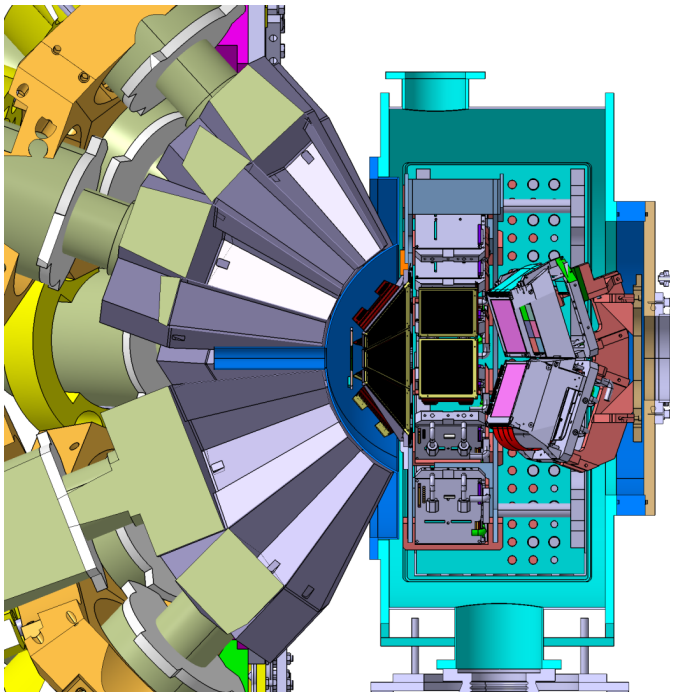
MUGAST



- *A step towards GRIT*
- *Physics case & LoI*
- *Integration : mechanics & detectors /specific targets*
- *Electronics*
- *Planning & campaign*

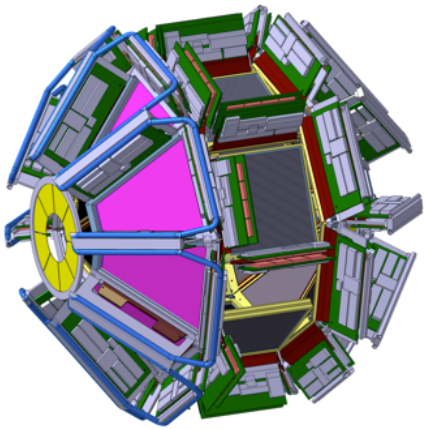
grit.in2p3.fr/mugast

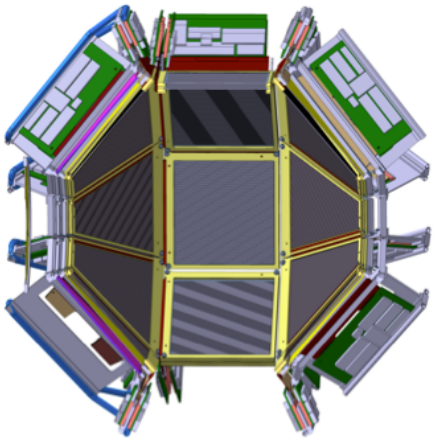
M. Assié, IPN Orsay, *assie@ipno.in2p3.fr*

GRIT : Granularity Resolution Identification Transparency

4π Si array fully integrable in PARIS/AGATA/EXOGAM2
IPN Orsay / INFN-LNL / LPC Caen / BARC Mumbai / University of Surrey

Direct reactions measurement and particle-gamma coincidence

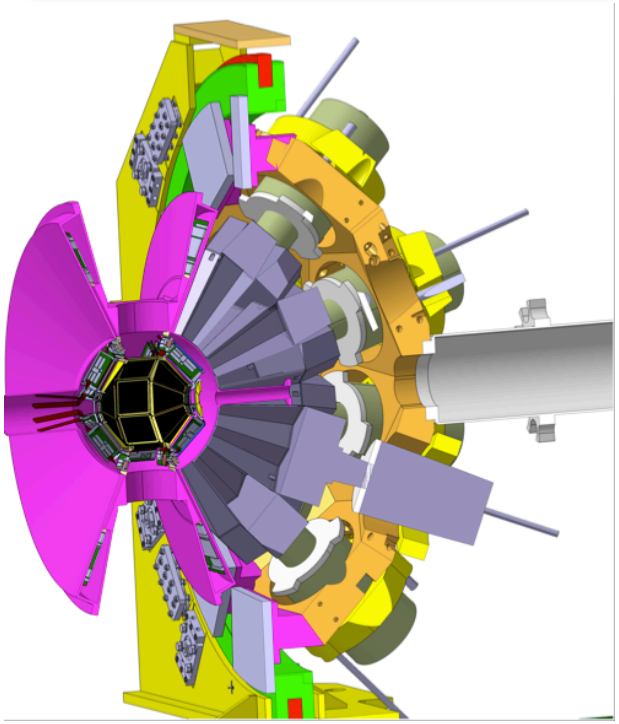




Physics cases :

13 LoI for Spiral2

. Shell evolution
. Pairing
. Clusters
. Near Barrier reactions
. Astrophysics



.Combination of **energy resolution (gamma) and good efficiency**

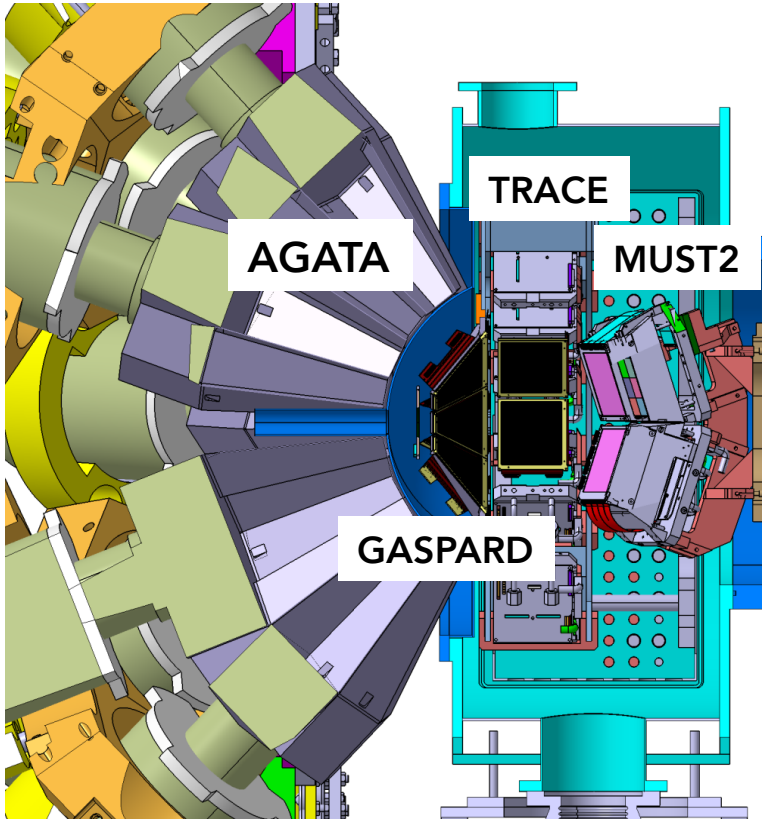
. Good **granularity** (pitch <1mm)

. **PSD** to identify low energy particles (1st layer)

. Integration of **special targets** (cryogenic ,Chymène…)

. **Integrated electronics** (iPACI, PLAS) designed by IPN & INFN Legnaro

MUGAST : a first step towards GASPARD



Campaign starting April 2019

- **New Spiral 1 beams** (low energy)

- **AGATA**
  . very high energy resolution
  . good efficiency : **13%** at1.3MeV in 2019 **@ 18cm**
  (depending on number of clusters)

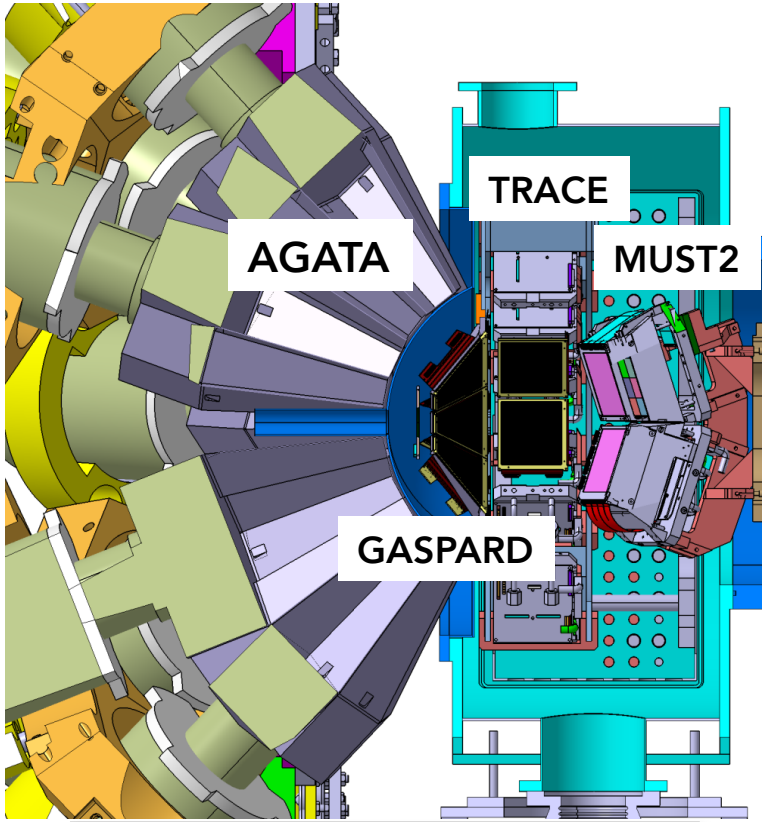
- **MUGAST**
  . one-layer of Silicon backward & 90 deg.
  --> **GRIT** detectors (5 trap. + 2 square)
  + **MUST2** (forward direction)
  → well-suited for stripping measurements
  . **existing electronics** (MUFEE+MUVI)
  . specific target (cryogenic)

- **VAMOS** : large acceptance spectrometer at 0 degree

AGATA efficiency (E_γ = 1.3 MeV)

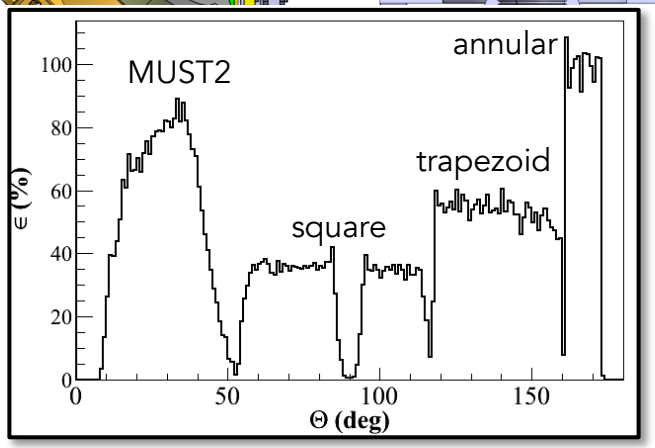
	2014/2015 (24 caps)	Now (32 caps)	2019 (45 caps)
D = 23.5cm	4%	5.3%	7.5%
D = 18cm		**8.5%**	**13%**

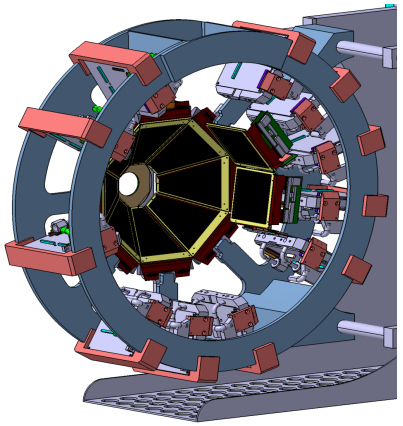
MUGAST : a first step towards GASPARD

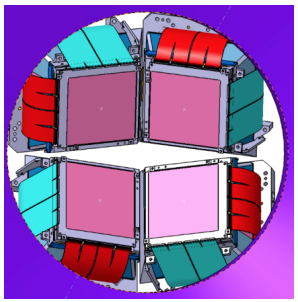


Campaign starting in April 2019

- **New Spiral 1 beams** (low energy)
- **AGATA**
  . very high energy resolution
  . good efficiency : 13% at1.3MeV in 2019 @ 18cm
  (depending on number of clusters)
- **MUGAST**
  . one-layer of Silicon backward & 90 deg.
  --> **GASPARD-TRACE** detectors (5 trap. + 2 square)
  + **MUST2** (forward direction)
  → well-suited for stripping measurements
  . **existing electronics** (MUFEE+MUVI)
  . specific target (cryogenic)
- **VAMOS** : large acceptance spectrometer at 0 degree







LoI for MUGAST

PAC 2015 & 2016

17 LoI submitted in the **"umbrella" LoI**

--> mainly stripping reactions (backward)
--> Spiral1 & Spiral1 new beams mostly

7 LoI submitted independently (Spiral1 beams)

Nuclear astrophysics

- **^{25}Al(^{3}He,d)** *(N.de Séréville, F. Hammache, IPNO)*
- **^{30}P(^{3}He,d) or (d,p)** *(N.de Séréville, F.Hammache, IPNO)*
- **^{79}Se(d,p)^{80}Se** *(G. de Angelis, INFN-LNL)*

Shell evolution

- **^{56}Ni(d,p)**(d,t) *(F.Flavigny, IPNO, O.Sorlin, GANIL)*
- **^{28}Mg(d,p)** *(A.Matta, W.Carford, University of Surrey)*
- **^{46,48}Ar(t,p)** *(D.Mengoni, University of Padova)*
- **^{67}As(^{3}He,d)** *(D. Mengoni, A. Goasduff)*

Clusters, pairing, correlations & others

- **^{56}Ni(^{3}He,p)(^{6}Li,α)** *(M.Assie, IPNO)*

Letters of Intent Presented to the GANIL PAC, June 2016

Summary

The science programme described by the LoIs 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.

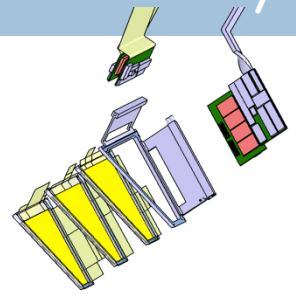
Scientific council of GANIL

In 2019, the priority has to be given either to the VAMOS stand-alone mode or to the MUGAST+VAMOS collaboration, provided that the construction of the MUGAST detector is completed in time.
In view of the large amount of time required to analyze AGATA data, the SC considers that much work still needs to be done to extract the science gathered in the first VAMOS + AGATA campaign and that, hence, a fruitful MUGAST + VAMOS + AGATA campaign would be most productive in 2019.

MUGAST Proposals & LoI

Reaction	Spokesperson	Comment
Accepted experiments		
$^{15}O(^{6}Li,d)^{19}Ne$	C. Diget, N. de Séréville	PAC 2017
$^{14}O(p,p')$	I. Stefan, F. de Oliveira	to be redone
Proposed experiment PAC 2018		
^{45}Ar (d,p) ^{46}Ar	A. Lemasson	
^{19}O (d,p) ^{20}O	E. Clément	DSAM
$^{47}K(t, ^{4}He)^{46}Ar$ or $^{46}Ar(^{3}He,d)^{47}K$	A. Gottardo	cryogenic target
^{14}O coulomb BU	D. Gupta	
$^{85}Kr(d,p)^{86}Kr$	F. Recchia	isomeric state (5h)
$^{46}Ar(d,p)^{47}Ar$	D. Mengoni	
$^{28}Mg(d,p)^{29}Mg$	A. Matta	new Spiral 1 beam
LoI		
$^{56}Ni(d,p)^{57}Ni$	F. Flavigny, O. Sorlin	
$^{56}Ni(^{3}He,p)^{58}Cu$	M. Assié	
^{69}Cu, ^{46}Ar, $^{49-50}Sc$ (t,^{4}He)	S. Bottoni	

Detectors for MUGAST

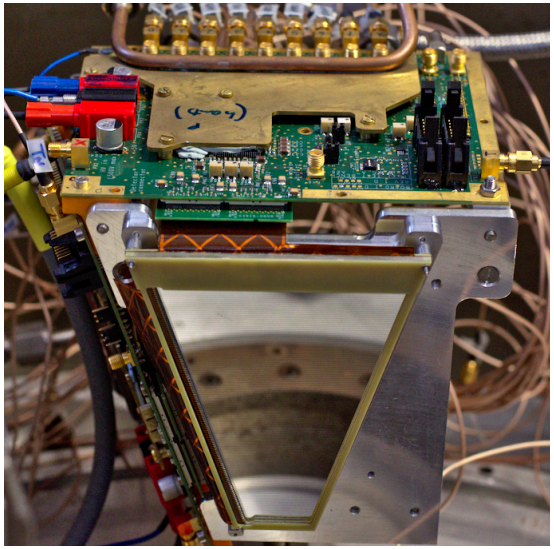


Trapezoidal DSSSD

Received from Micron : nTD, 4 deg. cut, 6 inches
- **2 prototypes 500 um** IPNO (june 2015)
- **3 pre-series** U. Surrey, Santiago, IPNO (feb. 2017)

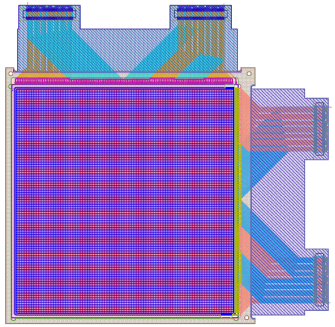
Test bench @ IPNO :
- numerical (iPACI): 9X+9Y
- analog (MUFEE) : 128X+128Y

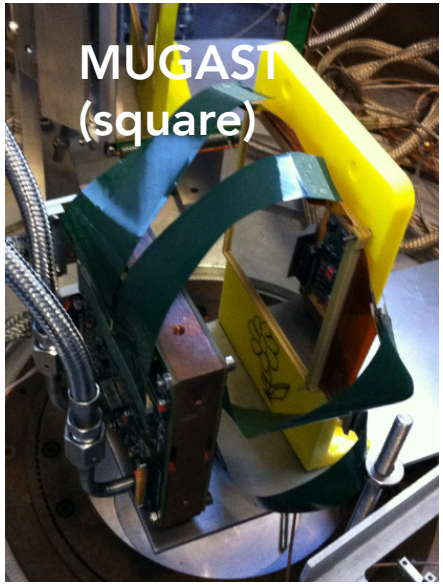
In-beam test @ ALTO
end of 2017.



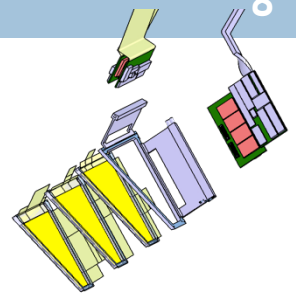
Squared DSSSD

Received from Micron Semiconductors :
- **2 prototypes** 500um INFN (beg. 2017)
- **1 prototype 1.5mm** INFN (beg. 2017)





Detectors for MUGAST



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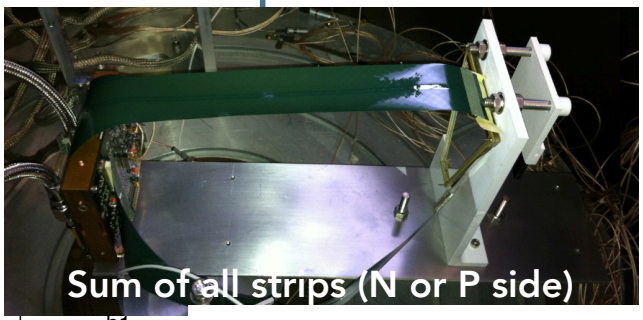
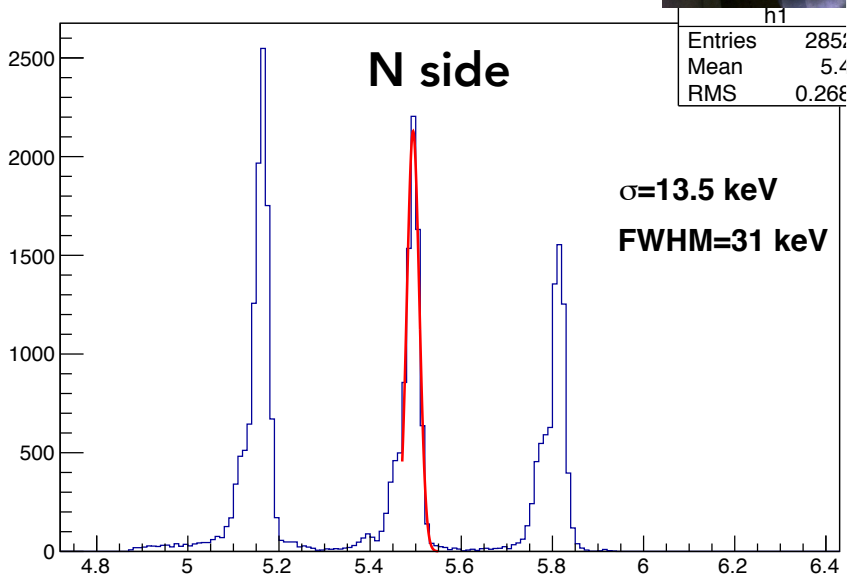
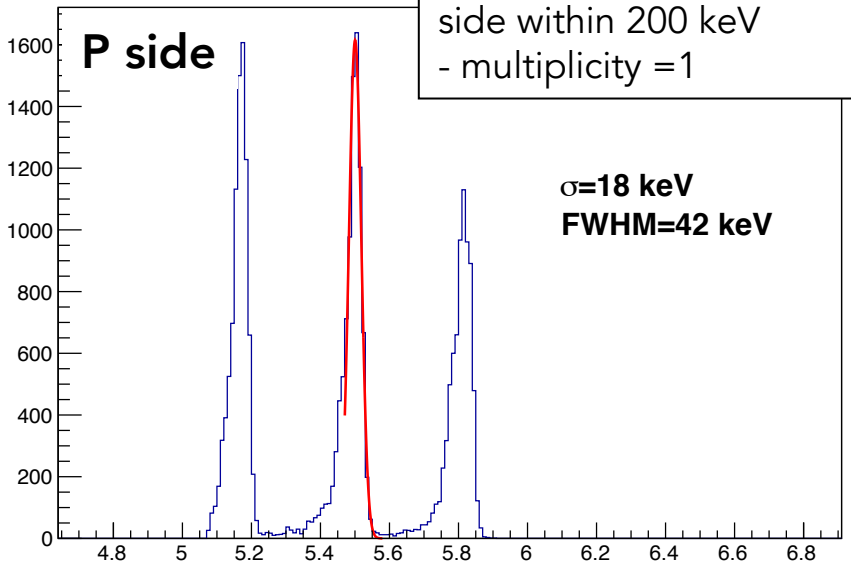
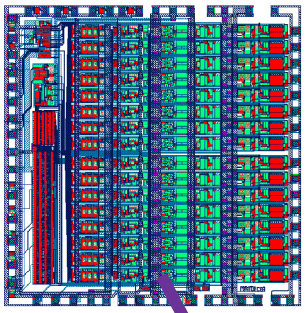






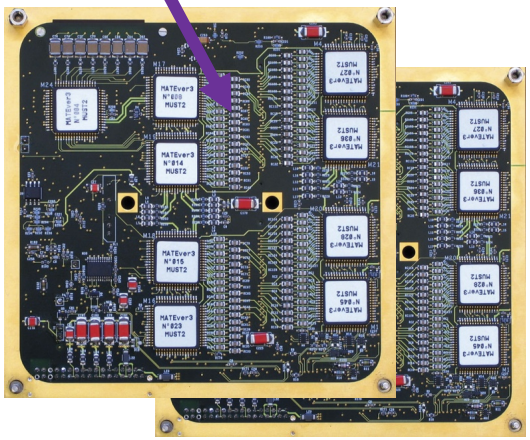
Conditions applied :
- same energy on both side within 200 keV
- multiplicity =1

Electronics for MUGAST



- 16 channels 28 mW/ch
- Energy & Time
- Si, Si(Li) and CsI
- Multiplexer
- I2C interface
- High linear. pulser
- T sensor

MOTHER BOARDS (IPNO)



MUFEE X & Y for 1 telescope

10 MUFEE pairs available for MUST2 (10 tel)

VACUUM | AIR

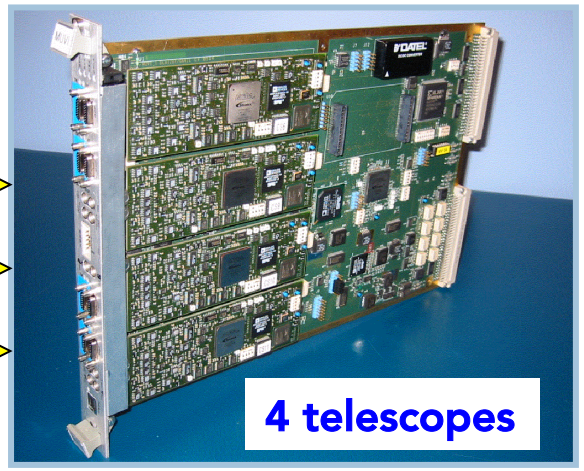
4 analog bus

Control signals

I2C bus

MUVI : VXI board (GANIL)

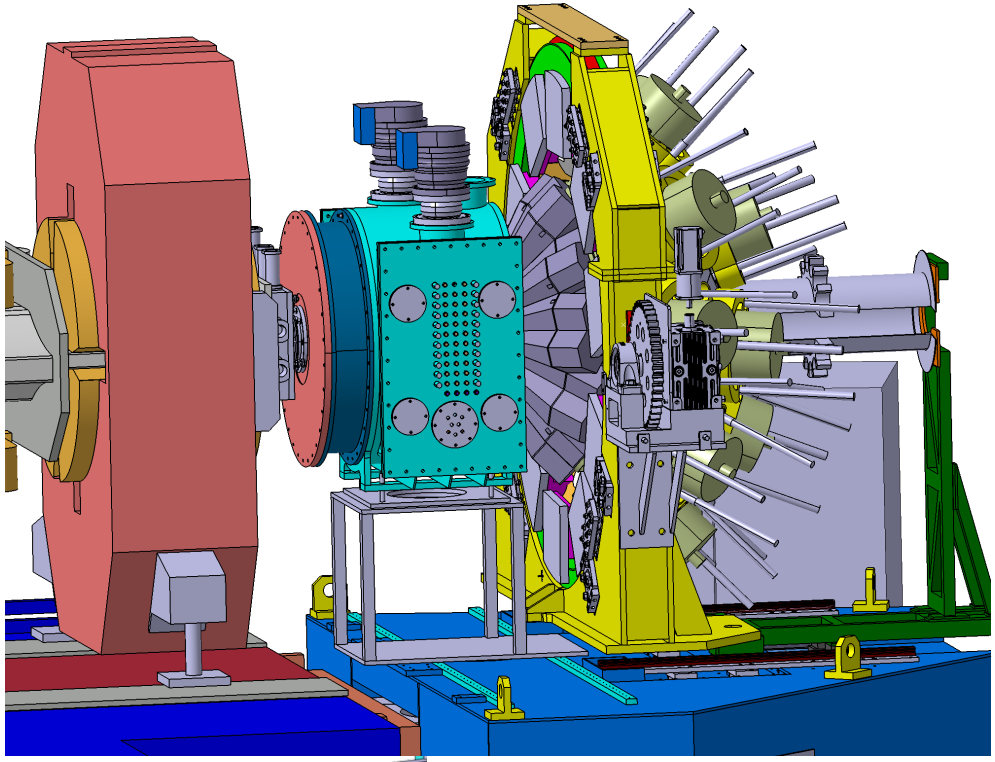
16 ADC14 bits
2.3K parameters
2MHz
Slow Control I2C
Pedestal substraction
DNL correction

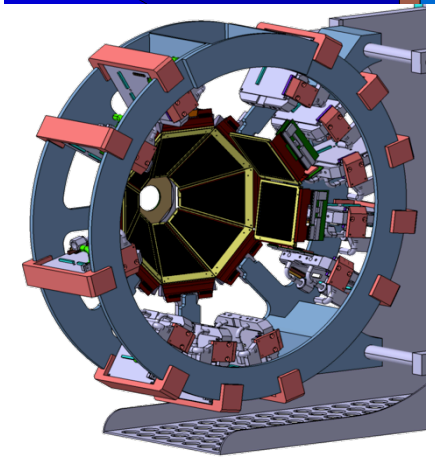


4 MUVI available for MUST2 (16 telescopes)

7 MUFEE pairs (X&Y) redone in 2016 (components & cabling)
tested with pulser at IPN Orsay in 2018
Coupling to be done at GANIL now !

Mechanics for MUGAST





Internal mechanics to hold electronics and detectors

Reaction chamber design :

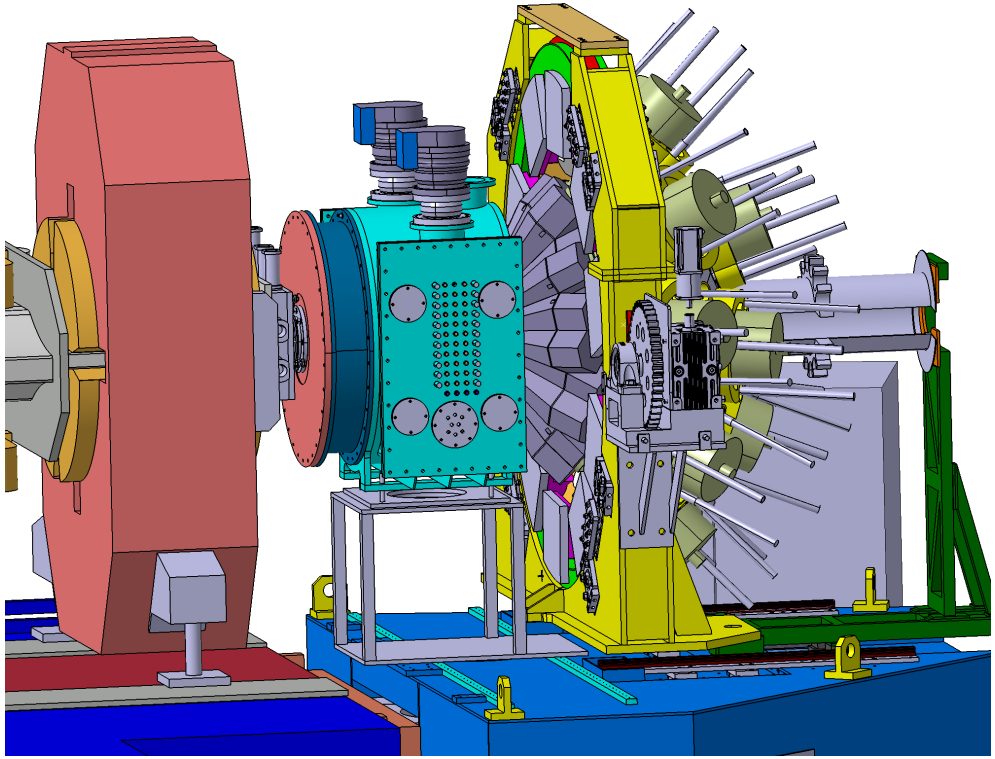
IPN by E. Rindel & L Vatrinet

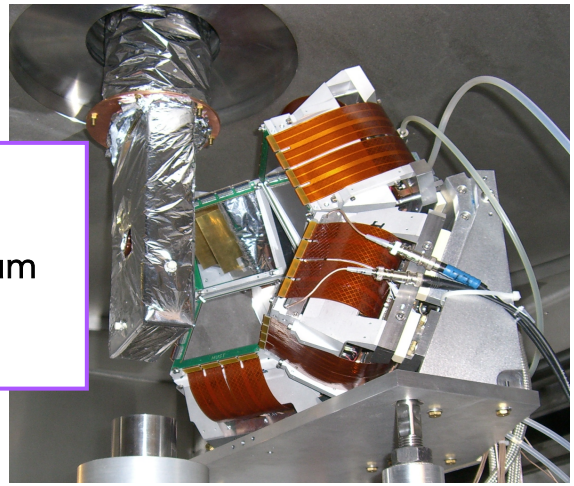
- 2 parts : main for GRIT
  extension for MUST2 (dark blue)
  with Vamos at 0 degree
- Mechanical support for detectors in order to maximize transparency

Mechanics for MUGAST

E. Rindel, J. Bettane IPN

Mechanics for MUGAST



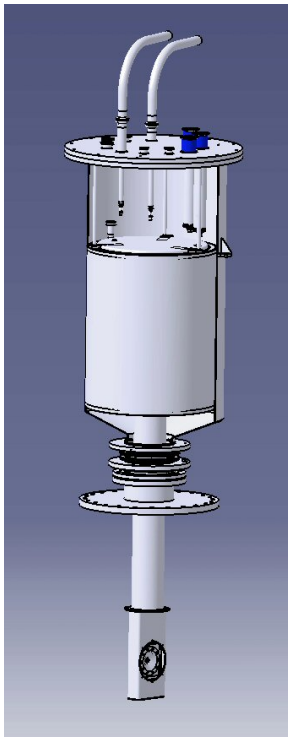


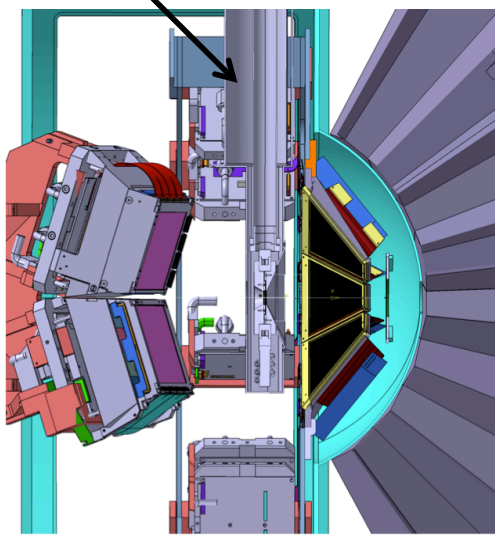
Ø 16 mm
3mm thick
Havar wind.=3.8um
T = 8.5 K
P = 1 bar

Reaction chamber design : done ! (2016)
- 2 parts : main for GRIT/MUGAST
extension for MUST2 (dark blue)

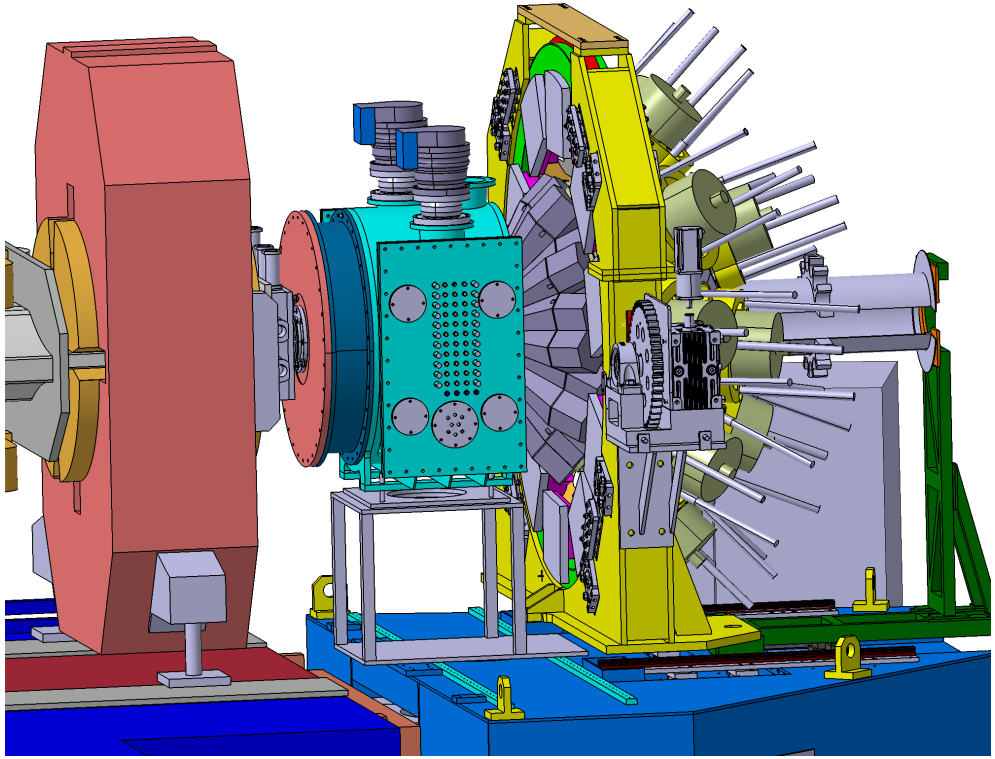
- Mechanical support for detectors in order to maximize transparency

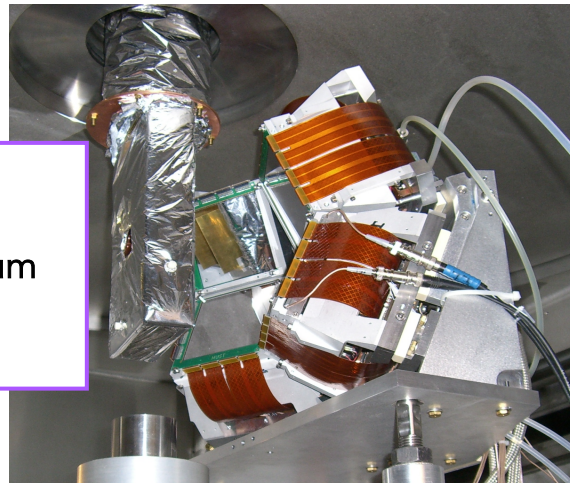
- integration of special target (cryogenic)
. redesign of existing target to fit
. conversion for ^{3}He (IPN – 2018)





Mechanics for MUGAST





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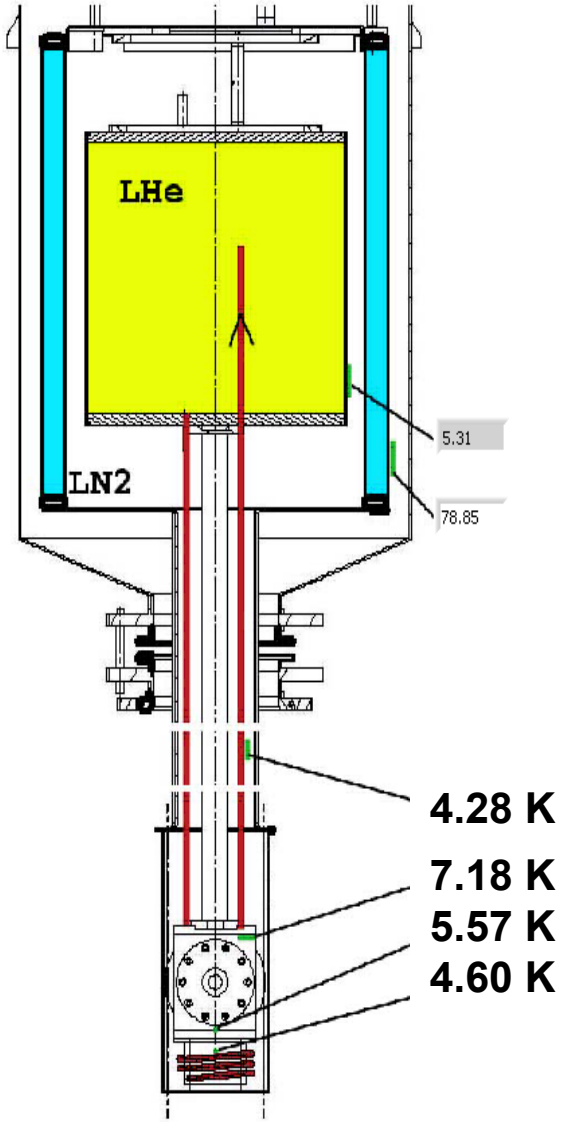
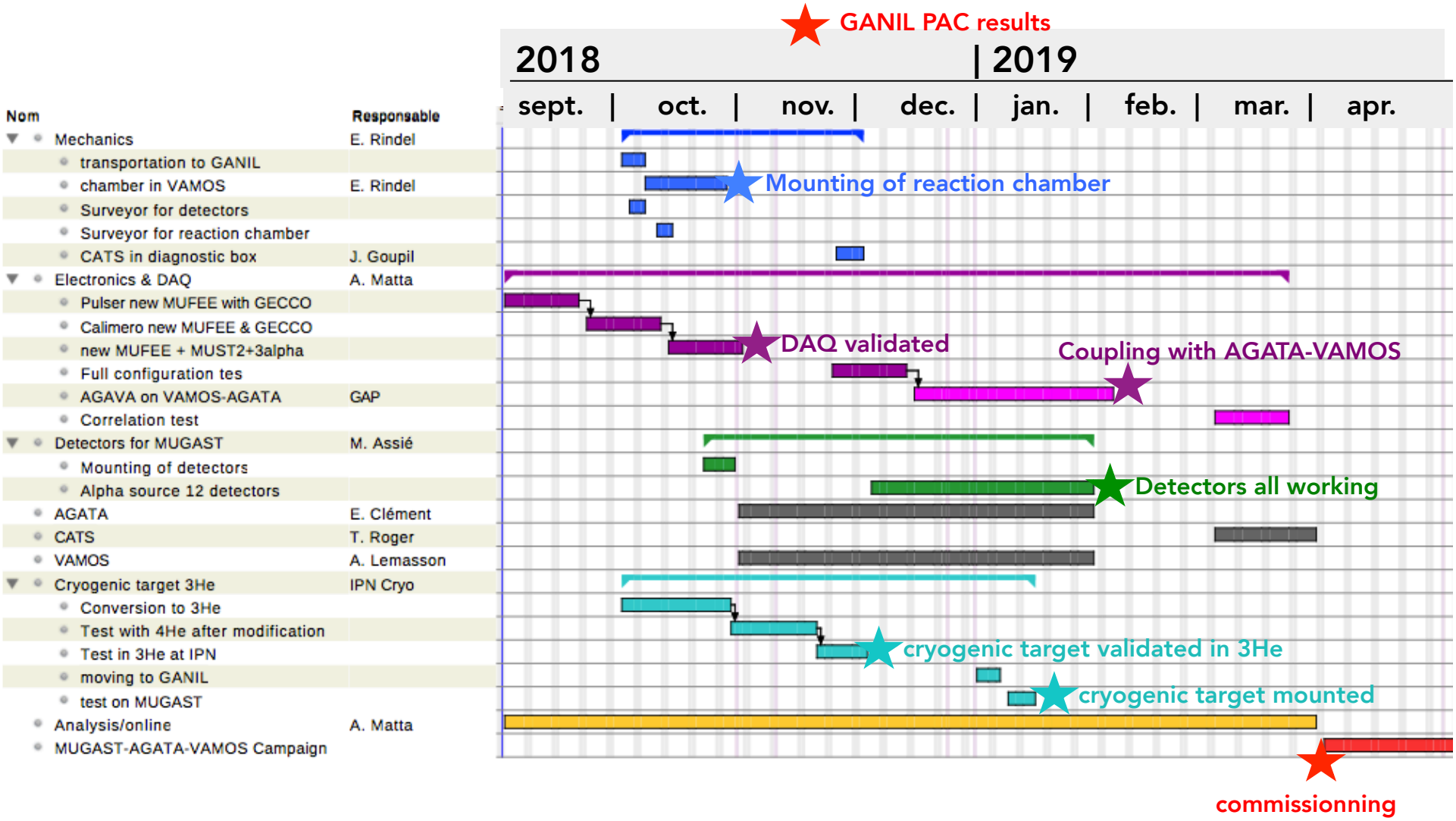


F. Galet, M. Pierens, H. Saugnac, IPN

Planning


GANIL PAC results
2018
| 2019
sept. | oct. | nov. | dec. | jan. | feb. | mar. | apr.
Nom
Responsable
Mechanics
E. Rindel
transportation to GANIL
chamber in VAMOS
E. Rindel
Surveyor for detectors
Surveyor for reaction chamber
CATS in diagnostic box
J. Goupil
Electronics & DAQ
A. Matta
Pulser new MUFEE with GECCO
Calimero new MUFEE & GECCO
new MUFEE + MUST2+3alpha
Full configuration tes
AGAVA on VAMOS-AGATA
GAP
Correlation test
Detectors for MUGAST
M. Assié
Mounting of detectors
Alpha source 12 detectors
AGATA
E. Clément
CATS
T. Roger
VAMOS
A. Lemasson
Cryogenic target 3He
IPN Cryo
Conversion to 3He
Test with 4He after modification
Test in 3He at IPN
moving to GANIL
test on MUGAST
Analysis/online
A. Matta
MUGAST-AGATA-VAMOS Campaign
Mounting of reaction chamber
DAQ validated
Coupling with AGATA-VAMOS
Detectors all working
cryogenic target validated in 3He
cryogenic target mounted
commissionning

Conclusion

- **AGATA-VAMOS-MUGAST campaign starting spring 2019**
  experiments submitted to the forthcoming PAC (Nov. 2018)
  campaign of 3 to 5 experiments foreseen.

  Mounting starts Oct. 2018
  Tests of detectors Dec. 2018
  Coupling with VAMOS-AGATA jan-fev 2018
  Commissioning : April 2019 ?

Visit our website : grit.in2p3.fr

- Cryogenic 4He/3He target will be available
- Tritium target will be ordered if proposals accep
- **Possibility to have a second campaign ?**
  more Spiral1 new beams available
  LoI for these new beams submitted