

# GASPARD status and PARIS

Wilton Catford (Surrey)  
on behalf of Didier Beaumel (IPN Orsay)



Annual PARIS collaboration meeting, HIL Warsaw, 25-26 January 2018

# DREB 2018

# DIRECT REACTIONS with EXOTIC BEAMS

## Matsue, Japan, June 4-8, 2018

The topics will include the subjects relevant to Direct Reactions.

- Spectroscopy of exotic nuclei, such as drip-line and unbound nuclei
- Shell structure and its evolution
- Bulk properties and collective excitations
- Nuclear astrophysics
- Nuclear force
- Advances in direct reaction theory
- New instrumentation for direct reaction studies

Local Organizing Committee:

Chairs: T. Nakamura (Tokyo Tech.), K. Ogata (RCNP, Osaka U)



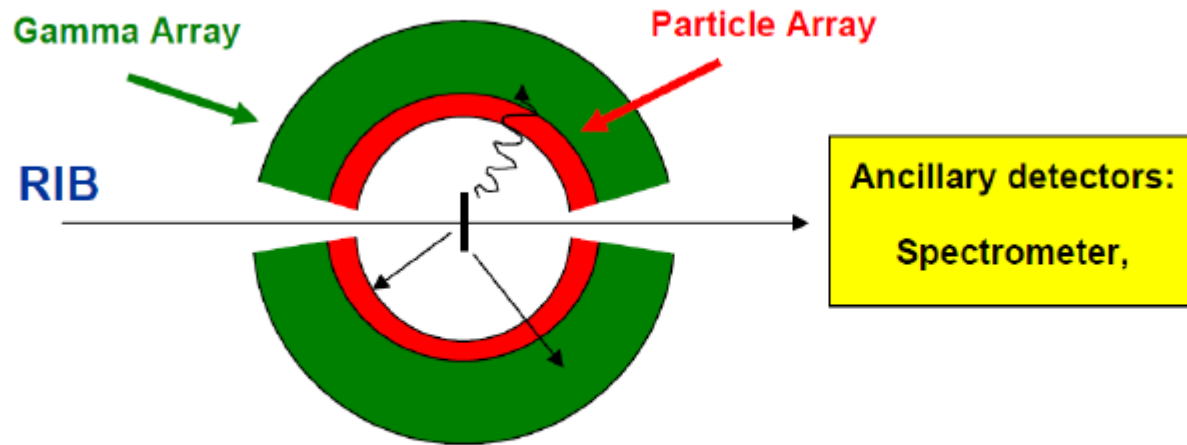
The Conference jointly organized by School of Science, Tokyo Institute of Technology, RCNP, Osaka University, and also supported by RIKEN Nishina Center and CNS, University of Tokyo.

DREB2018

Search

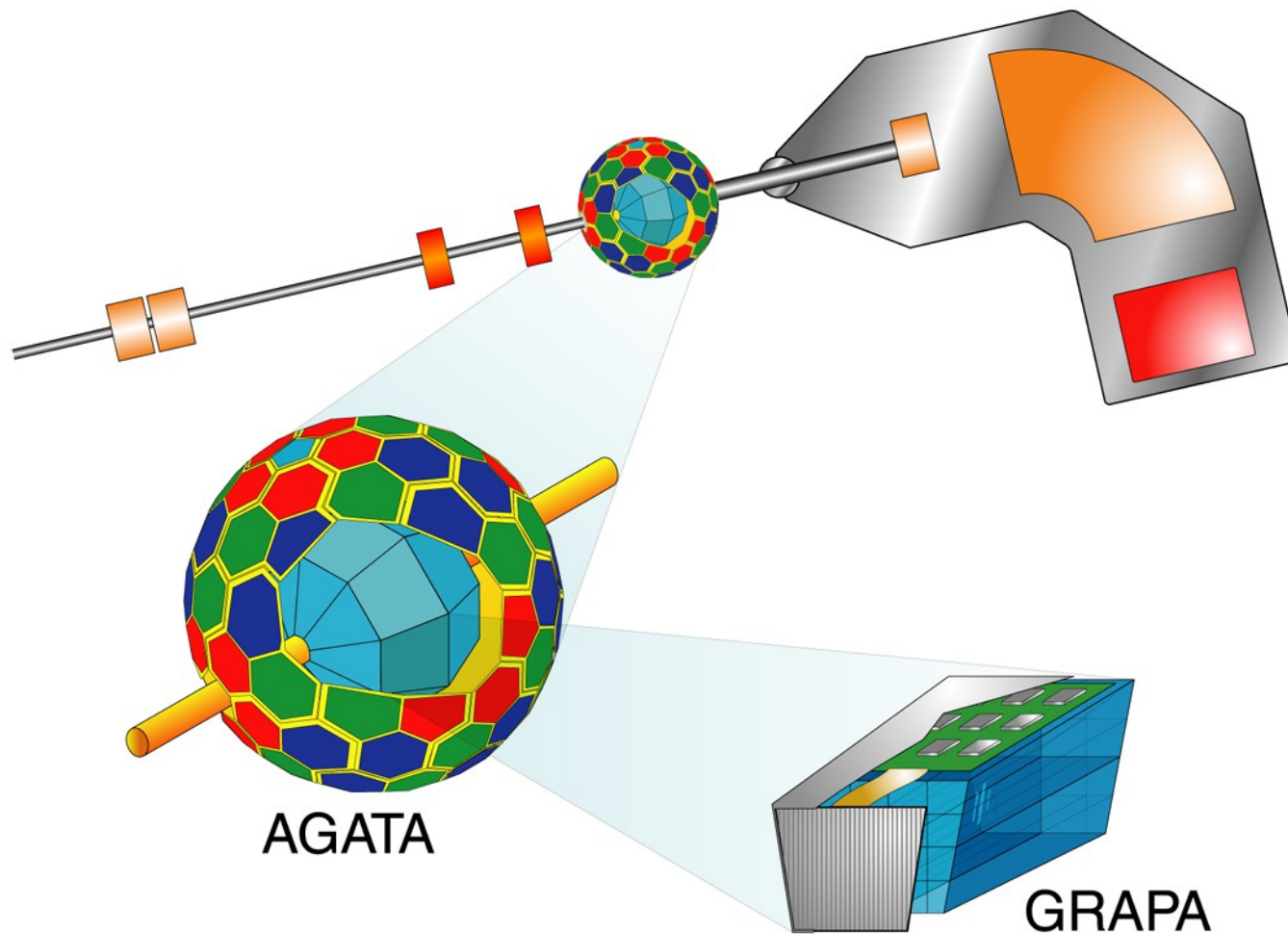
Contact: [ml-dreb2018-contact@rcnp.osaka-u.ac.jp](mailto:ml-dreb2018-contact@rcnp.osaka-u.ac.jp)

# HISTORY – 2001



The starting point was the GRAPA concept as developed initially for EURISOL, wherein a second detector shell is used to detect both charged particles and gamma-rays.

# HISTORY – 2004

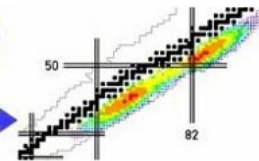


AGATA

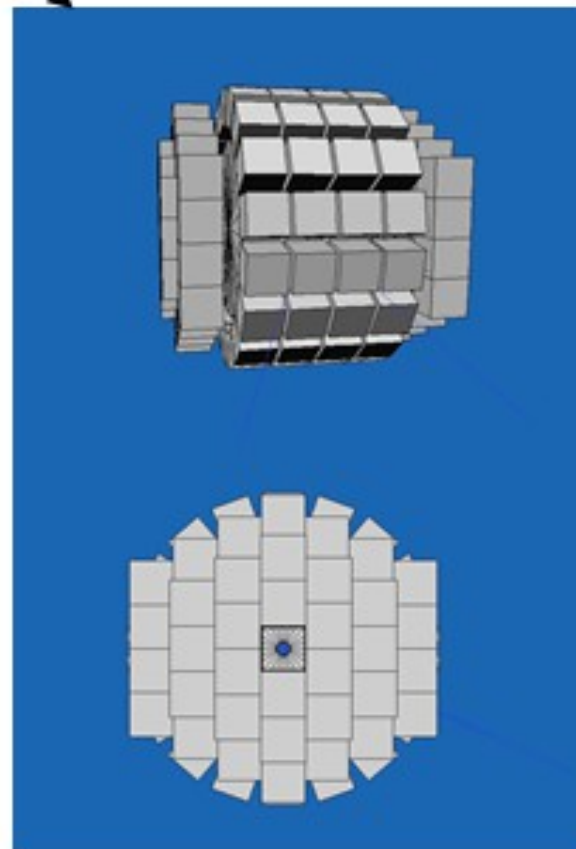
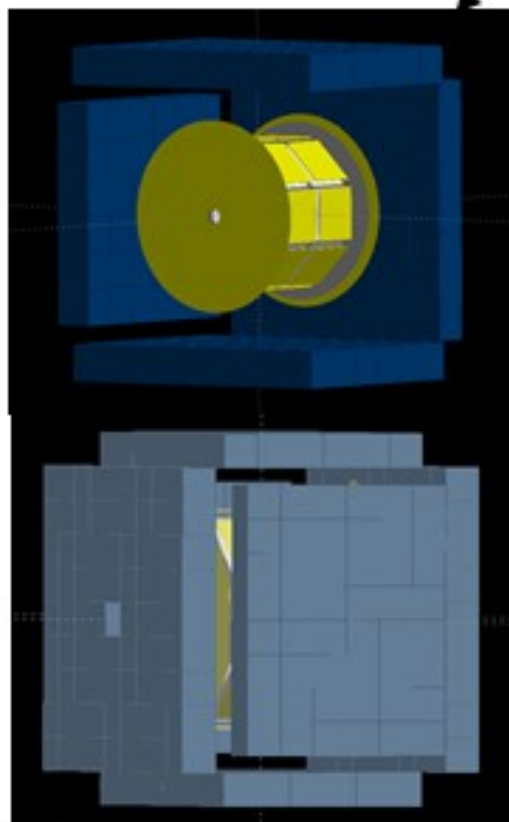
GRAPA

# HISTORY – 2010

*Spiral2*  
Preparatory Phase



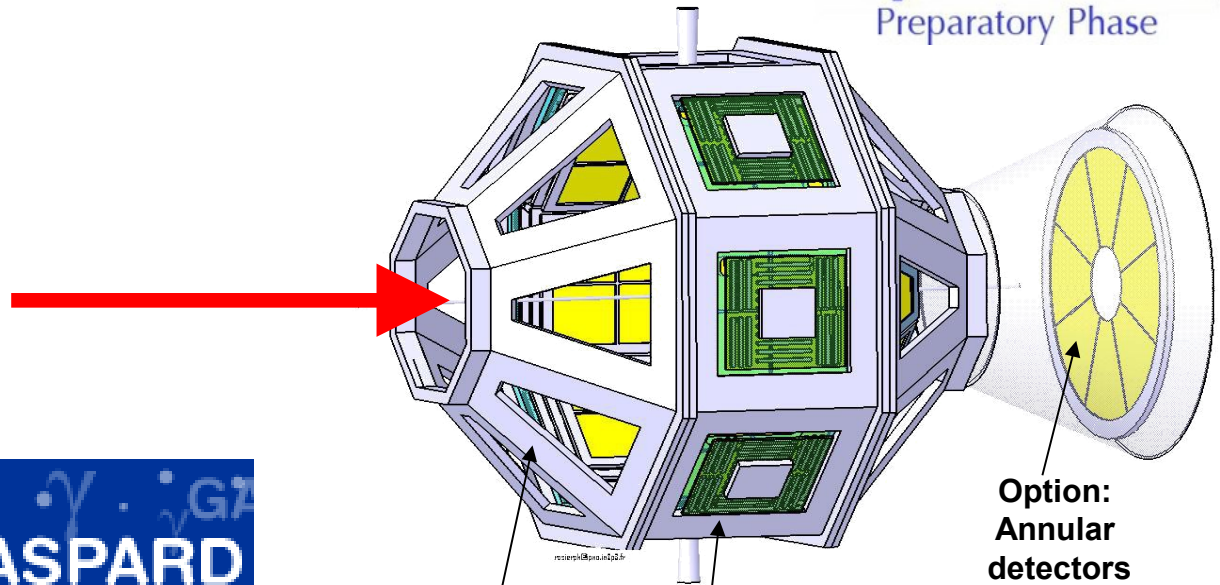
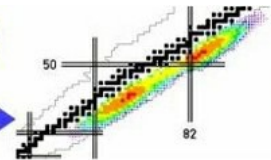
Tiara-like geometry for GASPARD  
+ 2 different layouts of LaBr crystals (2"x2"x2")



- Barcelona Jan. 2010

# HISTORY – 2011

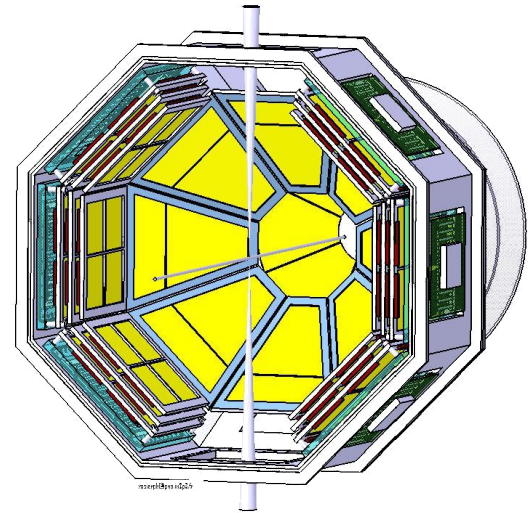
*Spiral2*  
Preparatory Phase



Central barrel

Trapezoidal shapes for end-caps

Details – angle gaps, mounting... tractable but still being addressed – there are many levels of design Work to be done and plenty of opportunities

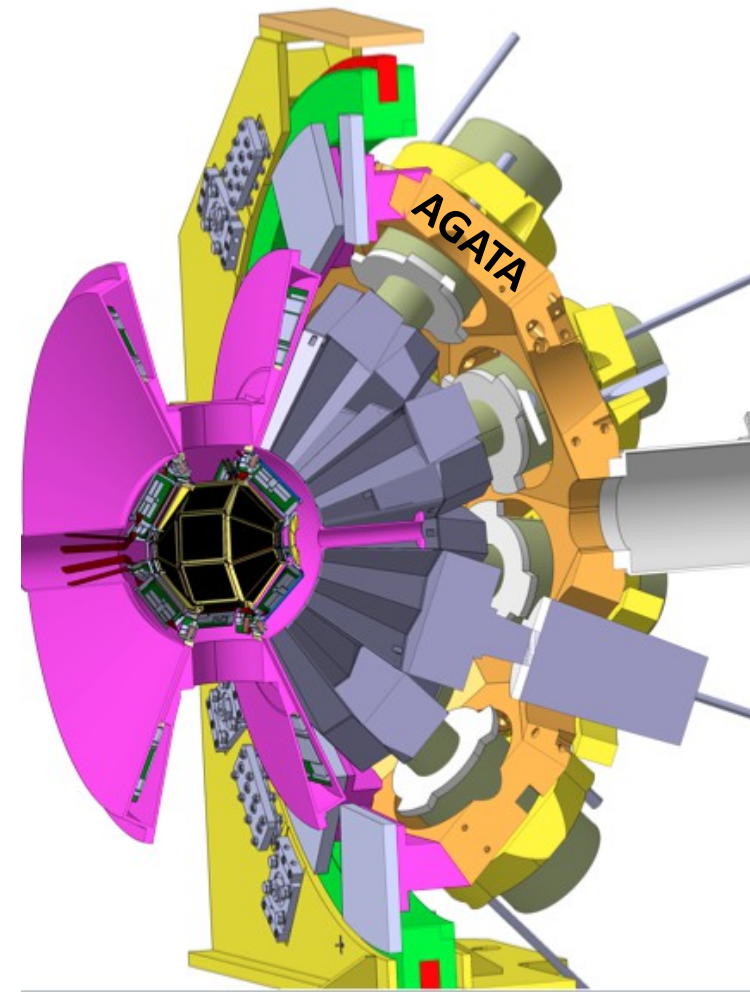
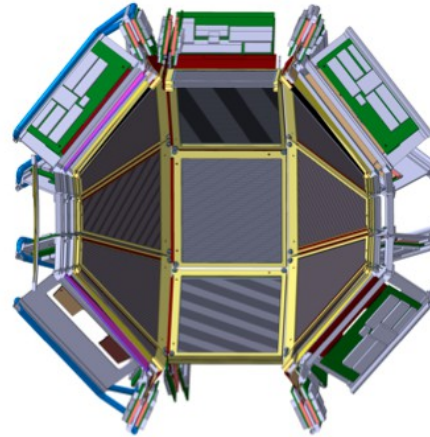
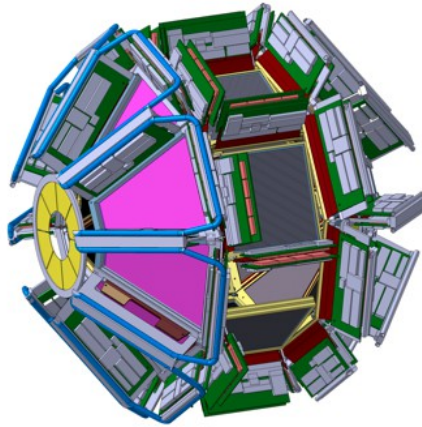


# GRIT project

(Granularity, Resolution, identification, Transparency)  
(GASPARD-TRACE collaboration)

TODAY– 2017

$4\pi$  Si array fully integrable in AGATA & PARIS



- › High efficiency for particles and gamma-rays
- › High granularity (strip pitch < 1 mm)
- › Large dynamical range
- › 0.5 + 1.5 + 1.5 mm thick DSSD's (forward hemisphere)
- › 0.5 + 1.5 mm DSSD's (backward hemisphere)
- › Special targets (Cooled  $^3\text{He}$ ,  $^4\text{He}$  gas cell, pure H, tritium)
- › PID using Pulse Shape Analysis techniques
- › New Integrated electronics

# MUGAST

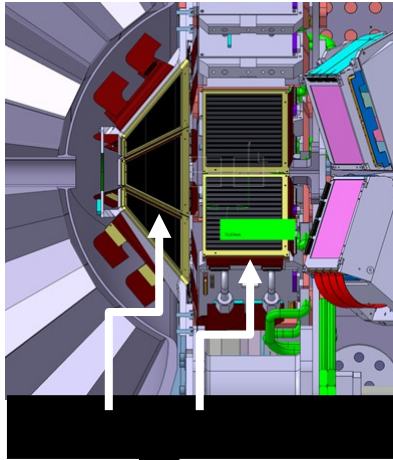
“TODAY” – 2019

*A step towards the ultimate array GRIT*

**MUGAST:** - New detectors of GRIT + MUST2 electronics

- Coupled with AGATA @ VAMOS

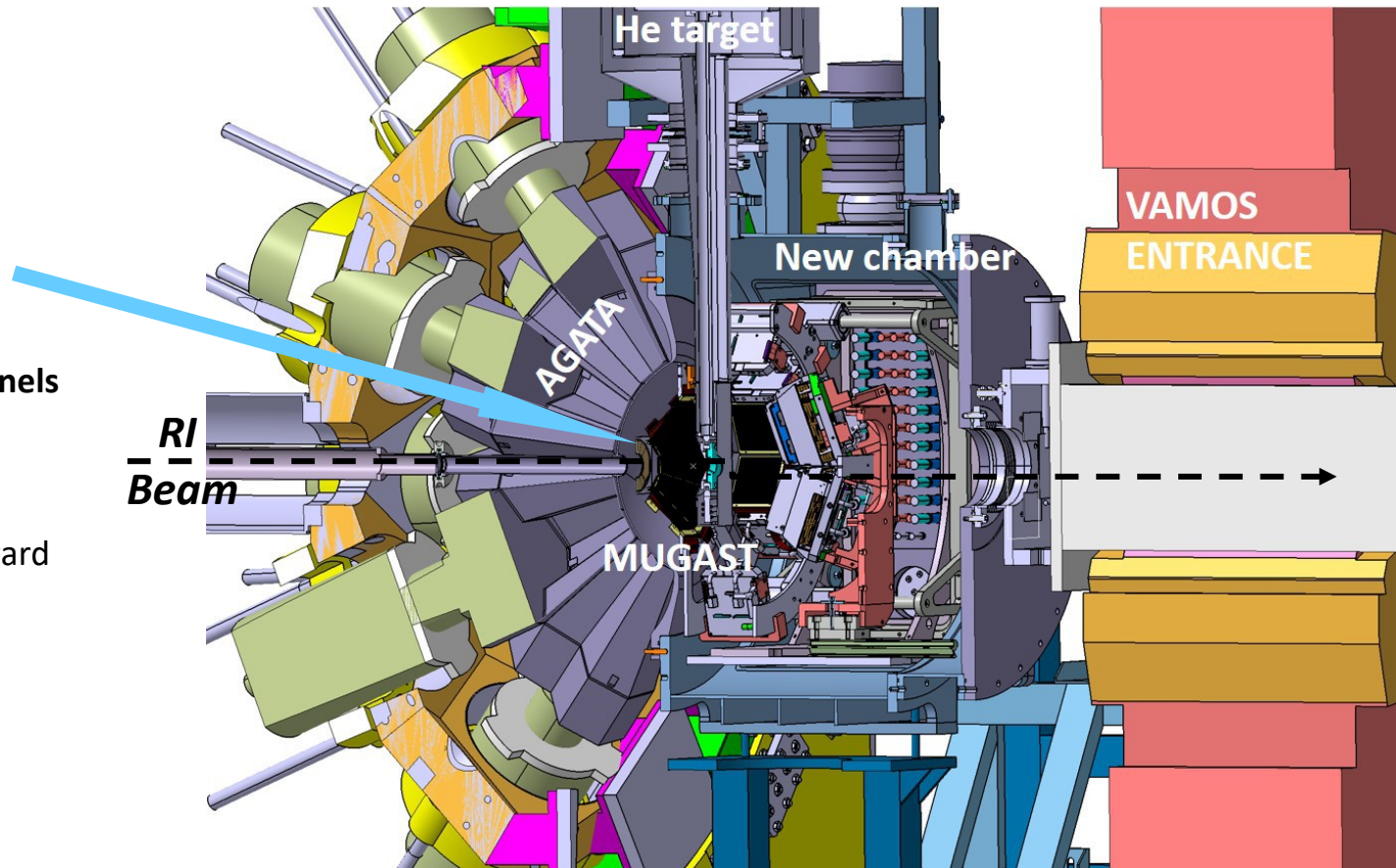
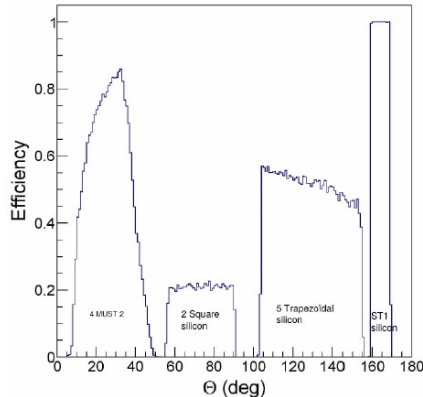
⇒ **First High resolution studies (new SPIRAL1 beams)**



~ 3000 channels

**MUGAST configuration:**

- 5 trapezoids backward
- 2 Squared around 90deg.
- 4 MUST2 telescopes forward



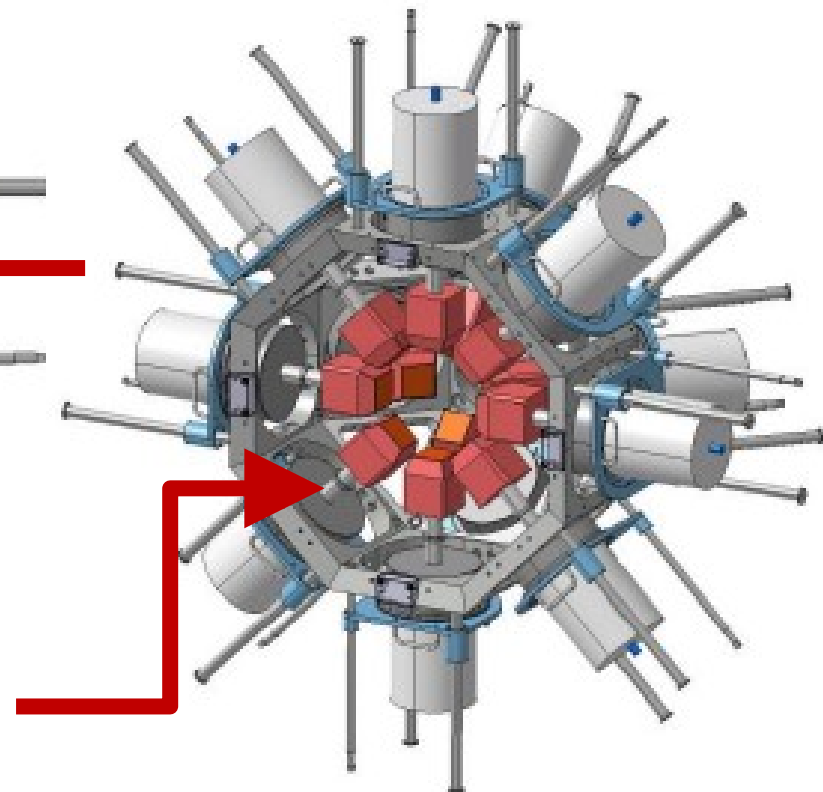
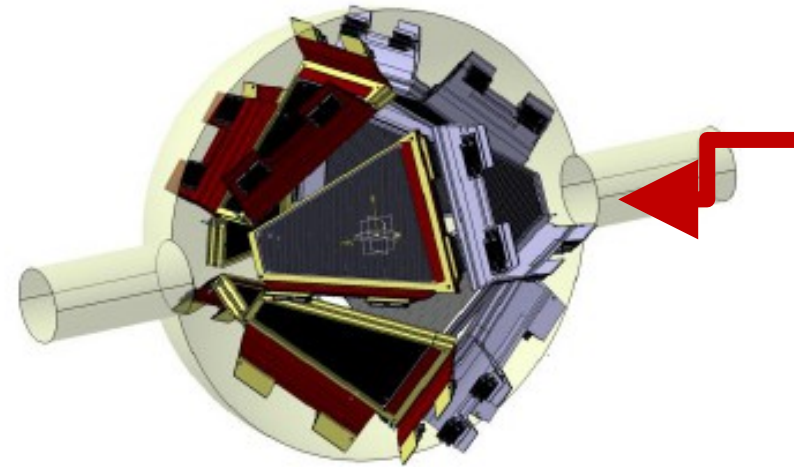
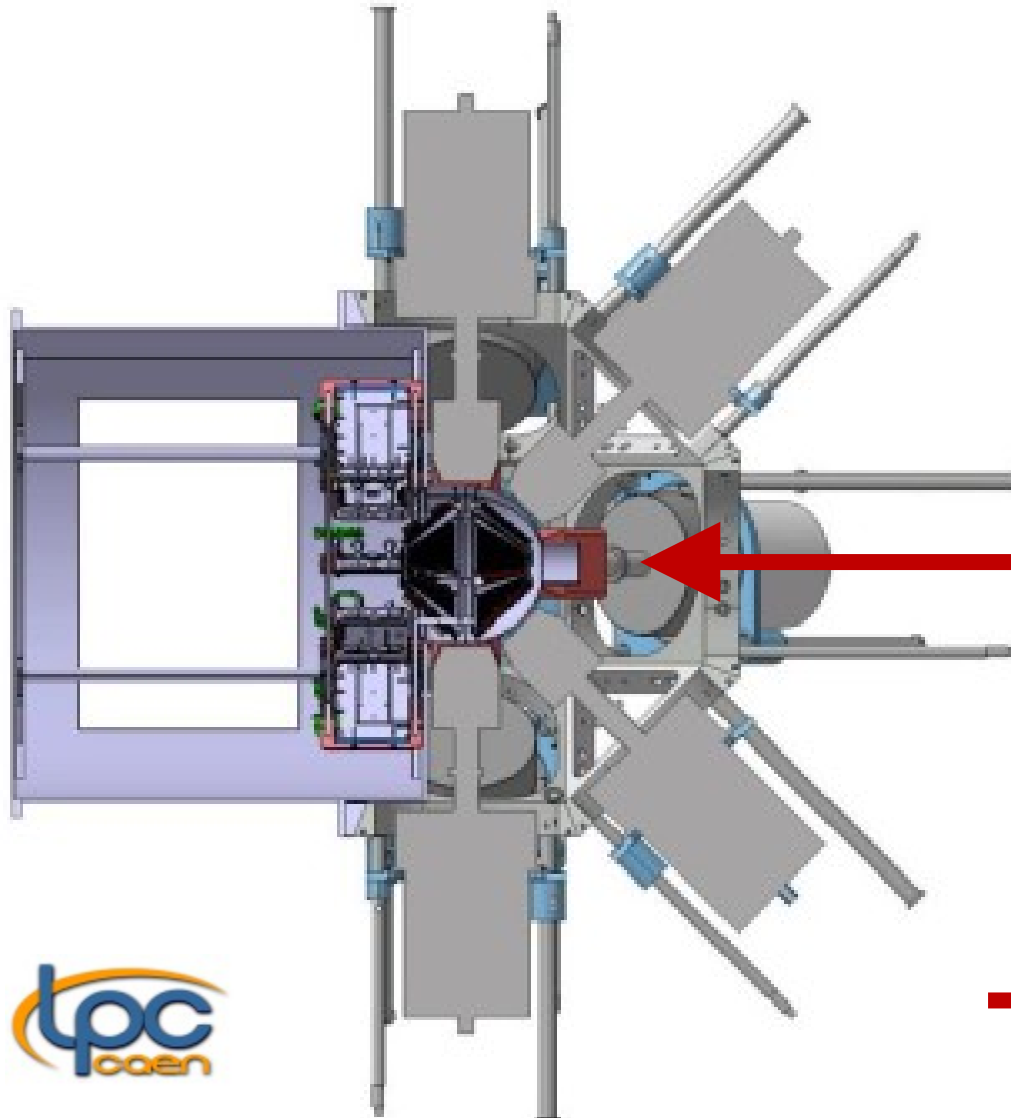
AGATA efficiency : ~ 8% at 1.3 MeV

**First Campaign foreseen in (early) 2019**



# TOMORROW- 2020

MGL – MUST-GASPARD-LISE



# Physics with MUGAST

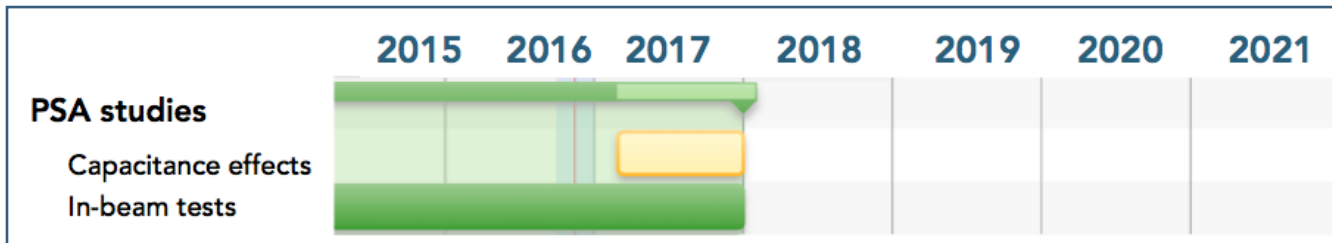
*2 dedicated workshops organized at Orsay and Padova*

- Shell structure and shape evolution
  - Mapping of neutron orbitals around N=28 *F.Flavigny, O.Sorlin et al.*
  - Oblate driving force in n-deficient nuclei above 56Ni *A.Goasduff, D.Mengoni, et al.*
  - Shape transition along and across N=28 *L.Fortunato, D.Mengoni et al.*
  - Interplay of single-part and collective structures in 46Ca *S.Leoni, B.Fornal et al.*
  - Shell evolution toward the island of inversion *A.Matta, W.Catford, N.Orr, et al.*
  - Shape coexistence in Kr isotopes *A.Matta, W.Catford, et al.*
  - Island of Inversion and shape coexistence in 30,31Mg *B.Fernandez-Dominguez et al.*
  
- Neutron-proton pairing
  - np-pairing in fp-shell *M. Assie et al.*
  
- Astrophysics
  - Breakout from hot CNO to rp process *C.Diget, N.de Séreville et al.*
  - Explosive H-burning in Novae *N.de Séreville, F.Hammache et al.*
  - Surrogate method for s-process reactions *G.de Angelis et al.*
  
- Reaction dynamics
  - Space-time characterization of emitting sources in HI collisions  
*G. Verde, A.Chbihi, Q.Fable et al*

Mostly stripping reactions

# PSA studies for GRIT

J. Duenas et al, NIMA 2012  
 J. Duenas et al, NIMA 2013  
 B. Genolini et al, NIMA 2013  
 J. Duenas et al, NIMA 2014  
 D. Mengoni et al, NIMA 2014  
 M. Assié et al, EPJA 2015



## Light particle discrimination @ Tandem-ALTO Orsay:

Z=1 : BB13+PACI+MATAcq --> discrimination down to 2.5 MeV

*M. Assié et al., EPJA (2015)*

Z=2 : BB13+ PACI+WaveC → good discrimination 3He/4He

*M. Assié et al., in prep.*

## Best observable for PSD :

At depletion -> **Raw data** : maximum of the current signal ( $I_{max}$ )

At nominal bias -> **Filtered data** : Haar filter + Time over Threshold

## Electronics specifications :

ADC sampling rate : > 200MHz

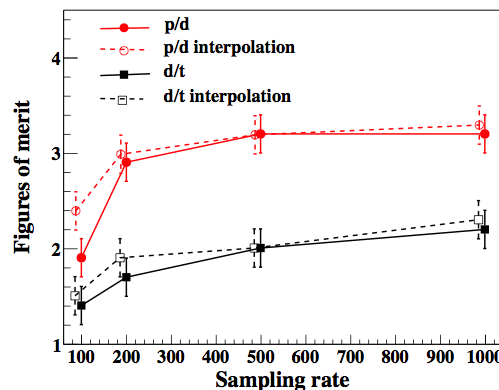
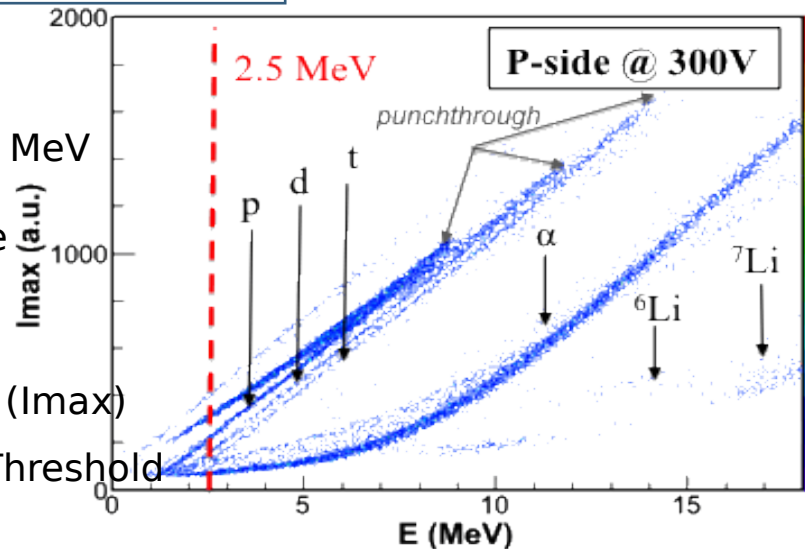
Noise study

Time resolution needed

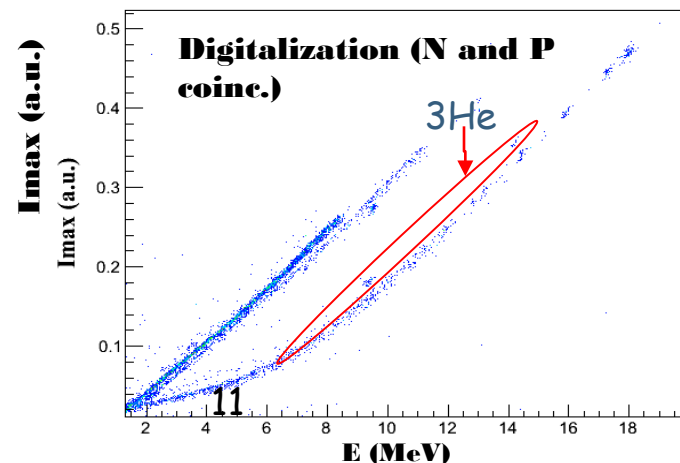
## To be investigated :

Capacitance effect

Radiation/damage effect



From M.Assié



# MUGAST-AGATA Lol's&proposals

## 2015

Single Lol submitted including a list of reactions

### PAC comments:

The PAC found the proposition of combining MUGAST+AGATA with VAMOS compelling, and it was clear that much progress had already been made in realising this ambition, with significant development of the instrumentation. The aim to deliver a campaign around transfer reactions (including stripping) was well received as it was believed that this should be a core component of the future scientific programme of GANIL, building on the rich heritage of the programme that the present collaboration has led. The PAC is therefore supportive of this development and it would seem that the best course of action is to present this proposition to the GANIL Scientific Council as directed by the GANIL Director.

## 2016

“Umbrella” Lol + 7 Physics Lol's submitted

### PAC comments:

#### **Summary**

The science programme described by the Lols was strong. In particular the PAC recognises the opportunity that the combination of MUGAST, VAMOS and AGATA presents and it suggests that this programme be made a priority for future calls for proposals.

## 2017

Two proposals submitted, one accepted with highest priority.

# MUGAST STATUS

ITEM	STATUS	Funds
<b>DETECTORS</b>		
GRIT Trapezoids proto (x2)	Commissioned	IPNO
GRIT Trapezoids pre-serie (x5)	Commissioned	Surrey, IPNO, Santiago
GRIT Squared proto (x2) + Thick proto	Commissioned	INFN Padova
Annular (x1) th = 500um	Available	
MUST2 (x4)	Available	
<b>ELECTRONICS</b>		
MUST2 FEE new boards (Boards + ASICs)	Commissioning ongoing	IPNO
Kaptons connectors (serie)	designed, to be ordered	INFN/Padova
Outer cables & feedthroughs	To be ordered	GANIL/IPNO
Inner cables	Available	
<b>MECHANICS &amp; TARGET</b>		
New reaction chamber	Available	Surrey/IPNO
Cooling blocks	Ordered	GANIL
Helium cryogenic target	Ongoing(*)	IPNO

(\*) Timeline: 12/2018 if funded

## Software aspects

- New FEE control (GECO) to be implemented (timeline: end of 2018) for MUST2 electronics
- DAQ coupling scheme (MUGAST-AGATA-VAMOS) defined and ready to be implemented

Technical aspects of the 1st MUGAST-AGATA @ VAMOS were reviewed in recent ICC workshop

<https://indico.in2p3.fr/event/16368/>

# Collaboration

- IPN Orsay , CEA Saclay, GANIL, LPC Caen (France)
- INFN Univ. of Padova, INFN-LNL Legnaro , INFN Univ. of Milano (Italy).
- Univ. of Huelva, Univ. of Santiago de Compostella, Univ. of Valencia (Spain)
- Univ. of Surrey, STFC Daresbury (UK)
- BARC, Mumbai (India).

# DREB 2018

# DIRECT REACTIONS with EXOTIC BEAMS

## Matsue, Japan, June 4-8, 2018

- The topics will include the subjects relevant to Direct Reactions.
- Spectroscopy of exotic nuclei, such as drip-line and unbound nuclei
  - Shell structure and its evolution
  - Bulk properties and collective excitations
  - Nuclear astrophysics
  - Nuclear force
  - Advances in

**ABSTRACTS NOW DUE – 31 JANUARY**



... direct reaction studies

Organizing Committee:  
Chairs: T. Nakamura (Tokyo Tech.), K. Ogata (RCNP, Osaka U)

The Conference jointly organized by School of Science, Tokyo Institute of Technology, RCNP, Osaka University, and also supported by RIKEN Nishina Center and CNS, University of Tokyo.

DREB2018 Search

Contact: [ml-dreb2018-contact@rcnp.osaka-u.ac.jp](mailto:ml-dreb2018-contact@rcnp.osaka-u.ac.jp)