

Commissioning of the AGATA Zero-Degree Configuration at LNL

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Multi-stage Commissioning of the AGATA array in its zero-degree Configuration at LNL-INFN

- ❑ It is presented the commissioning of the **AGATA** array in its zero-degree configuration at Laboratori Nazionali di Legnaro (LNL-INFN), with the physics campaign starting at the beginning of 2027
- ❑ In this configuration, **AGATA** will work either stand-alone or together with complementary detectors:
 - **NEDA, PARIS**, Si-based detectors for light charged particle (**EUCLIDES, SAURON and TRACE**) or for heavy ion identification (**SPIDER**)...

Multi-stage commissioning of the AGATA array in its zero-degree configuration at LNL-INFN

□ The commissioning is divided into **3 stages**, foreseeing both source tests and in-beam experiments:

➤ AGATA coupled with NEDA:

■ *source measurements (early 2027)*

➤ AGATA coupled with NEDA:

■ *in-beam experiments (early 2027)*

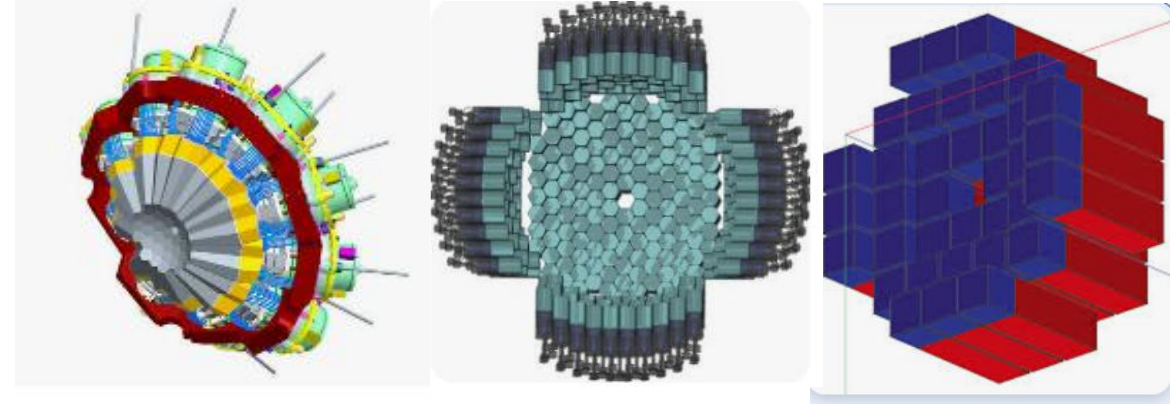
➤ AGATA coupled with PARIS:

■ *in-beam experiments (2027-2028)*

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□ Primary objectives include:

- *validation of mechanical integrations*
- *clock synchronization*
- *trigger propagation*
- *offline event reconstruction*
 - *all aimed at ensuring the successful realization of the main physics program*



- The AGATA-NEDA in-beam commissioning will be performed using the $^{96}\text{Zr}(p,p')$ and $^{32}\text{S}+^{58}\text{Ni}$ reactions to validate hardware triggers and $1n/2n$ discrimination algorithms
- Subsequently, the AGATA-PARIS in-beam commissioning will be devoted to the evaluation of the high-energy γ -ray response using $^{32}\text{S}+^{110}\text{Pd}$ and $d(^{11}\text{B},n\gamma)^{12}\text{C}$ reactions
- To fully validate both zero-degree configurations, a total of 16 days of beam time is requested

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- *PARIS and NEDA will be used in separate sub-campaigns due to incompatible support-structure designs*
- The three collaborations have agreed to conduct the **AGATA+NEDA** campaign first, followed by the **AGATA+PARIS** campaign
- The **AGATA+NEDA** campaign is scheduled to begin in early 2027. The **AGATA+PARIS** campaign will follow later, final part of 2027 or beginning of 2028.
- The zero-degree **AGATA** configuration will involve:
 - a minimum of **10 AGATA** triple clusters (**ATCs**) equipped with the phase 1 electronics (V1), and additional crystals read out using new electronics;
 - **54** available modules of **NEDA**, in wall configuration, read out with 4 NUMEXO2 electronics;
 - **10** PARIS clusters (made of 9 phoswiches each), distributed over two rings, read out by commercial CAEN digitizers

Multi-stage Commissioning of the AGATA array in its zero-degree Configuration at LNL-INFN

- The commissioning of the new **AGATA** configuration discussed here will be carried out in a sequence of stages of progressively increasing complexity
- The program will begin with off-line characterization using standard calibration sources, followed by in-beam tests of the coupling between **AGATA** and silicon-based detector systems (e.g. **SAURON**, **EUCLIDES**, and/or **TRACE**)
- Subsequent stages will involve the integration of the **NEDA** array and, finally, the **AGATA+PARIS** configurations
- *They are intended to be scheduled in clearly defined and separate experimental periods, allowing sufficient time between stages for performance evaluation, troubleshooting, and the implementation of any necessary improvements or new solutions*

Stage 1 (January 2027)

Optimization of **NEDA** neutron- γ discrimination using ^{252}Cf and AmBe calibration sources, followed by an extended coincidence measurement between **AGATA** and NEDA with a ^{60}Co source

This stage will be dedicated to determining the trigger processor response and to a comprehensive characterization of its impact on the overall detection efficiency of the setup

Stage 2 (early 2027)

□ In-beam commissioning of the AGATA-NEDA setup and ancillary detectors.

- For **AGATA-SAURON** we propose a **4-day** measurement of the $^{96}\text{Zr}(p,p')$ **reaction at 15 MeV**, using the hardware trigger gate on both the AGATA V1 electronics and the new **AGATA** electronics
 - This will enable a direct cross-check of the in-beam efficiency obtained under hardware-trigger conditions against the efficiency determined from source measurements. A comparison with previous data acquired using the Trigger Processor and AGAVA will provide a clear benchmark across different acquisition configurations
 - The beam intensity will be varied from 0.3 nA to 1.5 nA in order to study the corresponding evolution of the gamma-ray detection efficiency. By applying gates on the reconstructed excitation energy, we will be able to determine the γ -ray efficiency precisely over a broad energy range, from a few tens of keV up to approximately 6 MeV.

Stage 2 (early 2027)

- **AGATA-NEDA-EUCLIDES** system with the fusion-evaporation $^{32}\text{S}+^{58}\text{Ni}$ reaction at two different bombarding energies (130 and 125 MeV)
 - In this stage we aim to selectively populate fusion residues corresponding to $1n$ and $2n$ evaporation channels, allowing us to test the **NEDA** discrimination performances and select the best algorithms to be applied.
 - In this run, the 2 hardware coincidences with **EUCLIDES** will also be tested.
 - In this case, a minimum of 3 days per each bombarding energy (**6 days in total**) with an intensity of 1 pnA will be sufficient to achieve our goals.

Stage 3 (2027-2028)

- ❑ **AGATA+PARIS configuration**, following off-beam commissioning similar to the one performed for the **AGATA+NEDA** combination
- **Two reactions will be run to fully assess the performances:**
 - ^{32}S @ 135 MeV + ^{110}Pd (3 days of beam at 135 MeV with an intensity of 60 enA are requested)
 - 3 days are requested for ^{11}B beam on a deuterated target to study the **AGATA** and **PARIS** response to high-energies gamma rays. The $d(^{11}\text{B}, n\gamma)^{12}\text{C}$ reaction produces 15.1 MeV γ -rays from the decay of the excited ^{12}C state. The beam ^{11}B at 45 MeV degraded to 19.1 MeV with an intensity up to few pnA allows to collect enough statistics within 3 days

Conclusions

- ❑ To fully validate both the **AGATA–NEDA** and **AGATA–PARIS** zero-degree configurations, we request a total of 16 days of beam time (10 days for **NEDA** + 6 days for **PARIS**)
- ❑ This allocation will provide sufficient time for setup, optimization, and commissioning, as well as for the execution of the key reactions required to characterize and benchmark the systems
- ❑ Completing these activities will ensure that both configurations are fully validated and ready for the subsequent physics campaigns