AGATA AT FAIR

AGATA week 2026

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September 9, 2026

Installation of SuperFRS target July 2026

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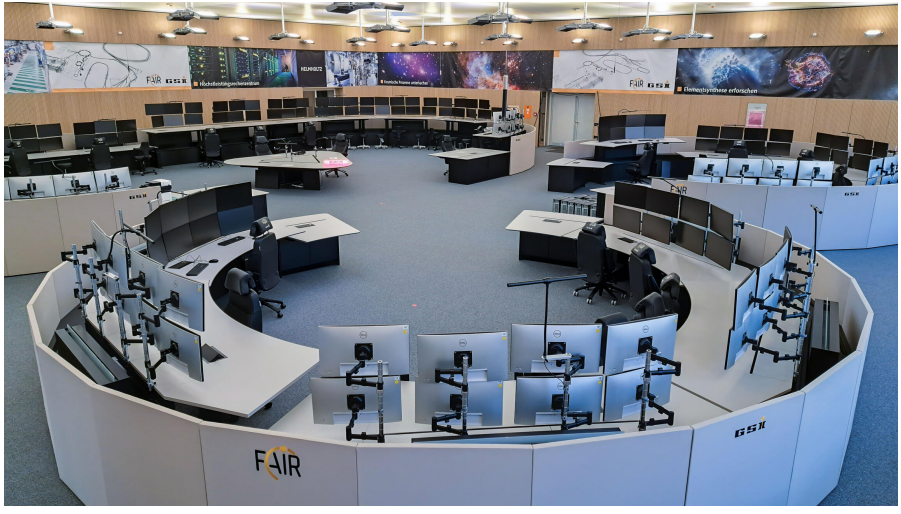
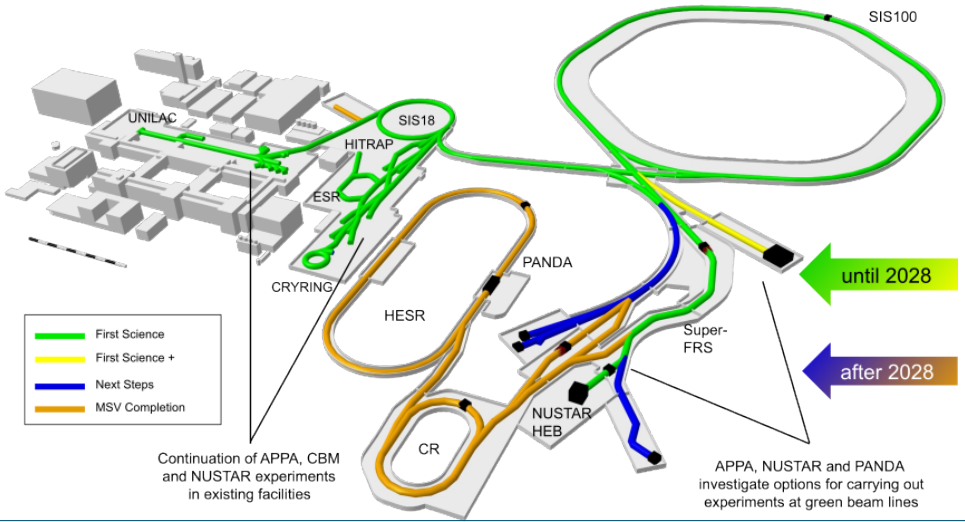
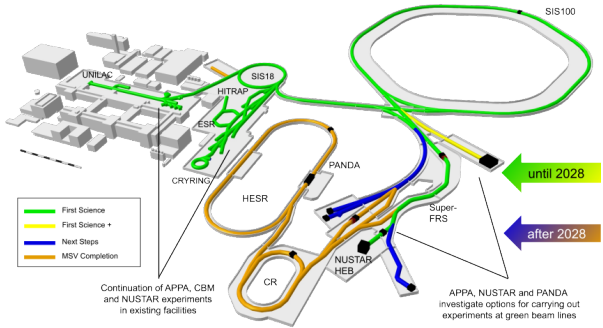
FAIR Control Center



FAIR timeline (last year)



FAIR time line (last year)



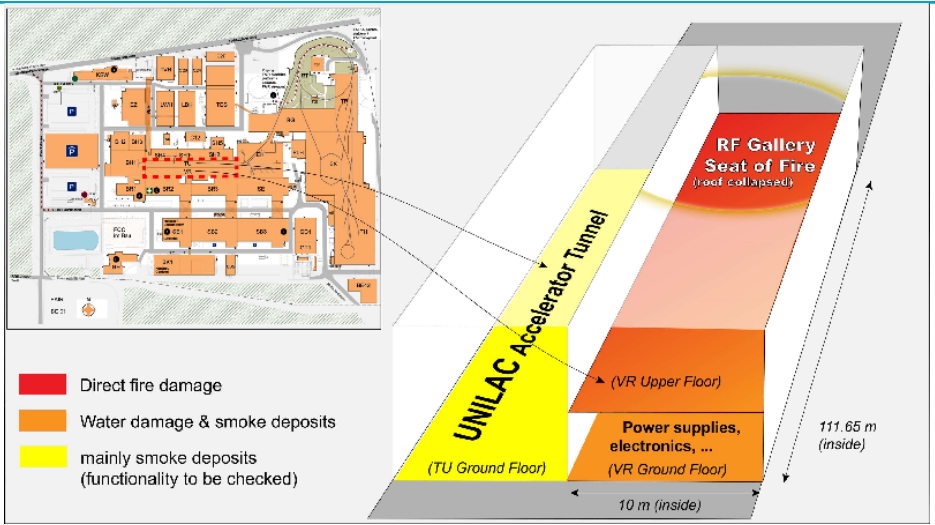
- End of 2028 “First Science”: NUSTAR experiments with SIS100 beams at Super-FRS
- S-FRS provides secondary beams to R^3B, Super-FRS EC, and DESPEC
- Continue experiments at GSI (SHE at UNILAC, ESR, CRYRING)
- AGATA to be installed at the low-energy (LE) branch of Super-FRS

Feb. 2026 fire at GSI

Feb. 2026 fire at GSI

- On February 5, 2026, at around 6:00, a major fire broke out at GSI
- The fire originated in the area of the RF supply for the UNILAC
- Approximately 200 emergency personnel were on site
- The fire was completely extinguished by Friday morning, February 6, 2026.

Feb. 2026 fire at GSI



Feb. 2026 fire at GSI

- Severe damage to high-voltage power supply for the UNILAC linear accelerator
- A technical fault within an electrical cabinet was determined to be the cause of the fire incident
- Lengthy cleanup proceedure, also in nearby offices and labs
- Experimental facilities and FAIR construction site not directly affected

The overarching objective is to rapidly commence solutions for the continuation of research in close collaboration with the scientific community:

- Beams for FAIR commissioning by Q4 2027
- Intermediate injector for FAIR2028 by Q4 2028
- Restoring UNILAC injector capability by 2030/2031
- The process of securing the necessary funding is on a good path

Perspectives and Beams at FAIR

Short term (1 – 2 years):

- Experiments with available beams, alternatives for science

Mid term (3 – 5 years):

- Resumption of the full physics program
- (possibly delayed) FAIR2028

Long term ($>$ 5 years):

- Ensuring research dependent on long beam-pulse structure
- superheavy elements, parts of materials research and fusion-related research and redundancy of the injector chain

- Beams for commissioning the FAIR machines and detectors (p, ^{12}C) in Q4/2027

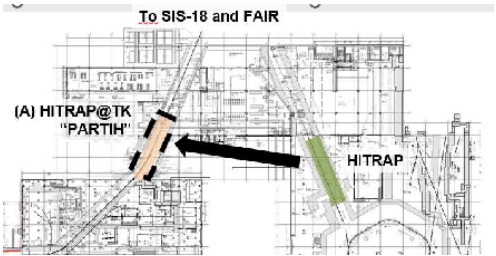
- Heavy-ion beams (up to Xe) for an intermediate science program latest Q4/2028 until Q4/2030

- Full GSI/FAIR capabilities with UNILAC as a high-intensity short-pulse machine within Q4/2030
- HELIAC for long-pulse operation as of 2032

FAIR commissioning

^{12}C beam at low intensity (10^{7-8}/spill, $^{12}C^{5+}$ up to 1.5*A*GeV)
(PARTIH $\leftrightarrow$ HITRAP in transfer channel)

- Technical commissioning with beam of FAIR HEBT (beam transport lines) and Super-FRS
- Beam parameters not sufficient for a broad competitive user beamtime, focus is on detector tests and selected experiments (e.g. BIO)



FAIR commissioning

Beams up to Xe at medium intensity from InterLAC for:
Commissioning:

- Accelerators Super-FRS, SIS100 commissioning
- Detectors for NUSTAR (Super-FRS, R3B), CBM and APPA-Laser experiments

Adapted FAIR 2028 science program:

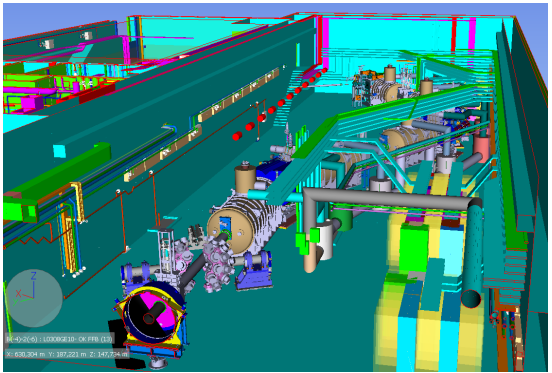
- Measurements with light and medium-mass beams at CBM
- Adapted NUSTAR ES/FS program with focus on light and medium heavy beams from Super-FRS

GSI UNILAC fire will not delay the start of FAIR2028, albeit with a modified staging

Next step: FS++

- APPA cave
- NUSTAR LEB for high-resolution gamma-ray spectroscopy with AGATA and stropped beam experiments

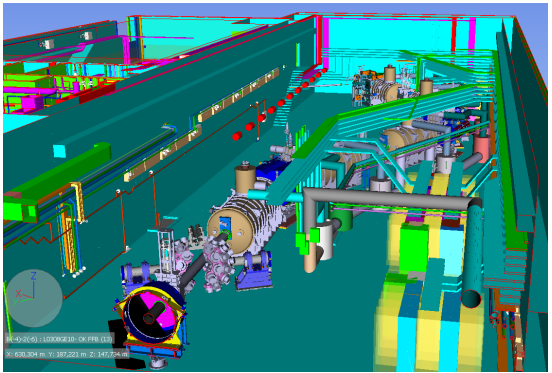
Low-energy cave



- Building completed, but installation of infrastructure awaits funding decision
- Operation currently planned for First Science++ phase from 2030+

H. Albers, P. Hofmann

Low-energy cave



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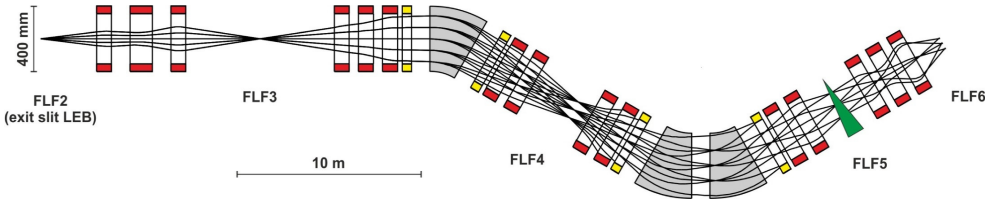
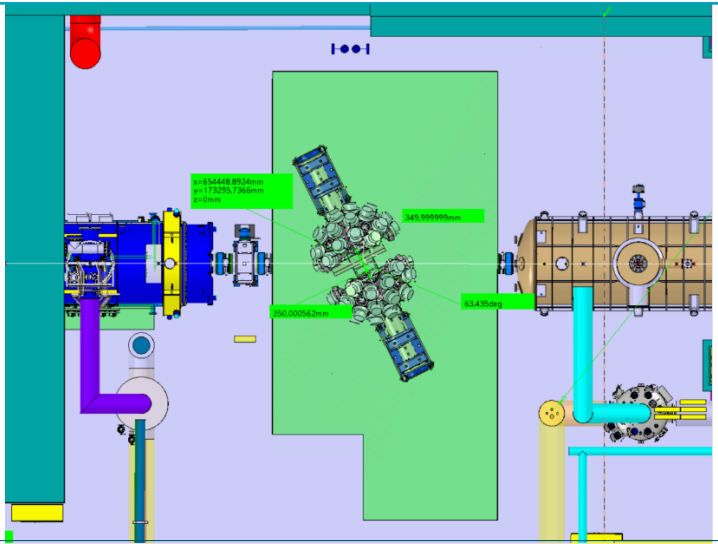
Low-Energy Buncher



Original conceptual design with flexible operation

- Large experimental area at FLF3, about 7 m along the beam line
- Large acceptance spectrometer
- Three dipole magnets with 30° deflection angle, maximum rigidity 7 Tm (about 300 *A*MeV depending on the species)
- High-resolution / energy buncher mode
- Dispersion matching (main-separator and energy buncher)
- Intermediate focus at focal plane FLF4, LYCCA for particle identification

AGATA at FLF3



Status of the LEB

- Cost estimate of the existing design presented to In-Kind Monitoring Group in June, under evaluation
- No details of magnets, etc., included, cost estimate allows for flexibility
- Technical building infrastructure for CBM was approved in the latest Council, once CBM approval is finished (end of the year), LEB can be next

Need to think about requirements now

- LEB will serve NUSTAR sub-collaborations (HISPEC/DESPEC, Super-FRS EC and Mats/LaSPEC)
- Coordination within NUSTAR supported by one dedicated person, discussion with radiation protection, safety, and 3D modeling groups needed

AGATA – LEB working group

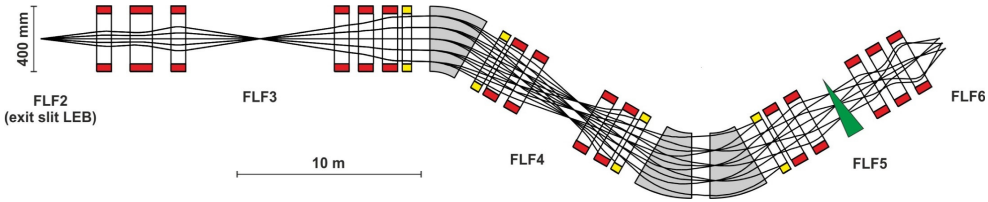
- Formed ad hoc at the last AGATA week
- Establish needs and wishes of the AGATA collaboration for the Super-FRS beam properties and the future Low-Energy Branch spectrometer

Members:

- Jose Javier Valiente Dobon
- Helena Albers
- Daniele Brugnara
- Pieter Doornenbal
- Andrea Jungclaus
- Magda Gorska
- Stefanos Paschalis
- Peter Reiter
- Dirk Rudolph
- Kathrin Wimmer

Since LEB design is still unclear, define our wishes and requirements based on a few representative test cases

Low-Energy Buncher



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Possible scenarios

Experiments at FLF3 with only LYCCA for product identification:

- Improved resolution and acceptance compared to PreSPEC campaign
- Limited to inelastic scattering with pure beams

Experiments with one dipole:

- Good transmission
- Large focal plane required to accept multiple charge states

Full LEB spectrometer:

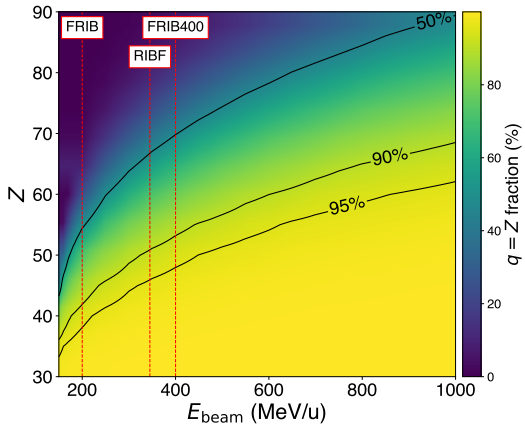
- Good momentum and A/q resolution
- Reduced transmission

Requirements:

- Resolving power of at least 2000
- Needed for charge state separation and momentum distributions

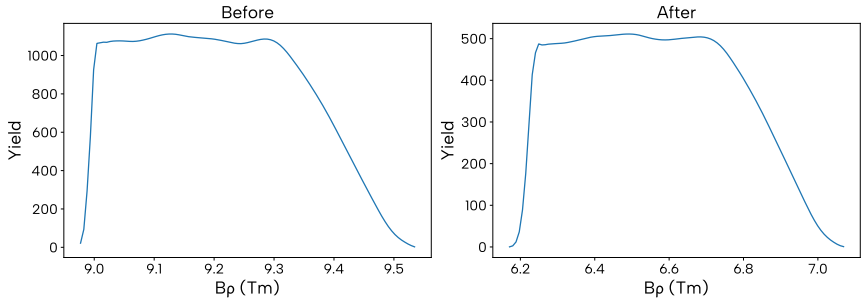
Maximum rigidity

- 7 Tm corresponds to 300 *A*MeV
- After energy degrader at FLF2, especially the heavy beams will be distributed over several charge states.
- The maximum magnetic rigidity of the EB system has been restricted to 7 Tm which is an optimized energy range for experiments based on range compression and applications of gas-filled stopping cells. Nevertheless, in view of the uniqueness with respect to other international facilities, it would be desirable to increase the rigidity up to 10 Tm, which would come into a more favorable energy range for the heaviest ejectiles. H. Geissel et al. Nucl. Instr. Meth. B 317 (2013) 277.



Example

Fission beam of ^{150}Ba, yield $\sim$ 500 pps, slowing down from 500 to 300 *A*MeV



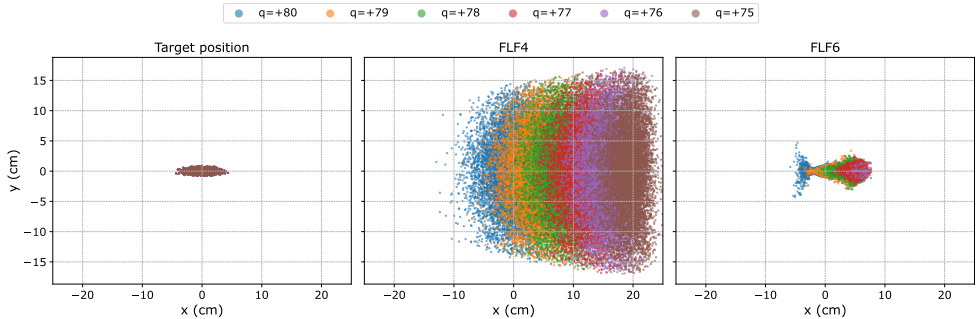
Losses due to slowing down:

- degrader survival $\sim$ 70%
- Momentum width increases by degrader alone from 5% (Super-FRS acceptance) to 10%
- Additional broadening in target due to straggling and reaction itself

In total a factor of at least 5 in statistics is lost

LEB transmission

- ^{206}Hg secondary beam on ^{12}C target (400 mg/cm^2)
- One-neutron knockout reaction to ^{205}Hg in $q = +80, 79, 78$
- Move AGATA target position toward LEB spectrometer
- Transmission to FLF4 97%, to FLF6 57% (upper limit, no material included)



simulations by D. Brugnara

Summary

- Fire at GSI has severely affected the planning of GSI experiments and the startup of FAIR
- Solutions based on alternative injectors allow for FAIR SIS and Super-FRS commissioning
- Early FAIR experiments suffer from reduced beam species and intensity
- First Science++ phase is still on track

AGATA physics program at FAIR LEB

- AGATA is considered a core instrument of NUSTAR
- Simulations to study AGATA LEB capabilities and wish list of the AGATA community for a LEB spectrometer are ongoing