

The FAIR Project

Realization of the world's unique particle accelerator facility in Darmstadt

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Introduction to FAIR Project

FAIR Highlights

In-kind Contribution to FAIR by Sweden

FAIR Project Time schedule

FAIR Project Progress – Civil Construction

Next Steps



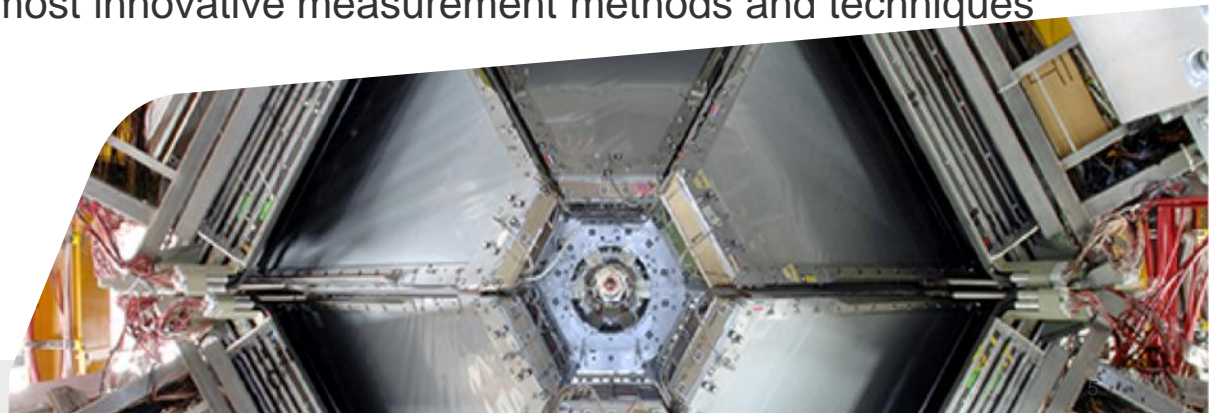
**We explore the
universe...**

...in the laboratory.



FAIR – Facility for Antiproton and Ion Research

- Unique particle accelerator facility for research with antiprotons and ions worldwide
- Matter as it occurs in the universe is first produced and researched in the laboratory
- Fundamental research and development of applications in materials research, radiation biology, aerospace, etc.
- Collaboration between several teams of top international researchers - more than 3,000 scientists
- Different research programs in parallel with different ion varieties possible
- FAIR develops and uses the most innovative measurement methods and techniques



Overview of Shareholders & Scientific users located worldwide

Shareholders

Germany
Finland
France
India
Poland
Romania
Russia
Sweden
Slovenia

Associated

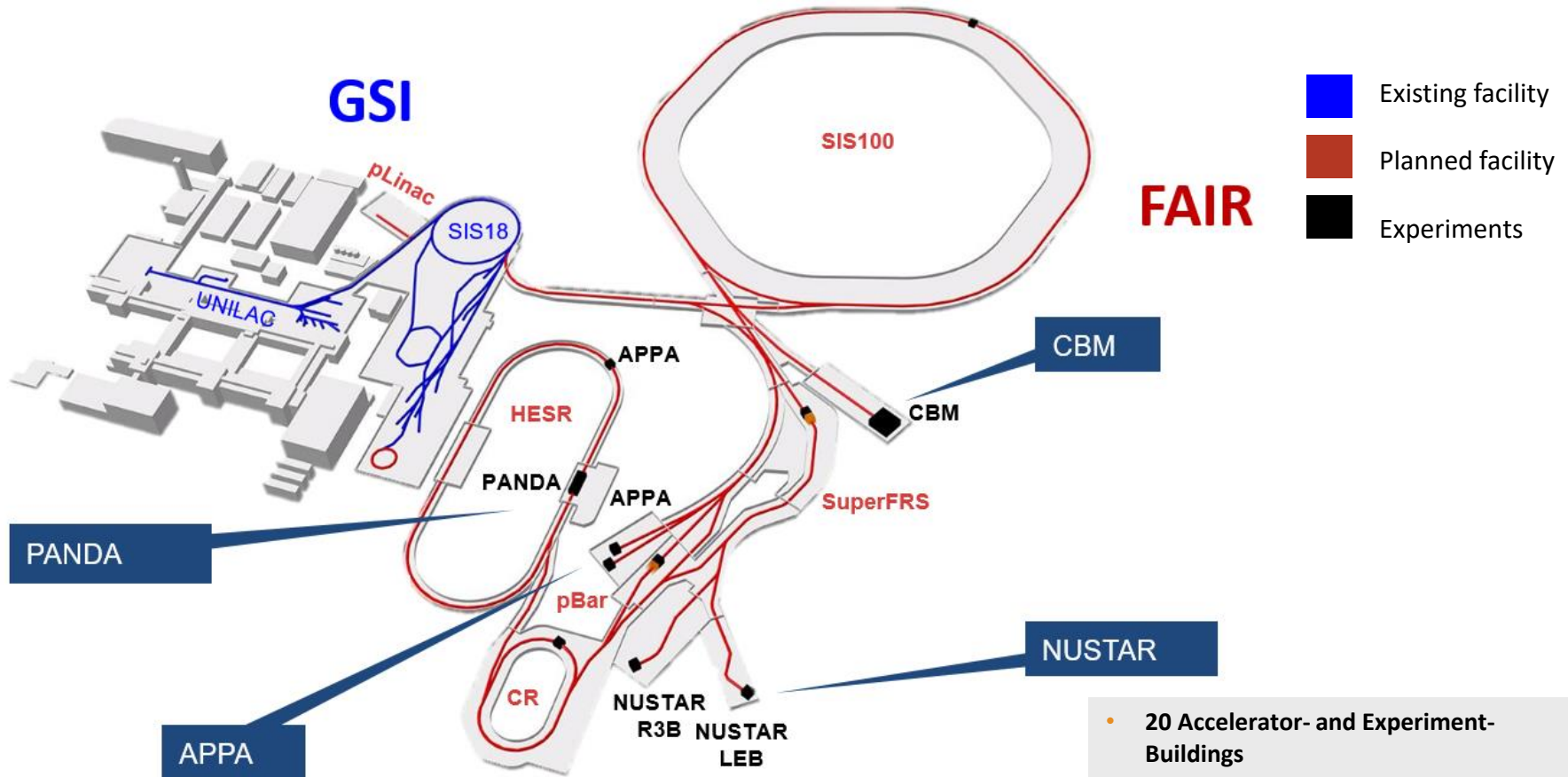
Great Britain

Aspirant

Czech Republic

Cooperation of about 400 institutes in more than 50 countries
1,580 employees on Campus FAIR / GSI in Darmstadt (Germany)

FAIR – The Facility



- 20 Accelerator- and Experiment-Buildings
- Underground accelerator ring with a circumference of 1,100 m
- Around 150,000 m² total space

FAIR Darmstadt



Finland



France



Germany



India



Poland



Romania



Russia



Slovenia



Sweden



United Kingdom



Czech Republic

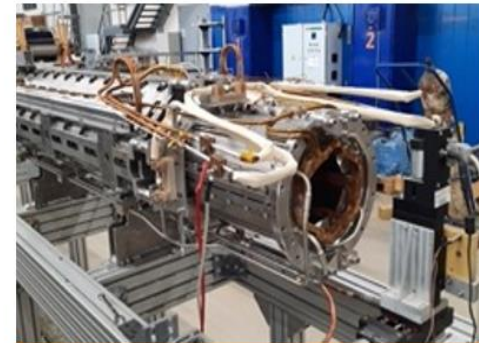
FAIR facility - worldwide production and delivery of accelerator components and experiments



HEBT: Dipole-Magnets



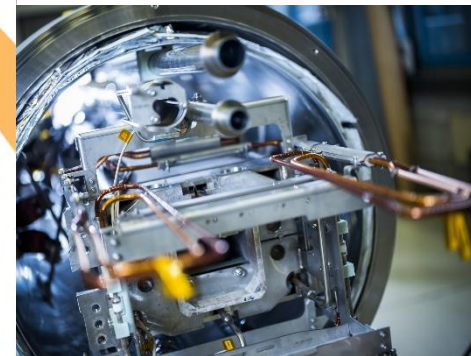
Power
Converters



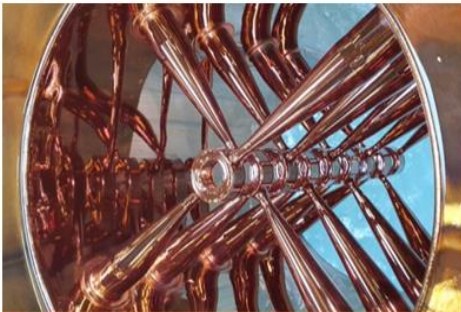
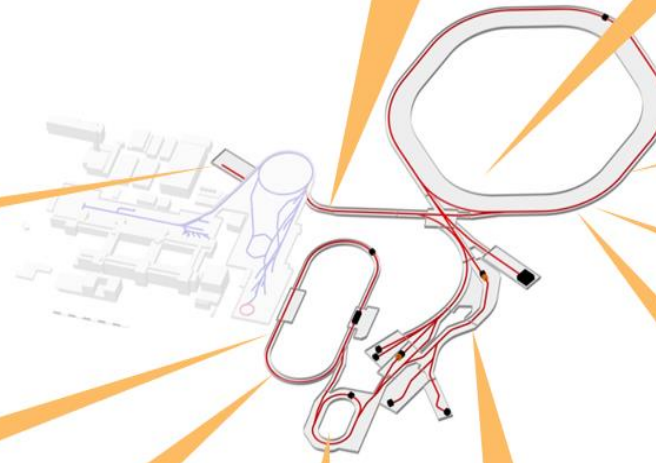
SIS100: Quadrupol-Magnet



SIS100: Vacuum Chambers



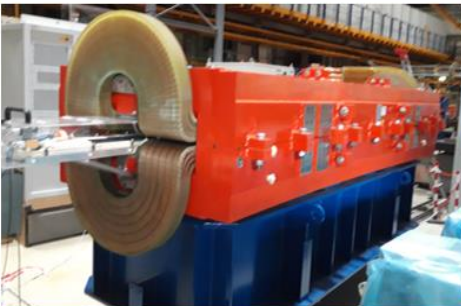
SIS100: Dipole-Magnet



p-Linac: RFQ- Development



HESR: Quadrupol-Magnets



HESR: Dipole-Magnet



CR: Dipole-Magnet



SFRS: Multiplet-Magnet CERN test facility

FAIR Highlights - Storage Area Weiterstadt

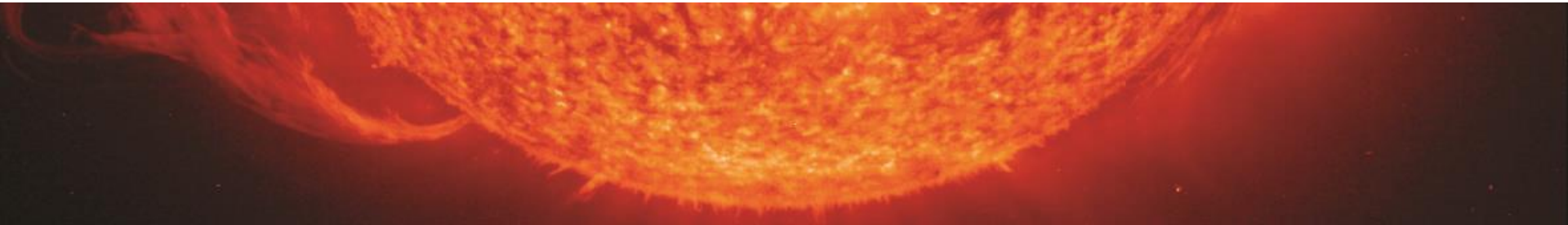
Completed and delivered high-tech components for accelerator and experiments



- Storage area: approx. 9.900 m²
- 4.195 objects (Components, assemblies, boxes, etc.)
- 50% of SIS100 components stored
- 90% of HESR components stored



The 4 scientific pillars at FAIR



NUSTAR

Nuclear Structure, Astrophysics and
Reactions: Stars and nuclei

CBM

Compressed Baryonic Matter:
Inside a neutron star

PANDA

Antiproton-Annihilation at Darmstadt:
Antimatter research

APPA

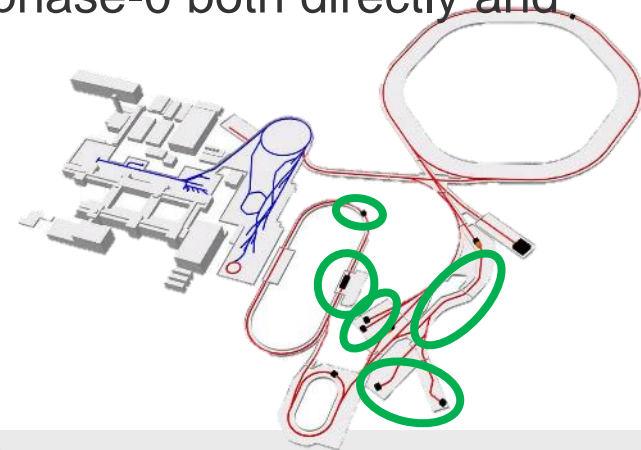
Atomic, Plasma Physics and Applications:
From atoms to planets to cancer research

- The Swedish contribution to FAIR is through a consortium with Finland. Swedish shareholder is the Science Council, Vetenskapsrådet
- In total, the Swedish commitment to FAIR is just over 19 M€@2005 (about 200 MSEK@2005). 4.6 M€ of this is in cash. The rest is in kind
- In-kind contributions are agreed within the council. Sweden chooses costbook items that are compatible with Swedish expertise and strategy. These items are then produced in Sweden and delivered to FAIR in exchange for shares. In-kind is the tool of choice for keeping Swedish science funding in Sweden, whilst strategically enlarging Swedish know-how

Together with Finland, Sweden owns over 1% of FAIR and contributes to FAIR with high technology, precision mechanics and closed systems.

- 1.7 M€@2005 (About 18 MSEK) has been reinvested in the Swedish knowledge economy through in-kind contributions to the FAIR accelerator and a further 4.3 M€@2005 to experiments.
- Sweden is supplying an entire accelerator ring - the cryring – in-kind
- Additional contribution to the further funding needs from 2015 accounts for 2.4 M€@2005
- Thank you for additional funding of 6.63 M€@2005 in 2019
- Swedish companies have also won open tenders.

- is founded on long-term expertise in the field of accelerator research
- comes from universities, SMEs and Swedish heavy-lifters
- provides expertise in high-tech and precision hardware and materials
- includes critical and vital operational components
- contributes to core FAIR machines needed for beams for first science (SuperFRS and pBar)
- contributes to three of the four scientific pillars at FAIR (APPA, PANDA and NUSTAR)
- ... and therefore supports experiments of FAIR phase-0 both directly and indirectly



Swedish contributions to FAIR

- Chalmers chips ladders and drives
- Cryring



You are part of FAIR



Contributions of Sweden

SFRS Beam Loss Monitor Electronics

(Lund Univ.)



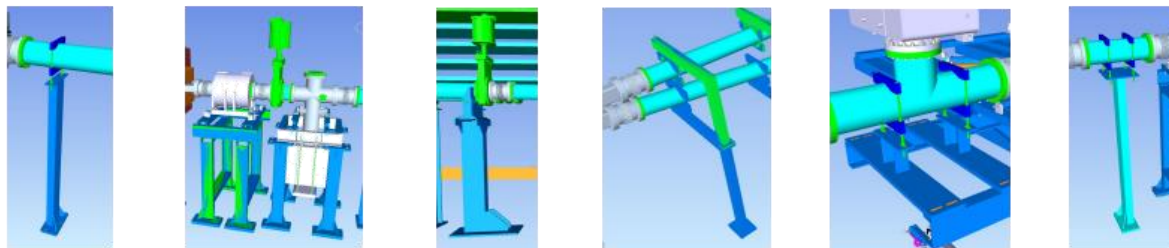
Chalmers chips ladders and drives (Chalmers Univ.)

Pulse compression gratings (Spectrogon AB)

SFRS Infrastructure & control (Lund Univ.)

Cryring

HEBT modular stands (Nordisk AB)

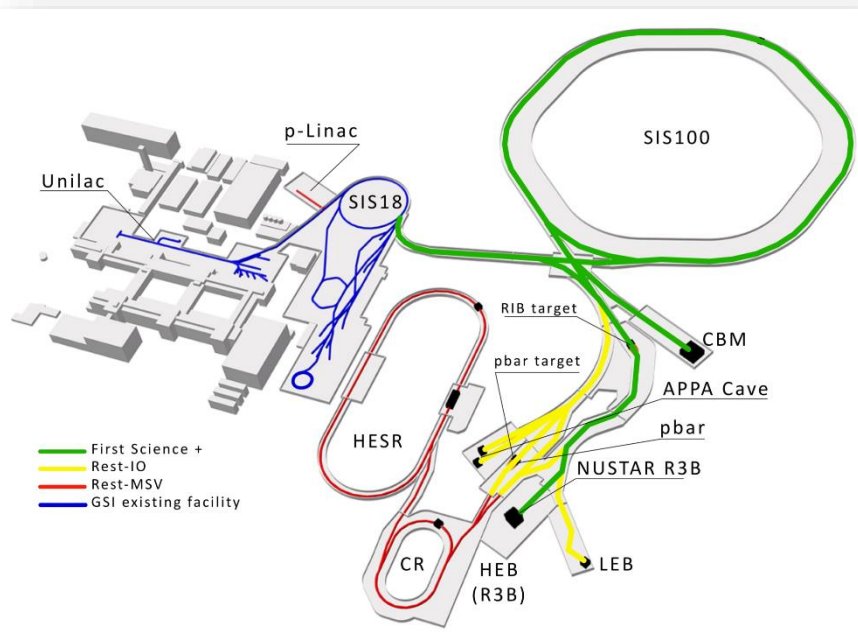


Implementation of a distributed real-time digitizer framework (Klarävdalens Dataconsult)

Research and development

pLinac Design Klystron modulator pulse transformer (Lund Univ.)

- Results of the “First Science and Staging Review of the FAIR Project” were presented to the FAIR Council on 25th of October 2022 with the following main conclusions of the FAIR Council:
 - The Scientific Review panel recommends that the **scenario FS+ (SIS100, Super-FRS-HEB and CBM)** would be the most appropriate starting scenario to achieve world leading science. Decision of FAIR Council on 9th & 10th March 2023.



Construction Dimensions

2 Mio. m³

Ground

will be moved

600.000 m³

Concrete

will be installed

65.000 t

Steel

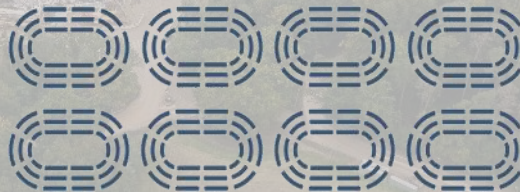
will be deployed

Status as of Januar 2023 : more than 58 % executed

Correspond to 5,000
single-family houses



Correspond to 8-times the
football stadium of Frankfurt



Correspond to 9 Eiffel Towers



FAIR in Construction

November 2022



FAIR in Construction

November 2022



FAIR in Construction

December 2022



FAIR in Construction

December 2022



- So, the „FAIR2028“ science program will include:
 - APPA experiments at the low-energy rings, at the caves at SIS18 and UNILAC, PHELIX and a limited set of experiments which could be hosted at the SIS100 caves
 - NUSTAR at the SFRS with SIS100 beams, plus SHE experiments at UNILAC and ILIMA at the low-energy rings
 - CBM at the new cave with SIS100 beams, and HADES at SIS18
- We will optimize our efforts towards optimum use of our resources and of the space in the new caves for these goals.
- For activities which will have beam only at a later stage, such as PANDA, suitable programs are being developed, when possible using the caves and beams available at GSI/FAIR.

- Construction is just the start: the operation phase brings completely new challenges; FAIR and ESS are at the same stage of development in this respect. Sweden and FAIR can learn together.
- Knowledge management is more than the established models of procurement and in-kind. Let us explore all avenues: education and training, technology transfer, staff and student mobility; shared installation crews... and anything else we can think of today.
- Knowledge is not used is lost. How can we build a knowledge ecosystem around FAIR that keeps knowledge fresh and to-hand for all our benefit in the decades to come?

A man with dark hair and a beard, wearing a dark jacket, is looking up at two robotic arms. The arms are white and black, with various cables and sensors attached. They are positioned in a way that suggests they are working on a task together. The background is a dark, industrial-looking environment with various equipment and cables visible.

Thank you for your attention!
Tack för din uppmärksamhet!