AGATA Pre-PAC meeting technical information for the proposals preparation

The present document is a guideline for the preparation of the proposals for the 5th AGATA@LNL Pre-PAC that will take place at LNL from May 13th to 14th 2024. AGATA will be coupled to a series of complementary detectors that will allow to perform a broad physics program.

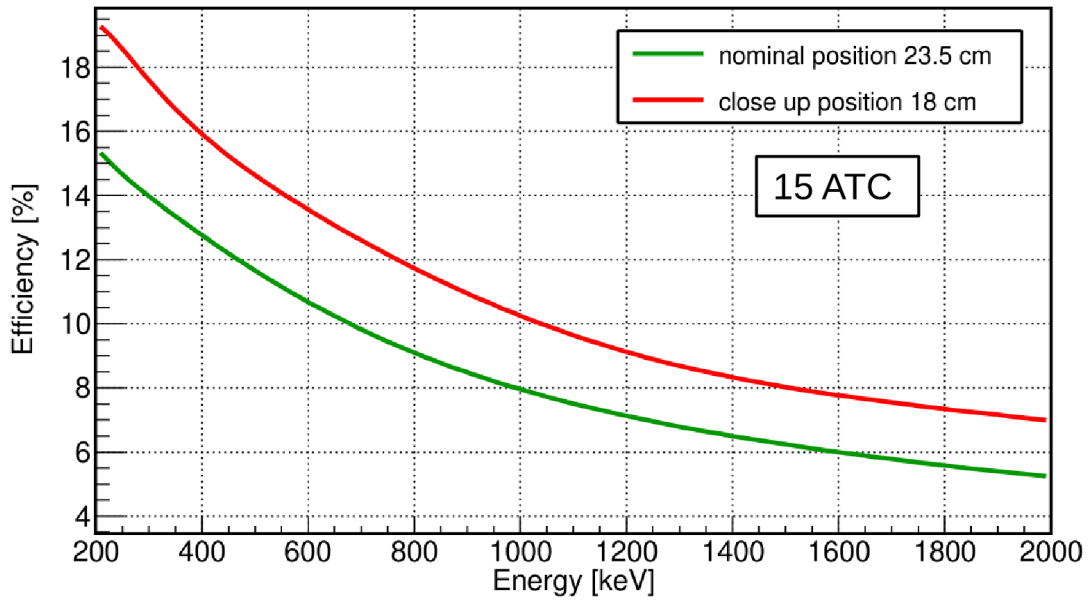
During this period, only **beams from the TANDEM accelerator will be available** at LNL, and AGATA is expected to consist of a minimum of 15 triple clusters (1π solid angle coverage). Following suggestions from the community, we are planning to include in the workshop **a special session dedicated to *future* experimental projects that will make use of ^{238}U beams** from the PIAVE-ALPI complex, which are currently being developed at LNL. The experiments involving these beams will conclude the physics campaign of AGATA in the PRISMA configuration. The maximum energy of the uranium beam will be 7,2 MeV/u with a maximum current of 1 pnA.

The list of TANDEM beams, intensities, energies are listed in:
https://agenda.infn.it/event/39886/attachments/115692/166550/Fasci_TAP.pdf

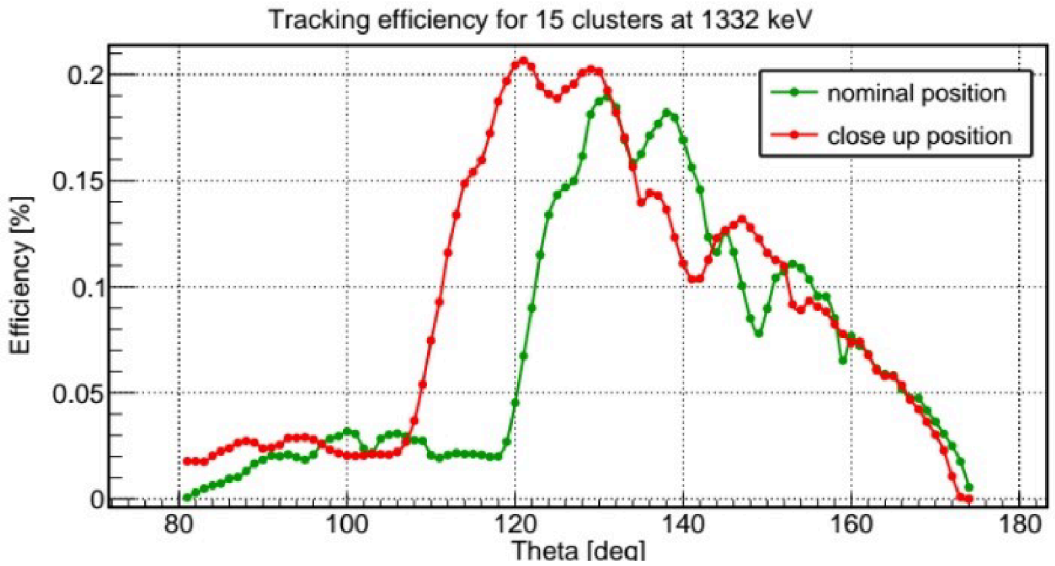
For any additional information, please contact the Linac operation team (PACbeams@lnl.infn.it)

AGATA efficiency

In the following pictures the simulated efficiency curves for the AGATA configurations at LNL, with 15 ACTs, are displayed (red line: close up position, green line: nominal position). The angles of the crystals range from 88° to 165.9° for the nominal position and from 75° to 143.2° for the close-up position. The first picture shows the energy dependence of AGATA efficiency.



In the second picture, the AGATA efficiency as a function of the theta angle for the nominal and close up positions at 1,3 MeV is displayed.



For a more realistic efficiency curve look into the report:
https://agenda.infn.it/event/39886/attachments/115692/166548/AGATA_Performance_Efficiency_PT.pdf

Reaction chamber configuration

Scattering chamber made of Aluminium, outer radius 170 mm thickness 2 mm.
Movable shells to cover angles between 20-88 degrees.
Close-up position (18 cm) only available from 32 to 88 deg.
Nominal position (23.5 cm) available from 20 to 84 deg.

Complementary detectors

- PRISMA [vacuum mode]:

  solid angle of ~80 msr, corresponding to an acceptance of Δθ = 12 deg in the dispersion (horizontal) plane and Δφ = 22 deg in the vertical plane. Wide momentum (±10%) and energy (±20%) acceptance. Maximum Brho = 1.2 Tm. Dispersion Deltap/p ≈ 4 %. Energy resolution up to 1/1000 (via TOF). Nuclear charge (Z) resolution ≈ 1/60. Mass (A) resolution ≈ 1/250. Rotation around the target from 20-88. Rate capability up to 3 kHz.

  For further details: A. Stefanini et al., Nuc Phys A, 701 (2002) 217 and S. Szilner et al., Phys Rev C 76 (2007) 024604.

- Gamma-ray scintillators:

6 x $LaBr_3$:Ce (3''x3'')~ 0.8 % efficiency for 1 MeV gamma ray at 25.5 cm. Time resolution ~ 700 ps. Energy resolution ~3 % at 662 keV.
Other possible detectors which use should be discussed are: 8 X $LaBr_3$:Ce (2''x2'') Time resolution ~ 500 ps. Energy resolution ~3% at 662 keV.

For further details: A. Giaz et al. NIM A Volume 729 (2013)

- SPIDER:

  Single layer 300-um tick segmented silicon detector for low-energy Coulomb excitation experiments. The angular coverage in the polar angle is 124 - 161 degrees and the covered solid angle is 17% of 4pi. The configuration consists of 7 detectors arranged in a cone-like configuration at 10 cm from the target.

  For further details: M. Rocchini, K. Hadynska-Klek, A. Nannini et al., NIM A 971 (2020) 164030.

- DANTE MCPs:

  Heavy-ion charged-particle detectors with position resolution$\lesssim$1 mm, timing resolution ≈ 130 ps. Up to 8 MCPs in a ring configuration, 40x60 mm^2 each MCP; angular coverage is modular, can go to forward angles. Configuration with DANTE in forward angles and SPIDER in the backward angles under study.

  For further details: A. Gottardo et al. Nuclear Physics A 805, 606 (2008).

- Plunger:

  range from micrometers to 1.2 cm. Coupling with particle detectors under study.

  For further details: A. Dewald, O. Moeller, P. Petkov, Progress in Particle and Nuclear Physics 67 (2012) 78.

- GAL-TRACE highly-segmented silicon det. telescopes (up to 5 units):

  Telescope unit: DE(100 mm)-E(1.5mm) . PSA available for light charged particles up to Oxygen. Angular coverage:22 . Angular resolution: 1.5 . Energy resolution (241Am) ~30 keV average. Solid angle coverage in a barrel configuration (~90 polar angle approximately) about 6%, coupling with SPIDER possible. Time resolution few ns.

  For further details: A. Goasduff et al., in preprint is in the pre-PAC WS web page.

- EUCLIDES DE-E silicon det. telescopes (with beam absorbers):

  absolute proton efficiency (reaction dependent) ~ 60%; absolute alpha efficiency 25% (reaction dependent). Average energy resolution (241Am source): ~120 keV average. Lower detection threshold under experimental conditions: few MeVs. EUCLIDES plunger configuration (with beam absorbers) Eff_p = 25% Eff_alpha = 15%.

  For further details: D.Testov et al., EPJA 55, (2019) 47.

- SAURON annular DSSDs:

3 thickness available: 300, 500 and 1500 um. Geometrical position ±5 cm from target, covering angles from 25 to 45 degrees (forward) and/or 135 to 155 degrees (backward). The position can be slightly adjusted, following the indications of the local responsibles.

For further details: https://www.micronsemiconductor.co.uk/product/s1/