_\gamma/E_\gamma \sim (3-5) \%$
  - $\Delta \Sigma_\gamma^{sum}/\Sigma_\gamma^{sum} < 5\%$  and  $\Delta M_\gamma \sim 4$
  - $\Delta T_{of} < 1ns$
  - high efficiency
  - angular coverage  $\sim 2\pi$  up to  $4\pi$
  - ancillary detectors : large variety (Ge's, scintilators, HI detector...)
- fusion-ER,  
fusion-fission,  
multifragmentation
- sym/asym  
direct/inverse  
kinematics

## Shell structure with intermediate beam energies - relativistic Coulex

- 20% <  $\beta$  < 60%**
- $E_\gamma \in [1-4MeV]$  with  $\Delta E_\gamma/E_\gamma \sim (3-5) \%$
  - $\Delta T_{of} < 1ns$
  - high efficiency
- two-step  
fragmentation
- Lesser adapted to high recoil velocities**
- mandatory recoil analyzer (A, Z, v)

(Courtesy of C. Schmitt)

*Since EGAN 2011 (Padova, 27-30 June 2011) ...*

**Last PARIS status report – September 2011**

→ Progress on Detector, Mechanics, Simulation and Electronics WG reported

**SAC Recommendations – September 2011**

→ closer work with Saint Gobain to improve quality control and performance repeatability

→ SAC&SC congratulates PARIS for the validation of the phoswich concept:

2" LaBr<sub>3</sub>(Ce) + 6" NaI(Tl) read by a PMT

→ need of an MoU

**MoU signed – January 2012**

→ between IN2P3, GANIL, COPIN, IFIN-HH and Turkey

→ signed for financing 5 clusters of 9 phoswichs each : PARIS Demonstrator

**Bormio 21<sup>st</sup> of February 2012 : last PARIS open meeting and GANAS kickoff meeting**

→ Started the work on the new organization of the collaboration (on the basis of the MoU)

→ Phoswich problems ...

→ GANAS NupNET – 3 years joined R&D for PARIS and CALIFA collaborations

**Orsay TANDEM-ALTO PAC – March 2012**

→ Accepted proposal for the first in-beam testing of the PARIS prototype (1 to 2 clusters)

**Report on possible experiments to characterize PARIS (April 2012) – PARIS web page**

## Work Packages:

**1. Physics cases and Theory background:** C. Schmitt (Lyon), I. Mazumdar (TIFR)

### **New Letter of Intent for IPN ORSAY ALTO PAC (March 2012)**

#### **Measurement of prompt gamma rays from fission fragments**

J.N. Wilson<sup>1</sup>, M. Lebois<sup>1</sup>, B. Leniau<sup>1</sup>, I. Matea<sup>1</sup>, P. Halipre<sup>1</sup>, G. Georgiev<sup>2</sup>, J. Ljungvall<sup>2</sup>,  
S. Oberstedt<sup>3</sup>, A. Oberstedt<sup>4</sup>, R. Billnert<sup>4</sup>

**2. Geant4 simulation:** O. Stezowski (Lyon)

**3. Detectors:** O. Dorvaux (Strasbourg)

**4. Mechanical design scenarios:** D.Jenkins (York), S. Courtine (Strasbourg)

**5. Electronics:** P. Bednarczyk (Krakow)

**6. Connections to other detectors:** M. Rousseau (Strasbourg)

## Simulation WG

One of the most advanced work done for PARIS, but still work in progress on:

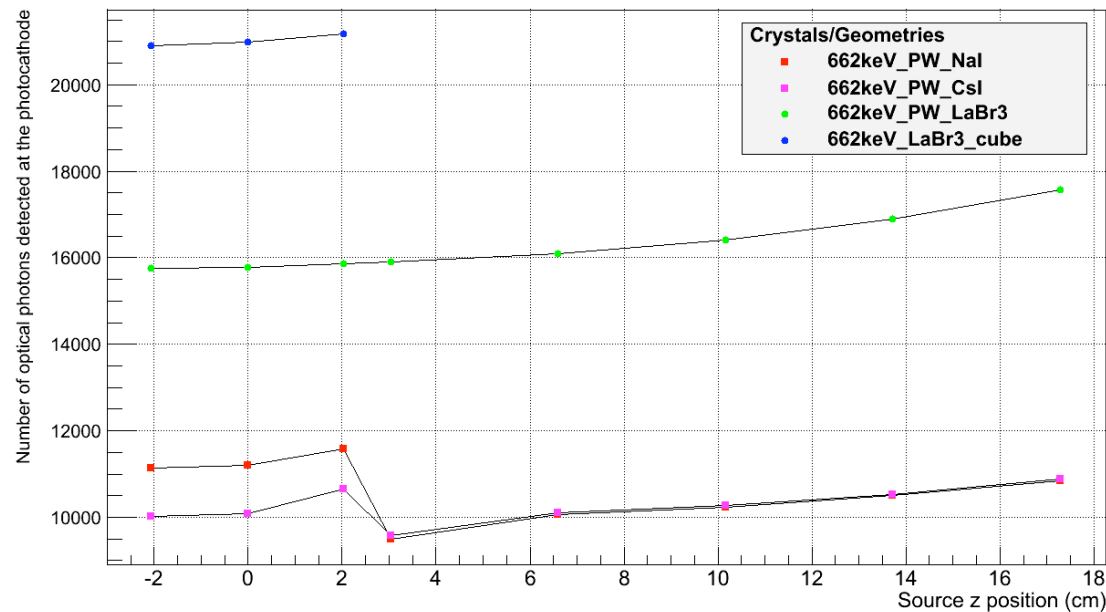
- physics generators implementation in GEANT4 (Krakow, Poland)

MC Cascade based external event generators for GEANT4, possible exchange of MC Cascade with GEMINI++ due to the possibility of better treatment of fission process

Internal GEANT4 (dedicated classes) fission – evaporation event generator is being tested

*(M. Ciemala presentation in Bormio, February 2012)*

- light collection in the phoswich (IPN Lyon, France, ongoing...)



Energy resolution degradation from 3% to 4.3% from simulations (very similar to the measurements)

*(Courtesy of X. Fabian, IPNL)*

## Detector WG (I)

- 5 phoswichs tested by the collaboration (3 Poland, 2 France)
- PMT validation: Hamamatsu R7723-100
- 4 more phoswichs ordered by India (2 already received)

	Energy resolution (%) - PM R7723-100					Energy gated Timing Resolution (ps)	
PWNaI A0_209	6.8 ET9815B		4.3	4.6 ET9815B		700	400
PWNaI M001	4.3	6.5- 7	4.5			389 @662	241 @1332
PWNaI M002	4.7	7.5- 8	4.8	3.4	5.3		
PWNaI A1504			4.5				
PWNaI A1544			4.6				

*(Olivier Dorvaux et al., Report from Detector WG – April 2012)*

## Detector WG (II)

→ 9 more phoswichs ordered by France + PMTs for the read-out (December 2011)

→ Bormio – February 2012 : all first 5 phoswichs showed aging signs : yellow spots on the crystals, worsened E resolution ...

3 of the phoswichs were returned to Saint Gobain for analysis (March 2012) and ordering process put in standby

→ Result: *“Today we think that we have identified the right assembly process together with the right housing which is the same thickness of 0.5 mm aluminium but space application quality”* (Saint Gobain)

→ “Repaired” phoswichs should be returned to the collaboration by end of July

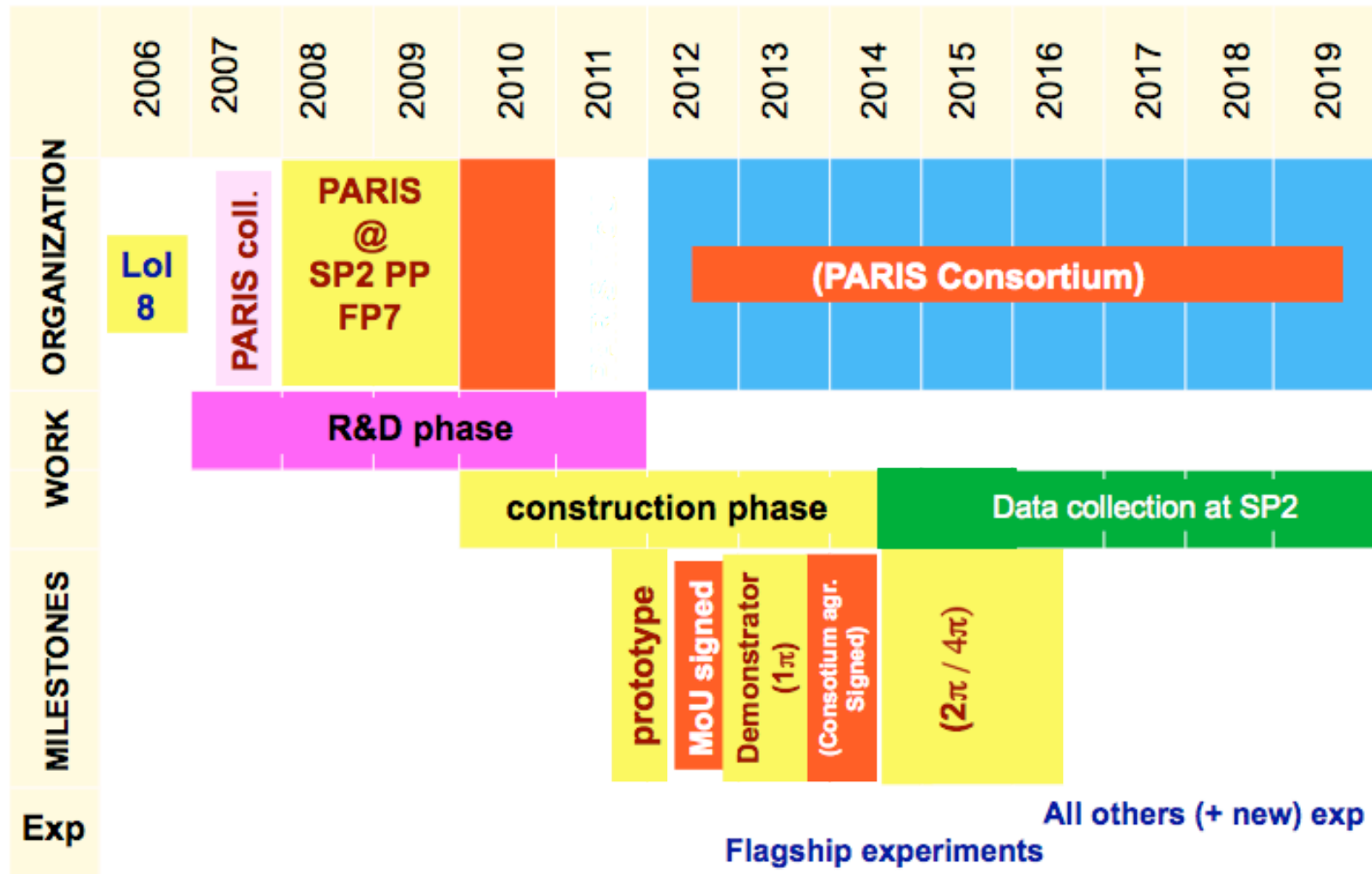
Hope to have at least an equipped cluster by the end of the year for in-beam cluster characterization in Orsay ....

**Next step :**

**Determine the response function of the cluster**



## “Preliminary” time schedule :



## Many thanks to :

A. Maj, M. Kmiecik, M. Ciemała, K. Mazurek - **Kraków**

J.P. Wieleczo, D. Lebhertz, Ch. Schmitt - **GANIL**

D. Jenkins, O. Roberts - **York**,

F. Azaiez, G. Hull, M. Josselin, I. Matea, M. Niikura, J. Peyré, J. Pouthas, A. Scarpaci,  
T. Zerguerras - **Orsay**

A. Chietera, S. Courtin, O. Dorvaux, J. Dudek, Ch. Finck, M. Rousseau – **Strasbourg**

M. Csatlos, Z. Dombradi – **Debrecen**

I. Mazumdar, D.R. Chakrabarty, V. Nanal, A.K. Gourishetty – **BARC&TIFR Mumbai**

J. Strachan – **Daresbury**

A. Smith – **Manchester**

K. Hadyńska, P. Napiórkowski - **Warsaw**

+ ...