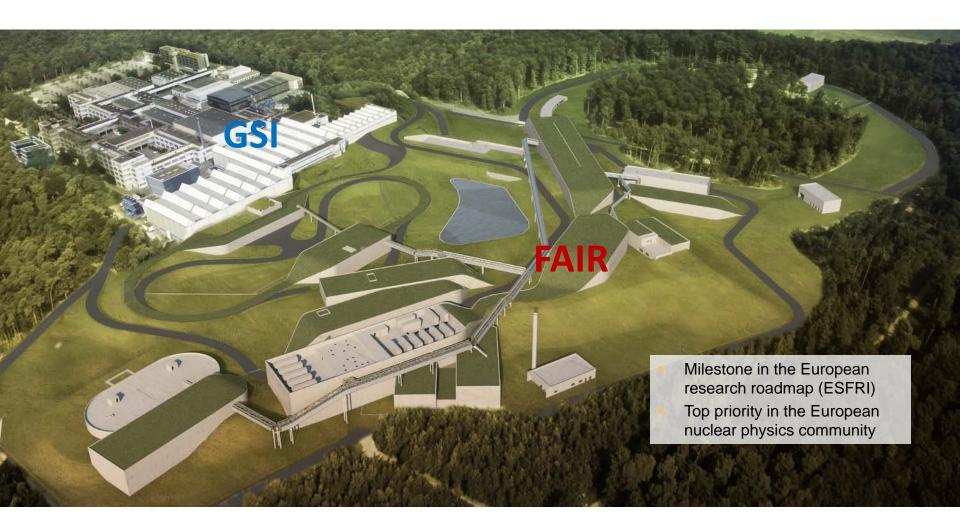


# GSI and FAIR: how it will be







# Our objective:

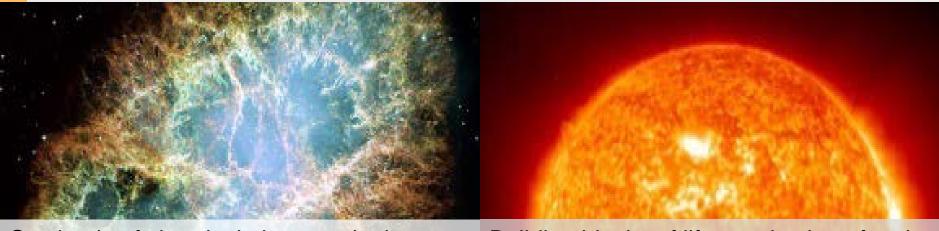
**Creating extreme** conditions existing in the universe with heavy ion accelerators



To find answers to fundamental questions about the Universe: The Universe in the lab ...

### The universe in the lab ...





Synthesis of chemical elements in the cosmos

Building blocks of life: production of carbon and oxygen in stars



Neutron star mergers: equation of state, strong force, neutron rich nuclei



Matter in the interior of Earth and of large planets

# ... with direct applications





High-performance and scientific computing, big data, green IT

Space radiation protection, unique facility fo simulation, collaboration with ESA



Development of nuclear clock: promising candidate thorium-229

Novel applications for tumor and non-tumor diseases

### **GSI GmbH – Facts and Figures**



- GSI GmbH Helmholtzzentrum für Schwerionenforschung
- Member of the Helmholtz-Gemeinschaft Deutscher Forschungszentren e.V.
- Founded in 1969
- Shareholders: German federal government (90%), Hesse (8%),
   Rhineland-Palatinate (1%), Thuringia (1%)
- Employees: about 1.500 (incl. HIJ, HIM)
- Ongoing: transfer of the Juelich IKP (TRANSFAIR)
- Research (all in Matter):
  - Broad in-house research program in theory, experiments and technologies, including activities in MU, MT and MML
  - Research relies on a system of accelerators which serves a large international community of users
  - GSI also participates in outside research activities, all in MU, such as the ALICE experiment at CERN, and provides support to university as national hub for nuclear physics in Germany (detector developments, IT)





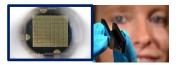


### **Institutes of GSI at Universities**









#### HI Jena (2022)

- 66 employees
- 56 students
- 6,751 M€ base budget

Founded: 2009

#### **Partners**

FSU-Jena, DESY, HZDR

#### Science

Coupling intense light to matter: atomic, plasma, quantum- and fundamental physics

#### **Technology**

High-energy and high-power laser, laserparticle acceleration, diagnostics, quantum sensors and cryogenic detectors

#### HI Mainz (2022)

- 92 employees
- 25 students
- 6,721 M€ base budget

Founded: 2009

#### **Partners**

JGU-Mainz

#### **Science**

Precise understanding of strong interaction effects in atomic, nuclear, hadronic and particle physics

### **Technology**

Superconducting accelerators, highperformance computing, detectors, magnetometers

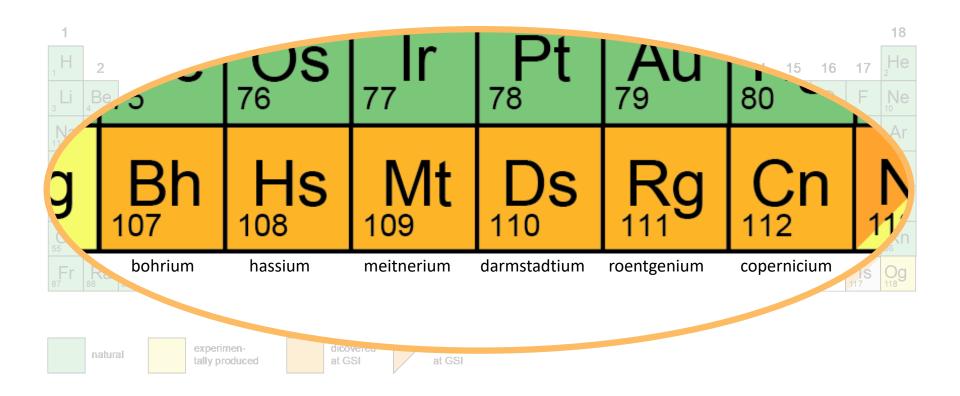






### **Production of new elements**





# **Cancer Therapy with Ion Beams at GSI**

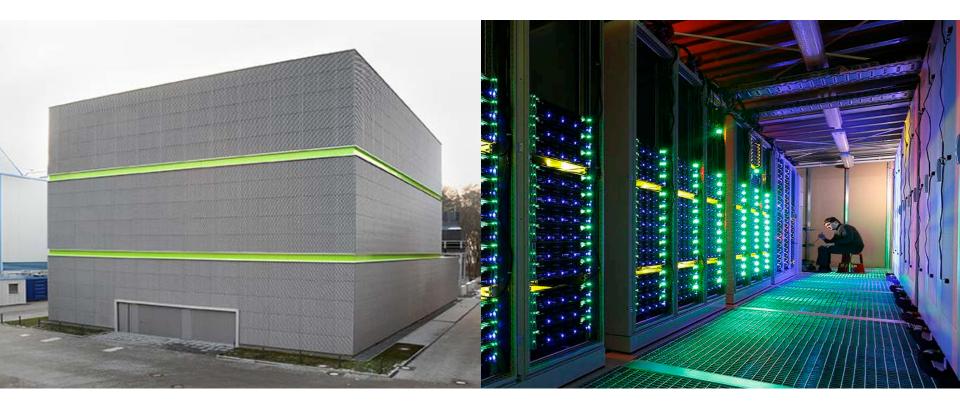


- GSI developed a new kind of cancer therapy.
- With great success from 1997 till 2008 over 440
   patients with tumour in the head and neck with ion
   beams.
- The advantage of the therapy is that the ion beam is strongest in the tumour and therefore spares the healthy tissue.
- Cancer research continues at GSI.



# **Forefront Technologies**





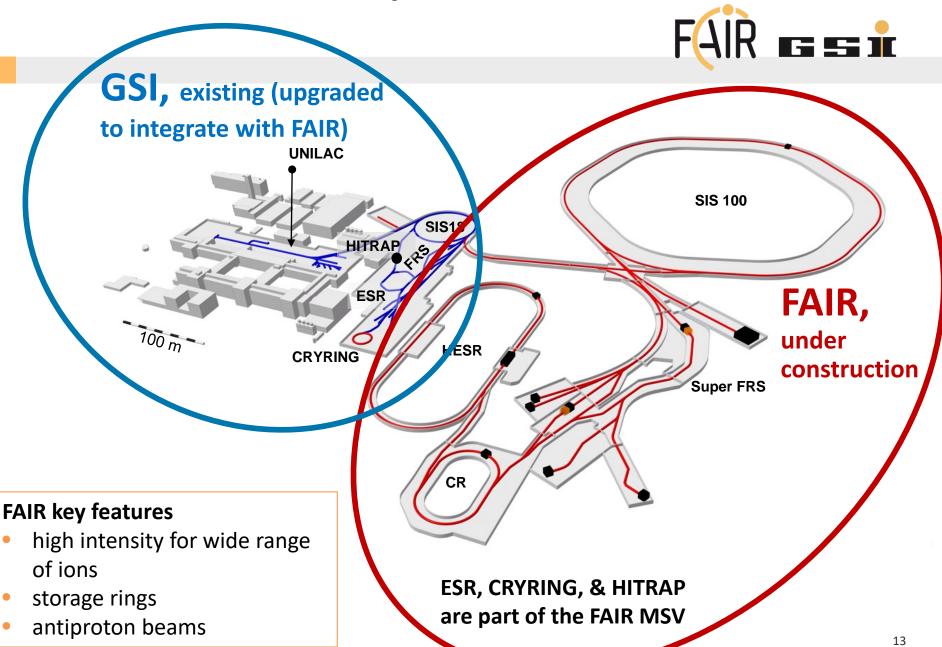
Technological advancements in high-performance & scientific computing,
 Big Data, Green IT

### **FAIR GmbH – Facts and Figures**



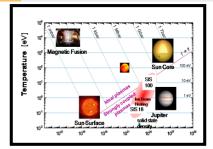
- FAIR GmbH Facility for Antiproton and Ion Research
- Founded in 2010
- Shareholders
  - Germany (70.2 %), Russia (17.5 %), India (3.5 %),
     France (2.6 %), Poland (2.4 %), Finland und Sweden (1.4 %)
     Romania (1.2 %), Slovenia (1.2 %).
  - The United Kingdom is associated, the Czech Republic is aspirant partner.
- Employees 2021
  - FAIR employees: 103

# **GSI** and **FAIR** – The Facility



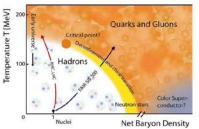
# The FAIR science: four pillars





atomic physics, biophysics, plasma physics, material research

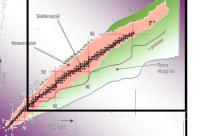




nuclear- and quark-matter

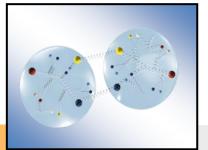






nuclear structure and nuclear astrophysics



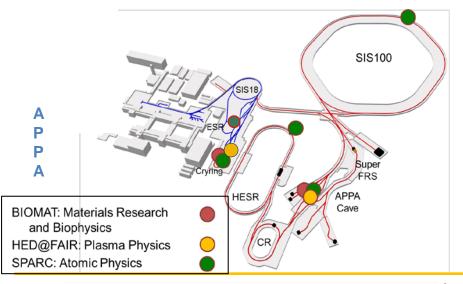


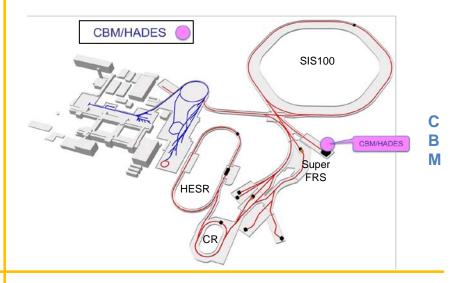
hadron structure and dynamics

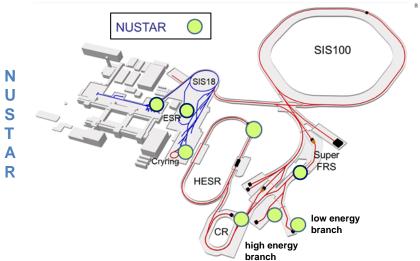


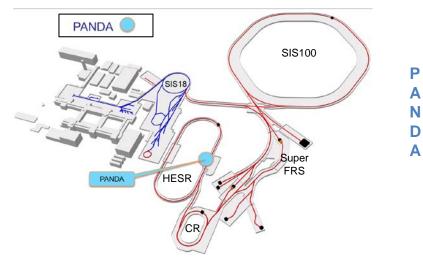
### **FAIR Pillar Locations**











### **Civil construction**



- Civil construction continues to make substantial progress.
  - The civil works for all buildings in construction area south are overall progressing well,
     with manageable time deviations in concrete works.



# **Civil Construction ctd**











# **Civil Construction highlight**



April 2022
SIS100 tunnel coating and TBI installation
progressing well





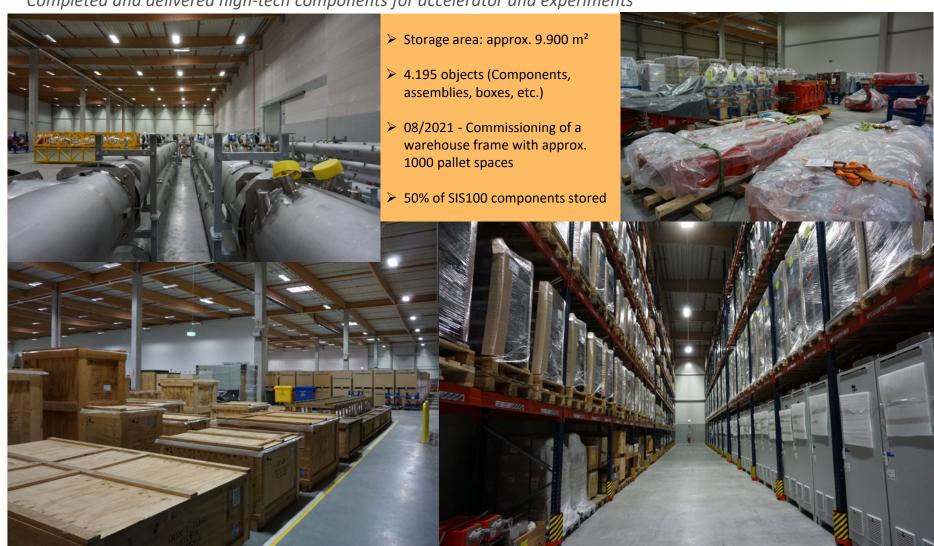


# Accelerators: delivery of components continues steadily



# Storage Area Weiterstadt

Completed and delivered high-tech components for accelerator and experiments

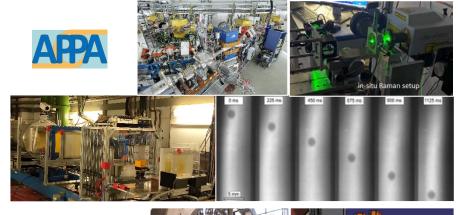


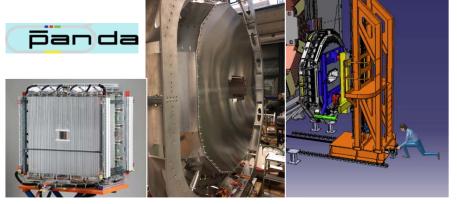
# **FAIR** experiments











# **FAIR - Finance Status (August 2022)**



- The corona pandemic, inflation, the shortage of raw materials, longer delivery times and the development of energy costs lead to considerable additional financial requirements for the FAIR project.
- From February 2022 on, an additional important factor has been added with the Ukraine war and the suspension of the cooperation with Russia.
- The FAIR Council and the BMBF have commissioned an external assessment and a scientific review (evaluation of the FAIR research program by an international panel of experts).
  - The aim is to decide further implementation steps and the corresponding investments by the end of 2022.
  - Results of the review are foreseen in October 2022 and will be the basis for further action
- Stepwise realization of the facility

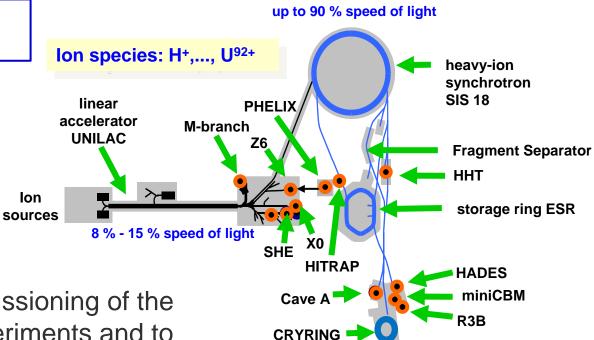


# Early science program FAIR Phase-0



Started in 2019, annual runs of ~110 days until FAIR operation





- Indispensable for the commissioning of the accelerators and of the experiments and to develop the know-how for their operation
- Science while commissioning FAIR
  - 2021 and 2022 runs completed as planned
  - Following the call for the next runs, the PACs, composed of international experts, evaluated the proposals in Sept 2022

## **Beamtime Proposals 2022 for the next two periods**





- 124 proposals submitted (to all 4 PACs: G-PAC, Mat-PAC, Bio-PAC and PPAC)
- 1729 participants of proposals
- From institutes in 45 countries (15% internal users)
- Committee evaluations in September 2022
- Beamtime granting expected in October 2022

