

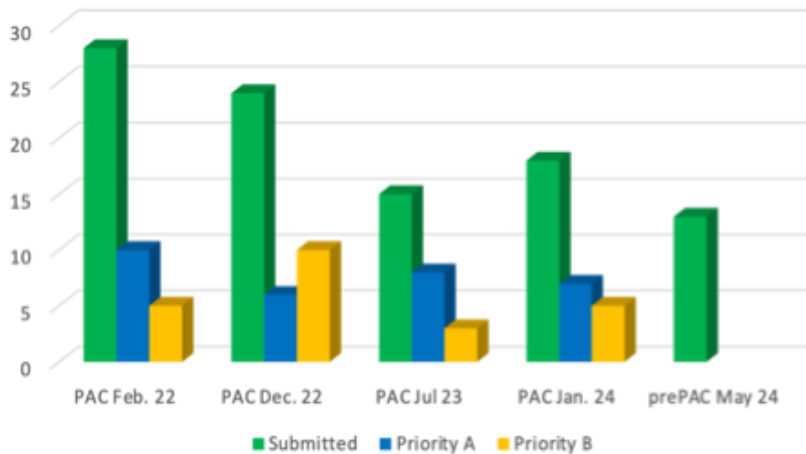


Sujet : AGATA AMB July 2024

Apologies: Valiente-Dobon,

LNL Status (J.J. Valiente-Dobon)

- Finalized the zero degrees conceptual design. Starting the executive designs and the production.
- For the last PAC (15th to 16th of July) we received 13 proposals only TANDEM. Below one can find the statistics for the previous years in terms of numbers of proposed experiments and number of approved priority A and B.



- The results of this PAC are:

Priority A:

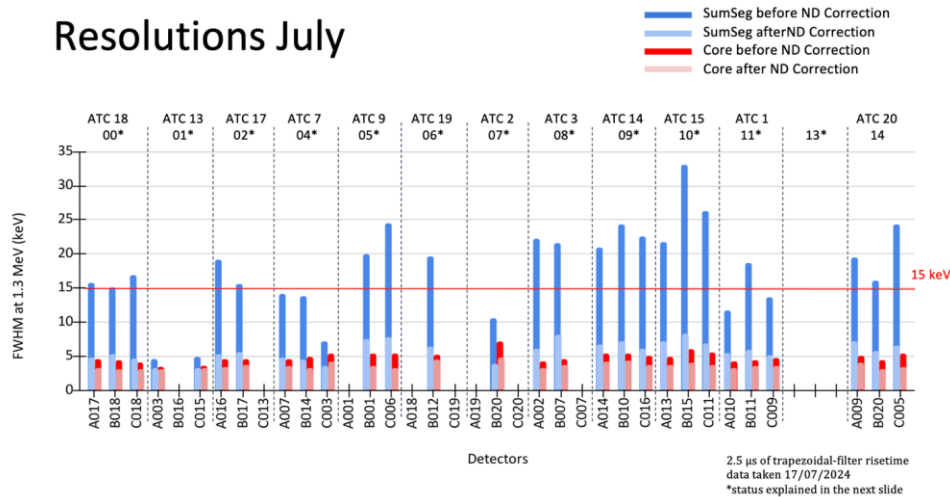
24.000	G.Corbari/S.Capra	2	Tandem
24.001	S.Chen	1(+1)	Tandem
24.003	C.Fahlander	6	Tandem
24.004	S.Pigliapoco/M.Zazzocco	2	Tandem
24.008	N.Sensharma	4(+1)	Tandem
24.011	J.Pellumaj	4*	Tandem
24.012	Y.Son	1**	Tandem
23.013	S.Valdré	2***	Tandem

Priority B:

Prop.	Spokesperson(s)	Days	Accelerator
24.006	A.Stefanini	7	Tandem
24.011	J.Pellumaj*	3	Tandem

* Exp. 24.011: the three days in priority B are for the DSAM of the second 2+ state.

- Two/Three detectors ready from Herbert/Raniero 15th to 26th of July. In September before the starting on f the new campaign we will update the array with the best detectors. Most probably the start of the campaign will be middle of October will start the new beam time. Any team interested in visiting LNL?
- Status of the detectors:



- Prototype of the hardware trigger for the GGP has been delivered that will allow to send to signals to the GGP and have two outputs. For example, to send the backpressure. This will allow to be in the safer side since the signal will be filtered before being sent to GGP.
- HV two boards sent to repaired to CAEN and repair. HV for ancillaries changed.
- New LVPS still did not arrived.
- Any news about the date of the possible arrival of the new RAM (delayed)
- Grid certificate to copy data to CNAF and CC-IN2P3?

ASC Report / ASC Matters

Magda Gorska is the new chair of the ASC.

Magda Zielinska is the new vice-chair of the ASC.

ARRB has asked for inputs from the institutes. CEA will have “Point Projet” on the 16th of December. At the project level, HR evaluation was done many years ago

during the MoU process. Milestone is spring 2025 to deliver the document to the ARRB for the mid-term evaluation and the MoU [2026-2030].

ACC Report / ACC Matters

Acc meeting at the next AW. See indico for all details.

GSI Status (K. Wimmer)

No much to say. New GSI director chosen from the NUSTAR field. No news on the detectors activities.

REPORTS FROM THE WORKING GROUPS

Detector Module (H. Hess)

1. Detector Module

Activities on Detector Capsules

A021: new detector, owner Liverpool, FAT by IPHC Strasbourg
Delivered to Cologne on 29th January

A022: new detector, owner Spain, FAT by Saclay
Delivered to Cologne on 24th April

A006: delivered to Mirion on 20th March for annealing
Delivered to Cologne on 25th June

A008: delivered to Mirion on 20th March for annealing
Under repair due to leakage current after annealing

B008: FAT after repair due to leakage current by IPHC Strasbourg & Saclay
Delivered to Cologne on 29th January

B005: delivered to Mirion on 20th March for annealing
Delivered to Cologne on 27th May

B009: delivered to Mirion on 20th March for annealing
Delivered to Cologne on 07th May

C001: delivered to Mirion on 20th March for annealing
Delivered to Cologne on 25th June

C014: delivered to Mirion on 20th March for annealing
Delivered to Cologne on 07th May

Allocation of the detectors:

66 detectors available within the AGATA community

INFN Legnaro:

At the moment 45 detectors are mounted in 15 ATCs

Saclay:

0 detectors

Liverpool:

0 detectors

IPHC Strasbourg:

1 detector

- **A005** mounted in the Salamanca TC, scanning ongoing

Salamanca:

1 detector

- **B003** mounted in the IPHC TC, scanning ongoing

IKP Cologne:

18 (+3 + 3) detectors

- **A001, A006, A015, A022**
- **B002, B005, B009, B013**
- **C001, C002, C008, C017**
- **S001, S002, S003**
- **A021, B022, C014**, mounted in ATC22
- **A012, B008, C022**, mounted in ATC23
- **A501, B501, C501** mounted in DEGAS TC

MIRION:

1 detector

- **A008** repair due to leakage current after annealing

The AGATA community is at the moment proprietor of 66 detectors. Out of this 66 detectors 36 are in use at Legnaro for the physics campaign and 6 are prepared to be transported to Mirion for annealing. In Cologne are at the moment allocated 18 detectors with 11 spare ones and **C017** which suffers from leakage current over segment B1. This detector will be delivered end of July for repair. Remarkable is also that for the first time one detector suffers from leakage current after annealing (**A008**).

Open Orders:

7 detectors

- **A023**: Owner (UK)

- **A024:** Owner (GSI)
- **A025:** Owner (Italy)
- **B023:** Owner (GSI)
- **B024:** Owner (CEA)
- **C023:** Owner (GSI)
- **C024:** Owner (Italy)

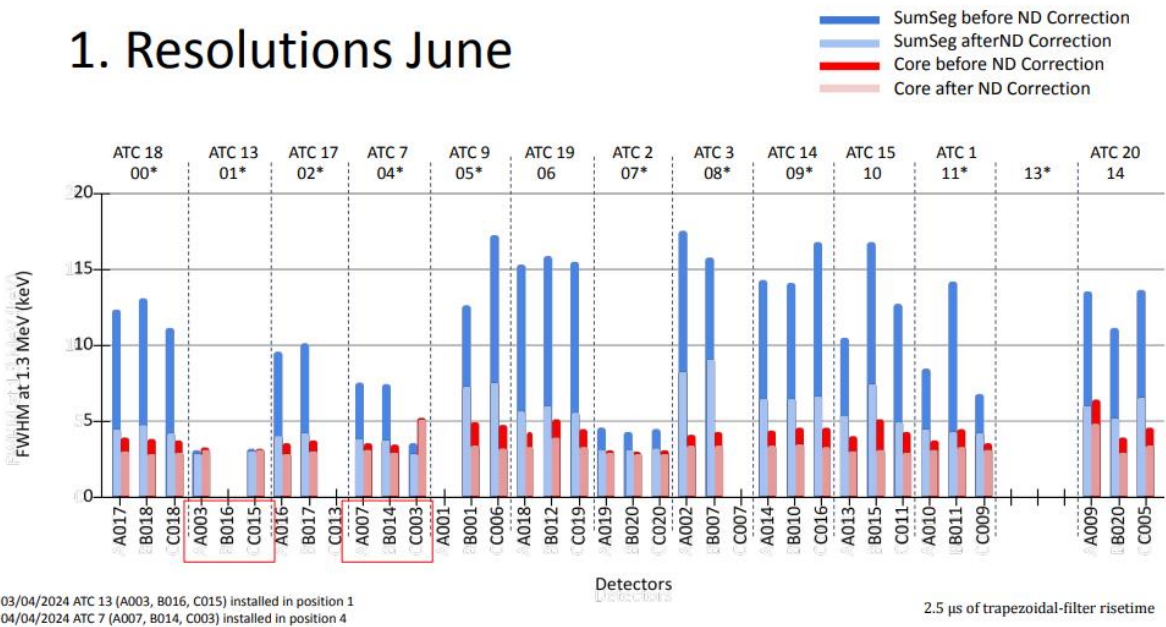
At the open orders the periodization is first at the UK order then the three GSI detectors.

Cluster Assembly and Maintenance

Legnaro:

Status Array & repairs:

12 ATCs mounted in the frame



5 ATCs in the lab:

ATC21: one segment missing used for new digitizer tests

ATC06: cryostat annealed waiting for detectors

ATC12: cryostat annealed waiting for detectors

ATC10: (A011, B006, C012) detectors waiting for transport to Mirion for annealing

ATC11: (A004, B004, C010) detectors waiting for transport to Mirion for annealing
Cologne:

DEGAS TC: assembled with A501, B501 & C501

Cold core preamplifier exchanged on detector B due to slightly degraded core

resolution.

Now the segment and core resolutions of all three detectors are within specification.

Waiting for delivery to FAIR, intention to use it for DESPEC experiments.

ATC22 (serial number 10092, owner INFN): assembled with A021, B022 & C014

Detector C017 was replaced with detector C014 due to leakage current, will be transported to Legnaro in week 29

ATC22 (serial number 10093, owner INFN): assembled with A012, B008 & C022

will be transported to Legnaro in week 29

ATC16 (conversion of ADC to Triple): tests with electronic test device finished, waiting for detectors

Infrastructure (B. Million)

Dry pump ordered (in saclay) and Leister arrived to LNL

Front End Electronics (A. Gadea)

Coordination: last Electronics W.G. VC July 23rd 2024, next Electronics W.G. VC meeting on Tuesday October 8th 2024 at 10:00 CET, 9:00 U.K.

AGATA week Parallel and Plenary sessions on September 10th 2024

Pending actions:

-Meeting with O. Stezowski and N.Dosme: RUDP discussion meeting. Possibly during the AGATA week

-Meeting with J.Collado, GANIL, LNL and Padova Colleagues: brainstorming on GTS alignment protocol.

Status at LNL (A.Goasduff et al.):

We are losing digitiser cord cards. 28 channels (detectors/electronics) are working.

Digitisers will be checked after the run

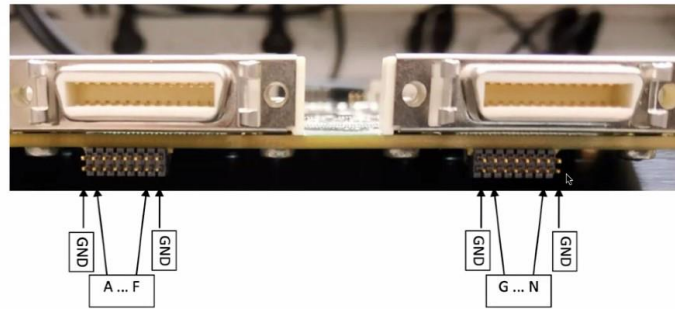
The problem seems to correspond to when the detector team are connecting/disconnecting the core cables. Possibly there is a physical effect that disconnects the signal backplane connection. Unlikely to be water because core cards are on top. Unlikely to be power backplane, more likely to be signal backplane. V.Gonzalez and A.Goasduff will investigate.

Procurement continues for an Isolated heat exchanger to cool the digitisers. Delivery scheduled on September

EMC at LNL discussion triggered by N.Karkour

Discussed the importance of getting inspection lines sorted out to ensure that the analogue inspection lines connected to the digitiser inputs are accessible to be connected (with some security such as screws and maybe active buffers) to patch panels for access to inspection lines while MDRs are connected. Normally MDR partially obscures the connector (see photos below). Needs more discussion with APullia, V.Gonzalez, N.Karkour, A.Gosduff and others (more discussion in EMC session at AGATA week).

Analog output pinout of segment Digi-Opt12



Channels A, B, C, D, E, F as shown
Channels G, H, I, L, M, N as shown
The upper pin negative polarity
The lower pin is positive polarity



DIGIOPT12 (A.Pullia):

No news from A.Pullia.

A.Gadea Reports that the 9 cards bought by GANIL on O.C. have been delivered to Valencia (8 segment, 1 core, mixed v6, v7) . These are spares to replace water damaged cards

PACE Status (J.Collado, reported by A.Gadea and V.Gonzalez)

V.Gonzalez, J.Collado and A.Gadea had a review meeting on 16/7/24 to look at problems in state machine. They got a detailed description of how firmware works, then looked at state machine failure modes.

Quad Link Packager

Input

- 4 block dFm (156,25MHz)
 - stream
 - data: 64 bit data stream (readChannel/readSample)
 - rdy: source device ready to send
 - trg: trigger signal on stream
 - tms: timestamp
 - bkp: sink is ready
 - dFm
 - enable: start mem read
 - request: number of sample requested
 - readChannel: select channel
 - readSample: select sample

Double FF Trig in
Longtrace

Output

- Axi Stream 64b
 - rdata: data to send
 - tvalid: data is valid (source)
 - tkeep: byte select
 - tlast: this sample is last
 - Trdy: sink is ready.

Main State Machine

- stmBuilder_IDLENR
 - Wait for tready
- stmBuilder_IDLERD
 - Wait for trigger
- stmBuilder_STARTS
 - Read package type (Config/IDLE/Error/Off)
 - Build header
 - watchdog
- stmBuilder_HEADER
 - Send 3 step header
 - watchdog
- stmBuilder_STREAM
 - Format stream output (dFm control)
 - watchdog
- stmBuilder_ENDSTR
 - Normal end
- stmBuilder_ERRSTR
 - End with error

Output Selector

- Long traces
- Spectra
- Trigger Match
- Monitor

Trigger Selector

- Trig signal from selector
- Constant 1
- Local trigger generator
 - Timer
 - Once

Config

- Register to IPbus

Observed that in a conditional "case" section there were undefined solutions.

V.Gonzalez suggested adding an "others" default action for unused states in the state machine.

This was implemented and tested last weekend with positive results.

Next step is to collect a data set for Lyon to verify that the modification was successful.

A.Gadea is in LNL to help with that and waits for JC to find an evening/weekend (Alain Goasduff noted that no sources are available after 1st of August)

Regarding the PCB production, manufacturers have looked at the manufacturing data.

JCollado has answered questions about the Gerber file holes; he is now dealing with questions about the solder mask and then the production can start.

As soon as the data packager is OK the next step is a GTS meeting.

PSU and Mechanics: (V.Gonzalez, J.Collado)

11 more heat exchangers produced

Repaired PACE received, trying to resume cooling test work. Card didn't boot.
Identified a cracked SD card but even with replacement SD, the card didn't boot.
Now boots by bypassing SD card- max 46°C measured during 24 hours.
Further integration tests under way.

Signal backplane PCBs arrived last week at assembly company. 60 units will be assembled

PSU noise tests under way (PSU manufacturing delayed while this is investigated)
Decision on logic trigger signal connector type : still looking at options.

Updated totals:

12 PACE cooling blocks

66 STARE cooling blocks

204 Digiopt12 cooling blocks (4 per box)

56 heat exchangers^{S1} (11 extra in the last month)

Front Panel- Al panels prepared for production

Rear panel Steel and Al prototypes produced (Al is for prototype only)

Trigger connector hole is implemented.

STARE Status (N.Karkour, X.Lafay)

X.Lafay looking at DHCP in STARE with a student. There seems to be a missing IP bus handshake. They will check with Grenoble (who wrote the code) whether this is a bug and how to avoid the problem.

X.Lafay wants to look at STARE IP bus part of the Base PACE firmware. Action placed to provide him with the last version of firmware.

Production- Hardware production is done and the manufacturer is testing the boards. So far there is one manufacturing error with 8 resistors mounted using the wrong value- needs to be updated.

1GB copper link works but 10GB fibre doesn't work. FMC side 10Gbit copper link works. 3 boards all behave the same way. 1 board will be sent to Orsay for X.Lafay to investigate in the lab.

Testing and Production of phase 2 electronics Summary:

DIGIOPT12 cards exist (upgrade to v3.7.1 is under test)

STARE production is under way. The cards exist and are under test. Issues found to be investigated

PACE production. Waiting for solder mask problems to be fixed then production will start. Waiting for confirmation of 45 day production start/end dates. Assembly time- normally 2 months including the time to schedule the work (4 weeks to do the work and 4 weeks delay to schedule the work). October is still the likely date for the first production PACE cards to be delivered.

Mechanics: necessary to finish PACE cooling block change for cable run, then front/rear panel for production so likely to have everything for 50 units by end of September.

Power backplane is produced, signal backplane PCBs completed 4th July, assembly completion due at end of August.

PSU production is not scheduled yet- assembly company offered 8-10 days to assemble 50 units (components exist)- production of PSU on hold to investigate noise reported by A.Pullia.

PACE firmware is possibly going to become the limiting critical path item for the scheduling of the final installation now that hardware production of both PACE and STARE are under way.

System debug and installation: In LNL there is already a prototype system which can test the new hardware, firmware and software alongside GGP, GTS, GANIL Trigger Processor which are all in the 2nd hall and ready to be used with an AGATA detector as soon as GTS progress can be made.

LNL summer shutdown is from 1st August to 19th or 26th August. The system will still be running with cooling water maintained, detectors remain cold, but no sources are available during the shutdown. Next experiment starts 14th October so system must be running from end of September (possibly first few days of October).

Personnel

A new candidate for contract exists but the candidate has no VHDL or firmware experience; their background is in AI so not useful to the project until they have received substantial training.

In June meeting E.Clement suggests trying to find a flexible contractor if we can't fill the post. We know that the documentation is not complete and sometimes missing entirely so we can't easily engage a contractor who delivers a fixed package of work for a fixed price. However, we could perhaps find a person who joins our team on site in LNL and we could buy their time as the deliverable rather than paying for specific tasks or pieces of code. During July A.Gadea has looked for a suitable contractor but has not yet found anyone.

The technical personnel working at the mechanical workshop in IFIC Valencia will have the contract extended until end of 2025 to contribute to the mechanical production of the V2 electronics.

ACTIONS A.Gadea- to organize asap a Firmware brainstorming meeting with all those who have worked on GTS recently e.g. at GANIL Matthieu and Frederic plus anyone from INFN who remembers the GTS to review GTS code in PACE. Need to understand what is not working and how the undocumented parts of the GTS system work.

Data Processing (O. Stézowski)

Coordination:

No regular meeting since last AMB
Page dedicated to current actions [here](#)

AGATA Week, current proposition:

Alain - report LNL

Patrick - infra DAQ-Prod @ LNL & DAQ-Dev @ Orsay

Jérémie - Report Data Analysis team

Daniele – Data analysis with ancillaries

Olivier - V2 data pipeline

Christian - Slow control & monitoring of cards

Souhir - Interface DAQ-electronics: Topology Manager & backpressure software

Guillaume - Report online/offline interface

Vincent/Roméo - Conclusions Roméo's Thesis ?

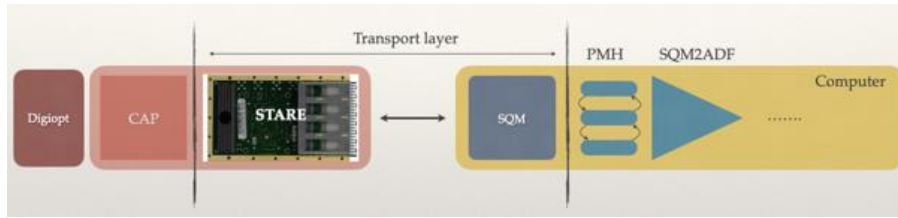
Phase 1 and commands:

- RAM memory to upgrade all current machines
 - Ordering done 16/05/2024
 - Waiting for delivery
- CEPH upgrade
 - 3 new (core) disk arrays to be bought. 2 for CEPH + 1 to be used as anodeds6
 - About 36 000 euros ... waiting for final quote from HP
 - should bring CEPH close to 400 [+100] To of safe disk [replica3]
 - hopefully at LNL beginning of September
 - NOTE: 2 other backup systems available on site
 - ancillary disk of LNL,
 - one old globicephala refurbished
 - Waiting for quotes from Orsay
- Many issues on analysis1
 - procedure on OC money [1U machine to be bought] to be initiated
- Host lab document
 - Better to wait for tests with the dev daq box
- To help getting data from the grid
 - Docker provided to be used as Grid User Interface
 - <https://agata.pages.in2p3.fr/handbook/data/grid/>

- Issues on agatagrid with identification ... on going exchanges Orsay-LNL to handle it

Phase 2 developments:

- V2 electronic data pipeline



- Slow control developed by Christian being installed at LNL
 - Tests with the card foreseen
 - First version of the oscilloscope mode to be tested with Javier's data
 - And then directly on site by IPBus
- Data produced at LNL
 - 3 'recent' runs produced (29/04)
 - 1800: many TS issues ... not checked more than that
 - 1801: 190 000 UDP packets supposed to be single ADF?
 - 188 300 single UDP
 - 1700 dispatched on 2 packets
 - 1802: 190 000 UDP packets supposed to be single ADF?
 - 188 366 single UDP
 - 1636 dispatched on 2 packets
 - Deeper validation on going
 - Would it be better to have a dedicated elog entry for the tests
 - Done with an entry in the elog
<https://galserv.lnl.infn.it:20443/Agata+Electronic/6>
 - On going modification of SQM2ADF to handle all possible frames produced by STARE.

Module Origin	Name	Crystal Status		Code	AdF		Description		
		Mode	Type		Type	Version			
GTS Trigger Match	DATA_100_SC	DA	Data 00	Call	DA00	Simple	0	Normal Data 100 samples triggered by slow control call	
	DATA_100_RP	DA	Data 01	Timer	DA01	Simple	0	Normal Data 100 samples triggered by timer (Fixed datarate)	
	DATA_100_TL	DA	LTC	10	Loc	DA10	Simple	0	Normal Data 100 samples triggered by localtrigger data from long traces buffer
	DATA_100_TG	DA	Data 02	Loc	DA02	Simple	0	Normal Data 100 samples triggered by localtrigger (datapath)	
LTb Long Traces Buffer	DATA_100_GT	DA	Data 03	GTS	DA03	Simple	0	Normal Data 100 samples triggered by gts validation	
	DATA_200_SC	DA	Data A0	Call	DAA0	Extended	0	Normal Data 200 samples triggered by slow control call	
	DATA_200_RP	DA	Data A1	Timer	DAA1	Extended	0	Normal Data 200 samples triggered by timer (Fixed datarate)	
	DATA_200_TG	DA	Data A2	Loc	DAA2	Extended	0	Normal Data 200 samples triggered by localtrigger (datapath)	
	DATA_200_GT	DA	Data AA	GTS	DAAA	Extended	0	Normal Data 200 samples triggered by gts validation	
	LT_4k_SC	CE	LTC	00	Call	CE00	Simple	0	Long Traces data 4k samples triggered by slow control call
	LT_4k_RP	CE	LTC	01	Timer	CE01	Simple	0	Long Traces data 4k samples triggered by timer (Fixed datarate)
	LT_4k_TG	CE	LTC	02	Loc	CE02	Simple	0	Long Traces data 4k samples triggered by localtrigger (datapath)
	LT_4k_GT	CE	LTC	03	GTS	CE03	Simple	0	Long Traces data 4k samples triggered by gts validation
	LT_4x1k_SC	CE	LTC	10	Call	CE10	Extended	0	4 channel Long Traces data 4k samples triggered by slow control call
	LT_4x1k_RP	CE	LTC	11	Timer	CE11	Extended	0	4 channel Long Traces data 4k samples triggered by timer (Fixed datarate)
	LT_4x1k_TG	CE	LTC	12	Loc	CE12	Extended	0	4 channel Long Traces data 4k samples triggered by localtrigger (datapath)
LT_4x1k_GT	CE	LTC	13	GTS	CE13	Extended	0	4 channel Long Traces data 4k samples triggered by gts validation	
vLTb Very Long Traces Buffer	LT_8k_SC	CE	LTC	A0	Call	CEA0	Extended	0	Long Traces data 8k samples triggered by slow control call
	LT_8k_RP	CE	LTC	A1	Timer	CEA1	Extended	0	Long Traces data 8k samples triggered by timer (Fixed datarate)
	LT_8k_TG	CE	LTC	A2	Loc	CEA2	Extended	0	Long Traces data 8k samples triggered by localtrigger (datapath)
	LT_8k_GT	CE	LTC	A3	GTS	CEA3	Extended	0	Long Traces data 8k samples triggered by gts validation
	LT_100k_SC	CE	LTC	B0	Call	CEB0	Extended	0	Very Long Traces data 8k samples triggered by slow control call
	LT_100k_RP	CE	LTC	B1	Timer	CEB1	Extended	0	Very Long Traces data 8k samples triggered by timer (Fixed datarate)
	LT_100k_TG	CE	LTC	B2	Loc	CEB2	Extended	0	Very Long Traces data 8k samples triggered by localtrigger (datapath)
	LT_100k_GT	CE	LTC	B3	GTS	CEB3	Extended	0	Very Long Traces data 8k samples triggered by gts validation
Spectra Buffer	SPC_100_SC	FA	SPC	01	Call	FA01	Simple	0	Short 100 bin spectra for all channel trigger by slow control call
	SPC_100_RP	FA	SPC	02	Call	FA02	Simple	0	Short 100 bin spectra for all channel trigger by timer
	SPC_4kp_SC	FA	SPC	10	Call	FA10	Simple	0	Long 4k bin spectra for one channel trigger by slow control call
	SPC_8kp_SC	FA	SPC	A0	Call	FAA0	Extended	0	Long 8k bin spectra for one channel trigger by slow control call
System	IDLE				BEDD	Simple	0	IDLE empty message sent each IDLE TIME (set by slow control)	
	ERROR				EEEE	Simple	0	On call (trigger/slow control) system was on error	
	SYSOFF				DEAD	Simple	0	On call (trigger/slow control) system is off (Digitizer/Readout)	

- Other Phase2 related developments: DAQ-Dev Box @ Orsay

- Operational !
 - Installation/tests of new tools (redis,InfluxDB,docker) OK
 - First benchmarks performed on the new machines bought in 2023-24
 - More CPU / RAM oriented
 - Confirmed about 8khz current psa thanks to more multi-thread
 - Parallel processing added with few 10 kHz reached

- Next step is to have a full DCOD environment operational
 - Still many issues to have DCOD running in recent OS
 - More network benchmarks oriented



PSA and Tracking R&D (A. Boston)

Characterisation

Last Team meeting 28th June 2024

Report received from Dan.

Report from IPHC:

- A005 scanning is ongoing. Data for comparison with Liverpool has been taken. Additional scans are being performed at the request of the PSA group to look at dead layers due to segmentation and passivated regions. These are being performed in both the horizontal and vertical orientation.
- Tomographic scans of the full detector at 30 degree steps have taken 12 weeks – currently on last step. Strange artifacts are seen on two of the scans towards the rear of the detector. A further 1-2 weeks will be required to retake this data.
- Jeremie Dudouet has requested some high statistics ⁶⁰Co flood data for cross-talk measurements with pulse shapes.
- Test imaging data will also be taken for a PhD student project. This will be a further 3 weeks.
- Jeremie is also working on translating the IPHC scanned data (IKP segment labelling) to the Agata segment labelling scheme. Data will then be available for the collaboration to use with the standard Agata PSA algorithms. Liverpool/GSI/Salamanca will also make their data compatible with experimental data and available.

All measurements should be finished by end of July – A005 will then be warmed, packed and driven to GSI, assuming this fits with GSI's timetable (need to confirm with Juergen). Question is whether the transportation to GSI has to be done beginning August or may be done after the AGATA week.

Humidity in the lab had been a problem last summer. An air-cooling system has now been installed. This does not fully dry the air, so leakage currents are seen to rise. Need to add an additional air-drying system, possibly this summer with 2024 funds.

Report from GSI:

Intend to implement new Febex cards, need a detector for commissioning. Commissioning / calibration will take around a month and long scan foreseen for large data set so A005 likely to be needed for 6 months total. Beam-time in 2025 means manpower will be needed elsewhere beyond this time scale. If a different segmented detector is available, could the setup be done before A005 arrives? To be discussed with J. Gerl.

Report from Liverpool:

New 4Gbpq ¹³⁷Cs source has been delivered and is in storage at the University of Liverpool. Waiting for document describing security / shielding to be provided to regulatory bodies by Radiation Protection team before final approval to be mounted in new scanning table. Once this is done, new table will be commissioned using A601 (formally DEGAS detector A501), hopefully in next weeks.

Have had many problems with test cryostat used with A601.

Detector failed while side scanning. Cold FETs and several warm preamps failed. Cold-spot on tapered endcap was observed when side mounted – only when mounted at one specific angle. A few degrees of rotational play in the cold finger noted,

Following repairs to vacuum leaks, mounting with cylindrical endcap and replacement of failed preamps, the detector is now operational and performing well.

Report from Salamanca:

Ongoing problems are being encountered with the Salamanca acquisition system. Currently no data is being written out. Computer Engineer Carlos is trying to resolve. Several versions of the DAQ have been tried. The initial version used old architecture and old computers and resulted in half of the data being lost.

A newer iteration was tried that was better but crashed a lot with online data.

A 3rd iteration using new architecture as used at GSI is currently writing out empty data files. Help has been requested from GSI, waiting for reply.

Cannot roll back to previous versions to check where data is being lost due to firmware changes.

AGATA and gamma-camera data are both missing. Appears to be fine up to the VME crate / Strux card. Maybe issue with data bus?

The AGATA detector has been kept cold as is used for testing / debugging the DAQ.

A new HV unit has been purchased as recommended previously by Marie-Helene.

R+D on PSA

Report received from Fraser.

AGAPRO Code status:

The current state of the proposed PSA algorithm is reasonable, the low-level deconvolution of the SIMPLEX and GRETA algorithms has been fully implemented along with appropriate code to handle the veto fallback. All functions have been refactored into a state where they are reasonably clear to interpret, functions that benefit from SIMD instructions have been implemented in SSE3.

Initial poor performance on the ^{98}Zr dataset was identified from a miscommunication between the PSA and GRT algorithms, this issue was fixed with a modification to the PF data struct passed to the GRT processing. A secondary issue was found that related to the ordering of the recursive subtraction and processing of the 1 and 2-interaction PSA, a hybrid PSA was developed that processes the 1 and 2-interaction PSA concurrently. Finally, an issue was identified relating to the precomputation of certain distance matrices and how they related to the dynamic masking used by the PSA, this issue is ongoing.

Complications due to the masking making precomputation more memory intensive have increased the RAM usage of the proposed algorithms by a factor of 36 and modified how the matrices are stored, a new index conversion code was written to handle the split distances, but this will need to be re-worked if the masking method is changed.

The ^{98}Zr benchmark dataset and ^{22}Na datasets both produce their expected results from the full AGAPRO pipeline but can only be run on a reduced set of crystals until the memory requirements are handled.

Current efforts are focussed on determining the most efficient method to store and calculate the precomputed distances in a way that they can be converted into their masked equivalents with the fewest operations. Once the optimum combination of sub-masks is determined then the index lookup code will need to be modified.

The transference of code to the AGATA performance team should be relatively straightforward, modifications to AGAPRO have been fairly contained to PSA-specific functions and so conflicts with other critical systems is unlikely.

In an effort to improve the processing rate and overall accuracy of the PSA two new methods have been developed to allow for more intelligent processing of the signals. A new machine-learning assisted preprocessing filter has been designed to allow for direct inference of how likely an experimental signal is to be comprised of multiple interactions, this will be useful in short-circuiting the 2-interaction PSA if requested. Secondly a crystal-wide PSA postprocessing filter has been designed to allow for a global fit of the experimental data to be determined, this should eliminate any possible complications induced from the windowing and recursive subtraction.

Existing Algorithm Outline:

In the existing algorithm pipeline the PSA is performed by fitting the 1-interaction solution first, going through all event windows with recursive subtraction until all 1-interaction solutions are found and produces an experimental residual that can be used to evaluate the deviation from the experimental signal. The algorithm then iterates through all event windows again to determine their respective 2-interaction solutions, in this case the query signal is generated by using the best 1-interaction solution added back to the experimental residuals.

If a 2-interaction solution is found to improve the fit and passes subsequent vetoes, then the 1-interaction solution is overridden and lost, equally the 2-interaction is lost if it fails to improve the fit or pass the vetoes.

This approach is possibly flawed as the experimental residual is influenced by the repeated fitting of 1-interaction events onto the signal, a sub-optimal fit produces a larger residual, which in turn affects subsequent fits. As such the sum of the experimental residual with the best 1-interaction solution does not produce the same signal as what was originally passed to the 1-interaction PSA, this may influence the 2-interaction PSA significantly.

The lack of information on the veto reason is also problematic as the PSA results are unnecessarily obtuse, which may make more intelligent processing and GRT more difficult in the future.

Proposed Algorithm Outline:

In order to overcome this limitation, the algorithm pipeline was modified to run the 1-interaction and 2-interaction concurrently, this approach allows for the best solution to be chosen for each specific window. For each window in the signal the 1-interaction PSA is run, calculating a Chi-squared, an optional veto can be applied if the fit is considered good enough to skip a 2-interaction solution.

I believe this is important as the residuals will be appropriately calculated depending on which PSA prediction is best, ensuring that any improvements from a 2-interaction solution positively affects the fit of subsequent fits.

Additionally, the veto procedure used PSA was modified to provide both 1 and 2-interaction solutions in a way that is still directly compatible with current GRT, the PF

struct was modified to allow for storing of the suboptimal solution and veto reason. Whilst these properties are not currently used by GRT they may be useful for more advanced GRT and crystal-wide optimisation.

Machine Learning Assisted Preprocessing Filter:

The current vetoes used in AGAPRO rely on parameters generated after a PSA search. Whilst this is the most accurate option for determining the best solution it should be possible to infer whether a 2-interaction solution is possible directly from the experimental signal.

In an effort to develop a more efficient veto I developed a machine learning-assisted algorithm to approximate the AGATA detector responses. The method utilises self-organising maps to approximate the underlying signal responses within AGATA and provide an efficient estimation of the energy fractions, Euclidean distance and Chi-squared improvement. This approach provides a fully analytical solution which is important to reduce erroneous behaviour and has been specifically designed to overcome the surjective mapping limitations of inference-based methods.

The new method works under the theory of the smooth manifold approximation, in which trends within the AGATA response may be considered as a smooth transition from one signal to another. In this case there is the opportunity to approximate the manifold with a low resolution polylinear fit. This polylinear approximation can then be used to predict novel parameters from experimental queries.

The polylinear map is generated using self-organisation, a form of competitive machine learning in which nodes in a network attempt to closely fit an underlying response. This method was initially tested on a DSSD to evaluate depth of interaction in which a nonlinear regression was successfully achieved. The novelty of this approach is the incorporation of the SIMPLEX deconvolution into the evaluation of the map segments. Utilising the same code developed for 2-interaction PSA it is possible to evaluate the best position along the map that corresponds to a single-interaction solution. In order for the best 2-interaction solution to be determined it was necessary to develop a new formalism for a 4-interaction event.

The best fits from the 1-interaction and 2-interaction approximations can then be used to inform the pipeline whether subsequent PSA is necessary. In cases where the improvement from a 2-interaction solution is negligible then the more intensive 2-interaction PSA may be skipped, conversely if the expected improvement is significant then it should be possible to skip the 1-interaction PSA.

The use of the node-based approximation provides a promising avenue for machine-learning assisted approximation of the AGATA response as a viable alternative to the coarse grid approximation currently used. If the approximation could be structured in a way to form an efficient link to the basis signals in close proximity, then the coarse grid search could be skipped entirely, and PSA optimisation performed only on the fine subset.

This work has significant promise in tackling the time-drift currently observed within AGATA, its adaptations to handle multi-interaction signals allow for it to overcome the

limitations originally described by F. Crespi and may allow for the iterative time-shifting present in the AGAPRO pipeline to be removed.

Aspects from this work have been submitted and accepted for talks at both IEEE (NSS MIC RTSD 2024) and ANP 2024, with the focus on detector parameter inference and multi-interaction vetoes respectively. Experimental data is currently being collected using a novel dual acquisition setup at Liverpool, which should allow for application to a variety of detector systems in the future.

Full-crystal PSA Postprocessing Filter:

Within AGAPRO the solutions from PSA are evaluated only at the window level, the effect of recursive subtraction may produce unintended knock-on effects on the PSA predictions as the events reduce in energy. Whilst the evaluation of which number of events best fits the data is technically possible using previous methods, it would only be able to swap between static solutions from previous PSA. Re-optimisation of the energy fractions is not possible with previous methods.

When investigating the solution for a 4-interaction event for the preprocessing filter, the generalised formalism for n-interactions was developed. Whilst this cannot be used exhaustively in PSA due to the exponential scaling with n, it provides a robust solution for the optimisation of a full-crystal solution across several segments. This method would effectively minimise the bias imparted by the use of windowing and recursive subtraction by producing a crystal-wide optimisation. Possible interactions would be limited by previous PSA with the collection of interactions that best minimises the residuals given as the final solution.

This method has been proven to work for up to 10 interactions within a Python test environment, numerical instability seems to introduce a functional limit when using 32-bit precision however this may be mitigated by moving to higher precision or specialised arithmetic ordering.

Full implementation within AGAPRO is possible but would require some specific code to handle the set of linear equations present at higher interactions.

Tracking report

No update since last meeting.

Upcoming workshops/meetings

AGATA week 9th – 13th September: Milan
AGATA/GRETINA workshop – 20 – 22nd November: ANL

Performance and Simulation (M. Labiche)

Self calibration beam to agree and High energy run to.
GEANT4 package upgraded on the gitlab.

Financial Reports (B. Million)

PACE PCB board 1st batch ordered

During AW : debate on the remaining 2024 French money allocation.

Expected reduction in Spain for 2024-2026

News on OC from Hungary? KTH ? Finland ?

IPHC on-going

Dissemination (J. Nyberg) : no news.

AGATA Week <https://indico.in2p3.fr/event/32956/>

Indico ready, registration open; Agenda on-line

AOB : none