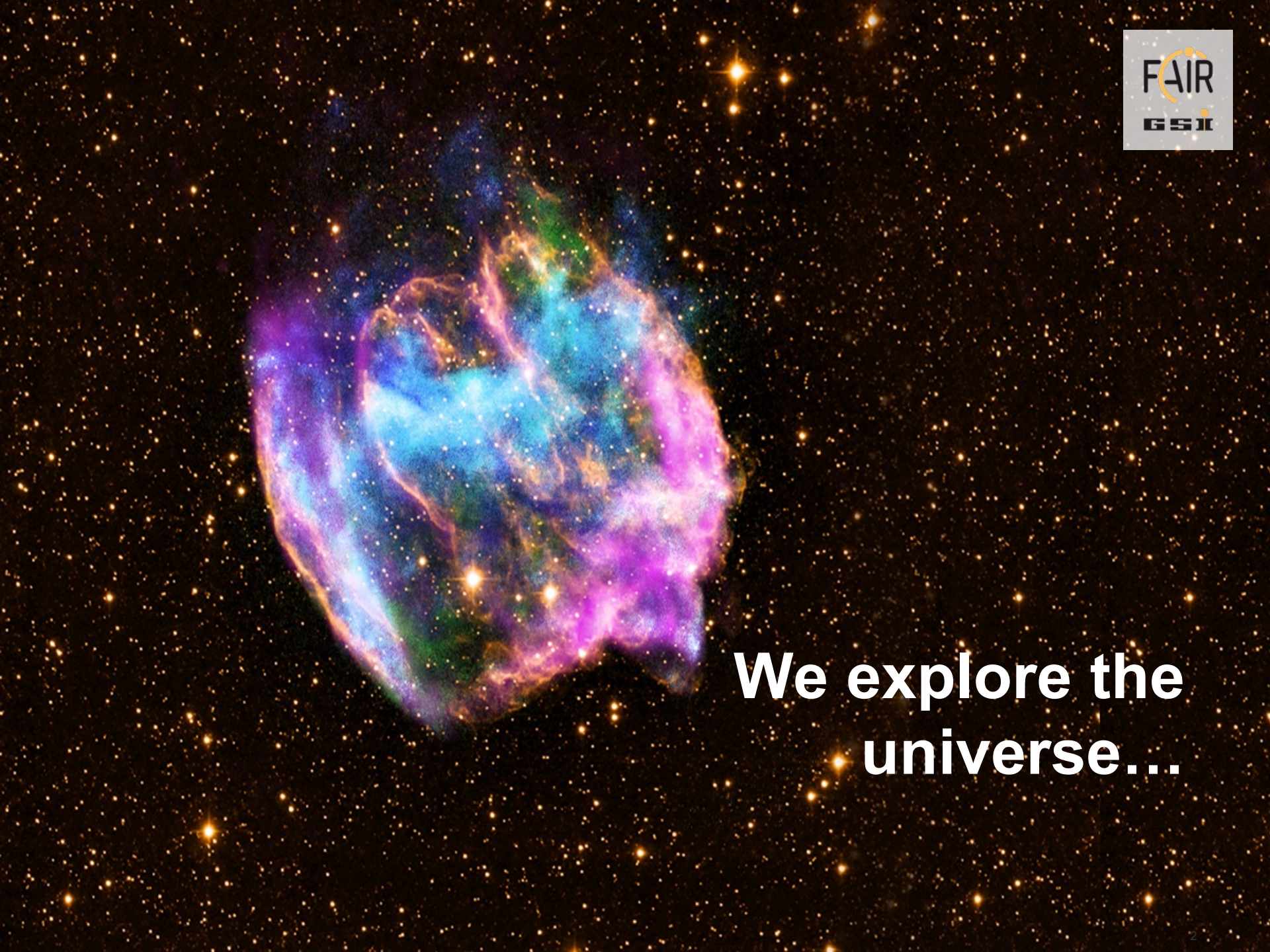
The FAIR Project

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

Overview in behalf of

Jörg Blaurock, *Technical Managing Director FAIR GmbH & GSI GmbH*

Talk given by: **Thomas Hahn,** *Deputy Head Inkind Office & Procurement (IOP)*

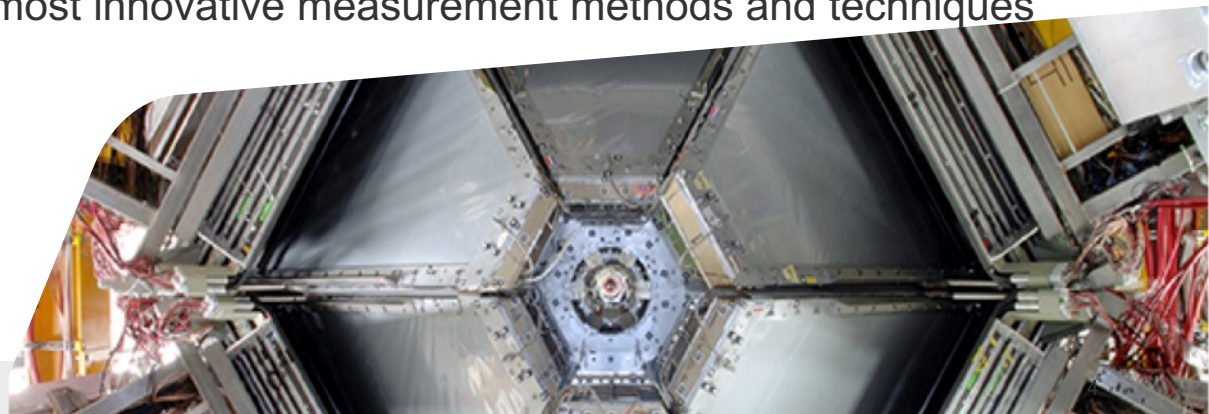

We explore the
universe…

…in the laboratory.

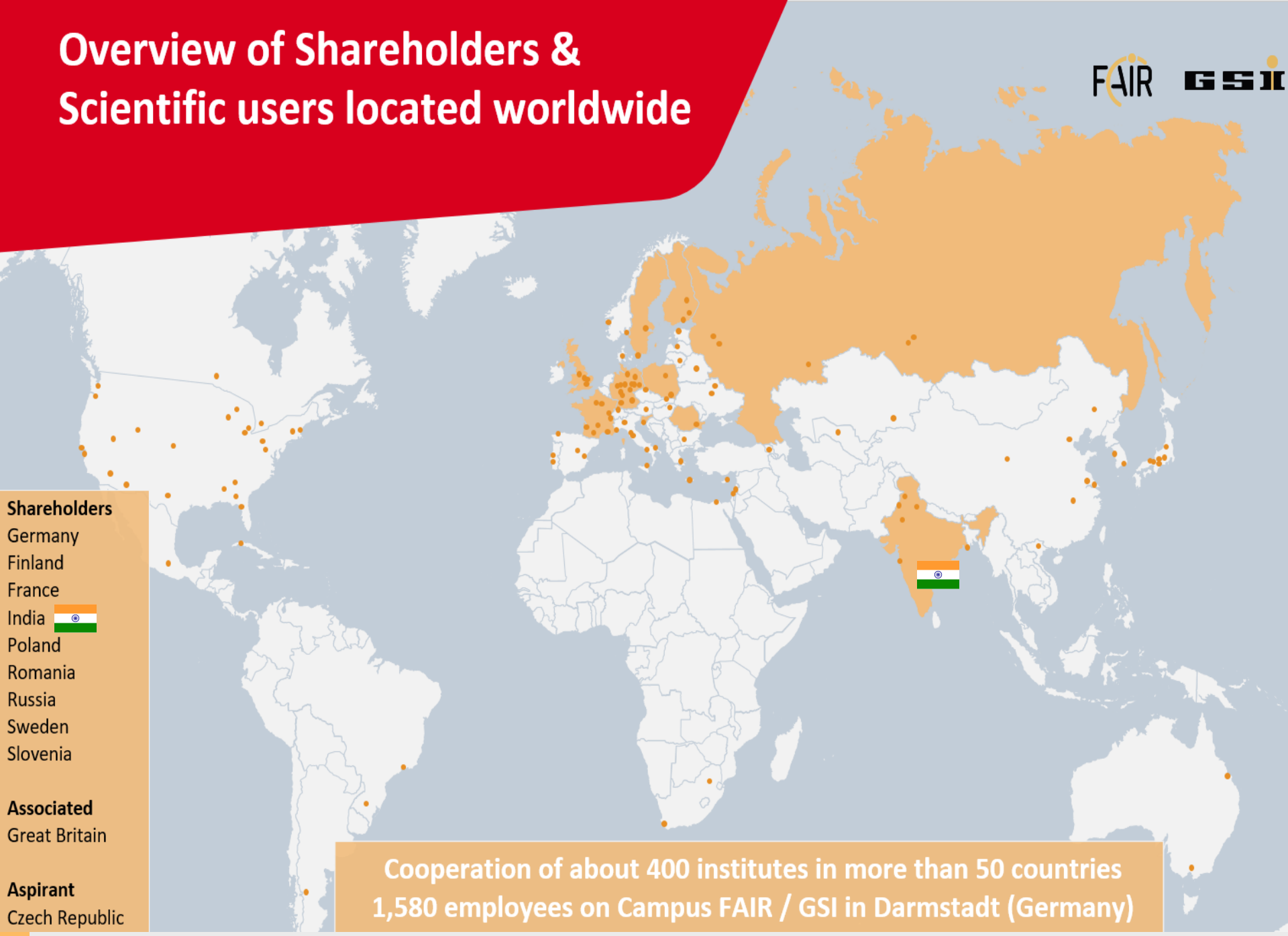
Foto: J. Hosan/GSI, "NASA, ESA, the Hubble Heritage Team (STScI/AURA), A. Nota (ESA/STScI), and the Westerlund 2 Science Team"

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



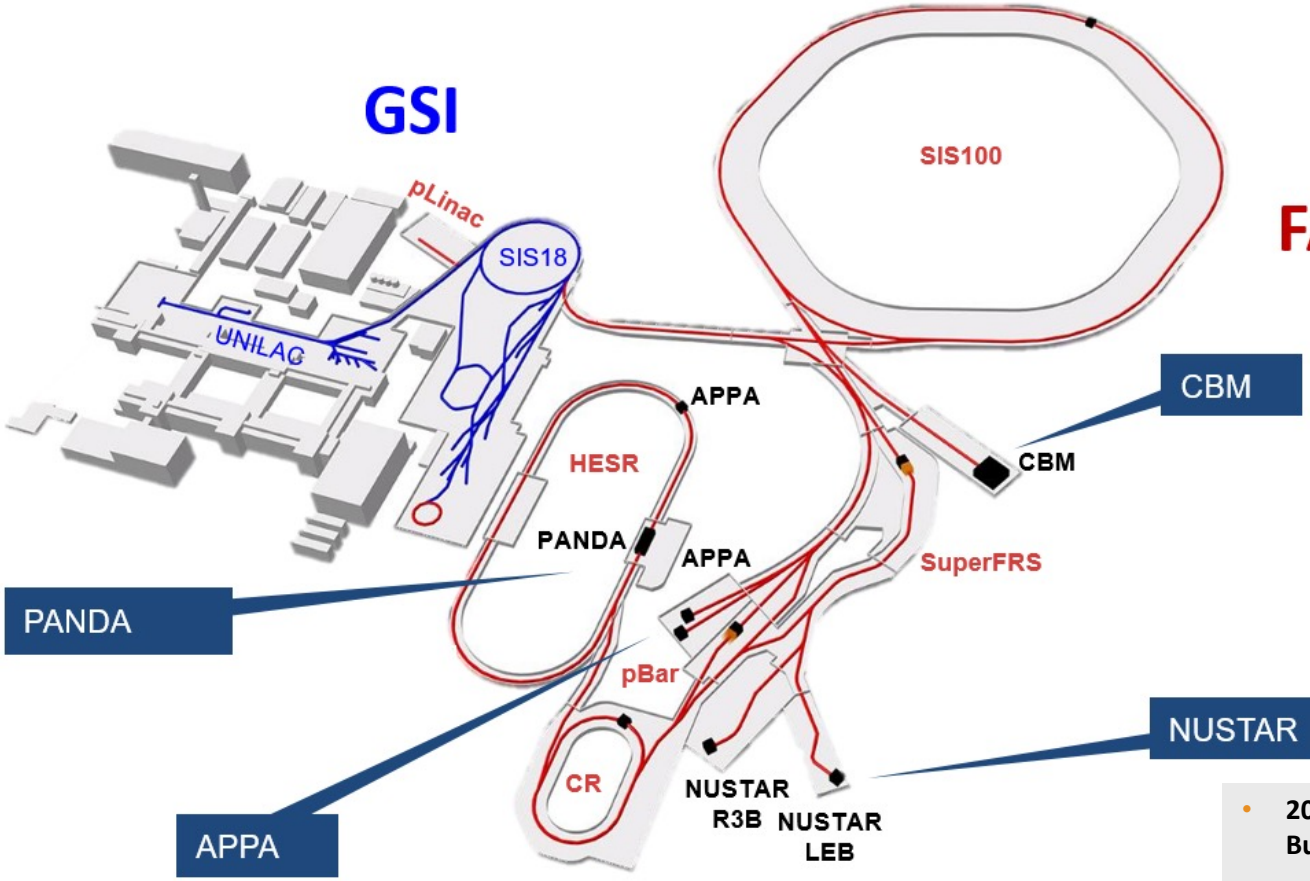
Shareholders
Germany
Finland
France
India
Poland
Romania
Russia
Sweden
Slovenia

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



Existing facility

Planned facility

Experiments

- **20 Accelerator- and Experiment-Buildings**
- **Underground accelerator ring** with a circumference of 1,100 m
- **Around 150,000 m ²** total space

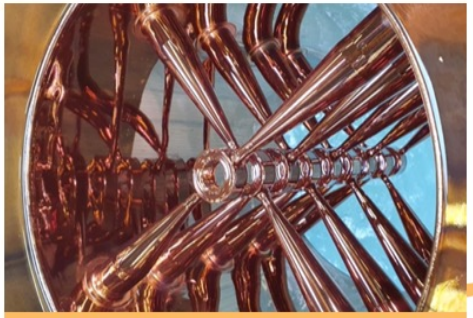
FAIR Darmstadt

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

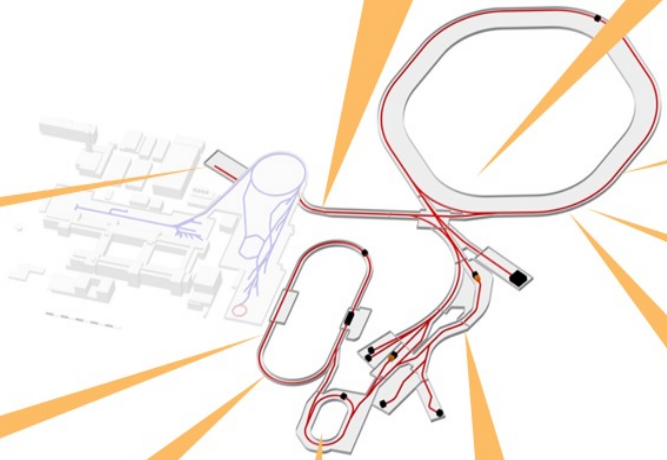
HEBT: Dipole-Magnets

Power Converters

SIS100: Quadrupol-Magnet

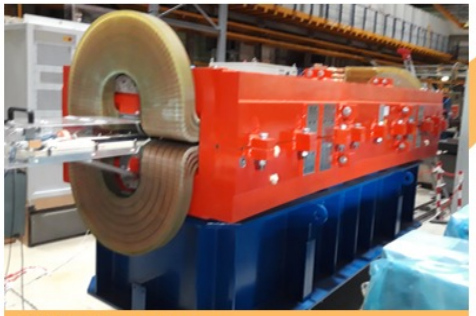


p-Linac: RFQ- Development



HESR: Quadrupol-Magnets

SIS100: Vacuum Chambers



HESR: Dipole-Magnet

CR: Dipole-Magnet

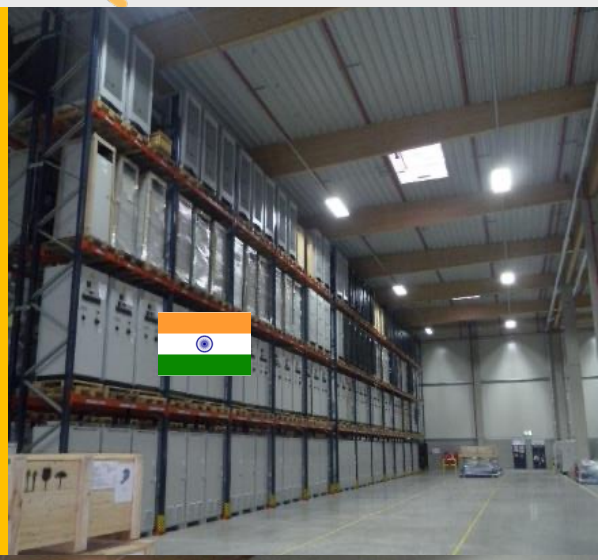
SFRS: Multiplet-Magnet CERN test facility

SIS100: Dipole-Magnet

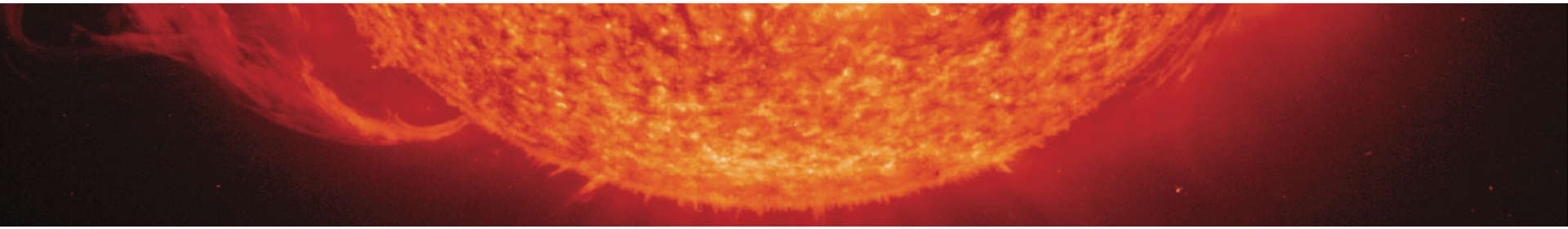
FAIR Highlights - Storage Area Weiterstadt

Completed and delivered high-tech components for accelerator and experiments

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



The 4 Scientific Pillars @ 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

@ FAIR

- **INDIA** owns 2.65% of FAIR. The Indian shareholder is the event hosting Institute, the Bose Institute in Kolkata.
- In total, the Indian commitment to FAIR is just over 51.4 M€ @ 2005. 7.5 M€ of this is in cash. The rest is in kind (contributions en nature).
- In-kind ontributions are agreed with the FAIR Council. India chooses costbook items that are compatible with Indian strategy, expertise and technology. These items are then produced and tested in INDIA and delivered to FAIR in exchange for shares.

- Is founded on long-term Indian-German collaborations in heavy ion and accelerator research

... and many others

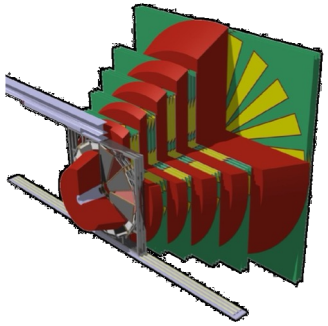
- Comes from selected Industry companies and cooperation's and through academic collaborations
- Covers some important technologies needed in the accelerator and experiments
- Contributes to core FAIR machines, key components and services needed for the start of operation from day 1
- Contributes to two of the four scientific pillars of FAIR (CBM and Nustar)
- And therefore supports experiments of phase 1 both directly and indirectly

@ FAIR EXPeriments

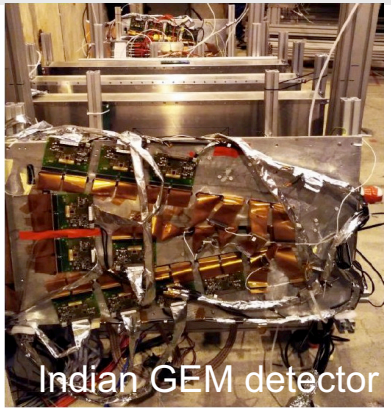
- CBM:
  - *Collaboration* : Coordinated by VECC, along with 13 further Indian Universitites and Institutes
  - GEM Detector and electronics for MUCH (Muon Chamber System)

- NUSTAR:
  - *Collaboration*: IUAC Delhi, Delhi University, BARC Mumbai, TIFR Mumbai, VECC Kolkata
  - HISPEC/DESPEC: DEGAS
    Parts for DESPEC Germanium Array Spectrometer
  - HISPEC/DESPEC: Monster
    Modules of the MONSTER Neutron Spectrometer (VECC)
  - MATS, Penning trap

CBM - MUCH

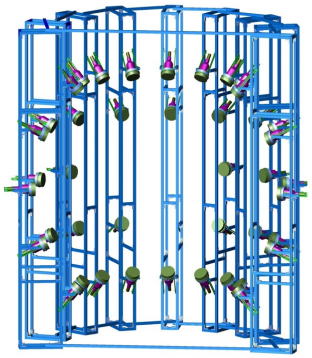


C/Fe hadron absorbers instrumented with GEM and Straw-tube detectors.



NUSTAR-Monster

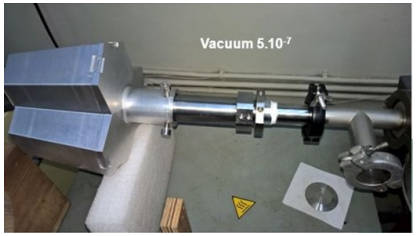
Holding Structure:



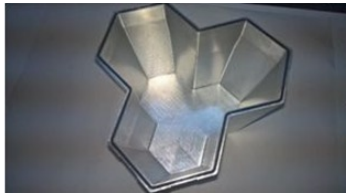
Detector modules developed & produced at VECC Kolkata

NUSTAR-Degas

HPGe array spectrometer



First mechanical tests, TIFR, Mumbai, Feb 2016



In operation: Fall 2017-Spring 2018

@ FAIR Accelerator parts

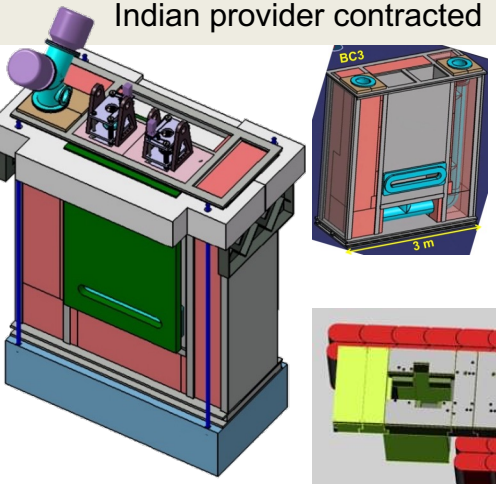
- Power converters (~ 450 pcs, various types)
- High Vacuum chambers for Beam Diagnostics (71 pcs)
- Coaxial Power Cables (~120 km)
- IT/Diagnose Cables
  → 80% of all these cables types for FAIR
  → more than 50 different types
- S-FRS Beam catcher
  → stop primary beam/unwanted fragments
  → leave path for secondary beam (2 experiments)
- Super-FRS Radiation Shielding Roof (~500 tons)

350 of 450 power converters sent to FAIR as in-kind from ECIL Ltd., Hyderabad

You are part of FAIR

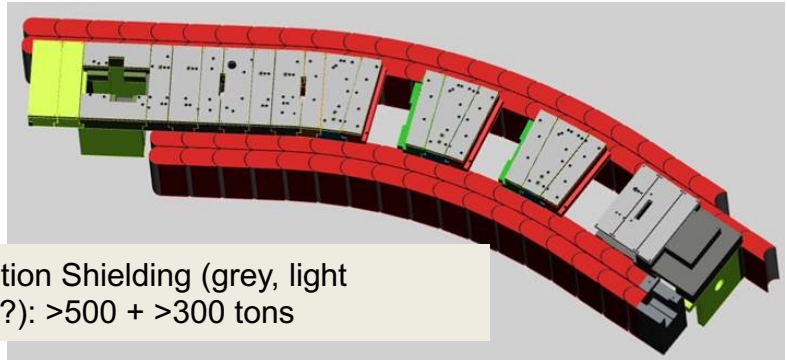
Contributions by India

6 pcs. Beam stopper: designed by cooperation of GSI and CMERI (India), Indian provider contracted

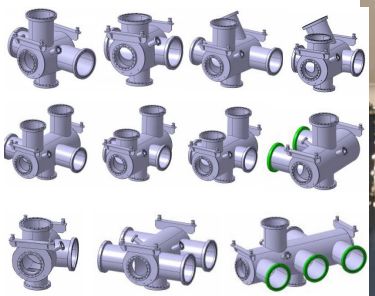


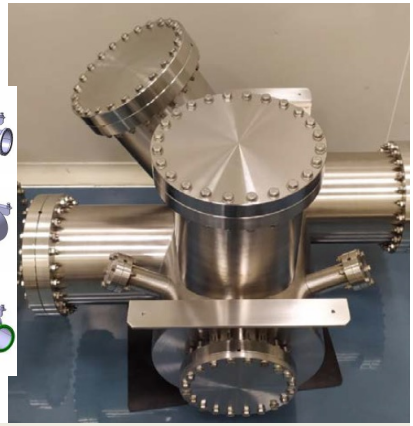
Power Converter: First of Series Unit

Event at ECIL Hyderabad, ECIL rolls out first batch of power converters to FAIR



Radiation Shielding (grey, light green?): >500 + >300 tons





58 pcs. HEBT beam diagnostic high vacuum chambers (12 types) manufactured in Bangalore

IT / diagnose cables (> 50 types); 80% of all in FAIR

>100 km Coaxial Power Cables

You are part of FAIR

Indian Companies contributing already

Technologies developed together with public and private Industry partners and research institutes in India

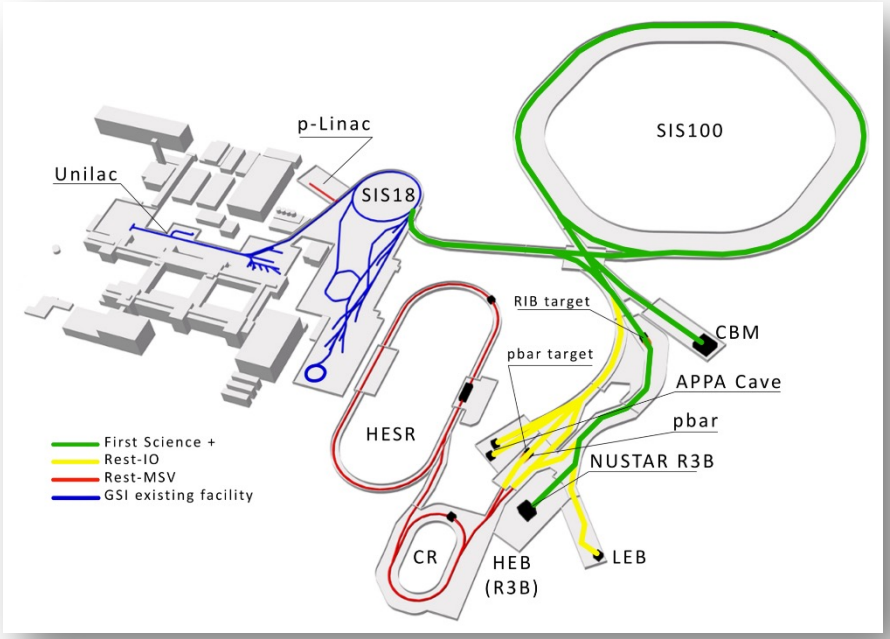
- Ultra High Vacuum Chambers
- High intensity beam stopper
- Ultra stable Power converters
- Co-axial power cables for powering the magnets
- IT / Diagnose cables in various types
- Self-triggering Front End Electronics
- Various Detector modules
- …

you, too ?

like to present your company on FAIR/GSI Campus ?

FAIR stepwise approach towards MSV

- 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+ (Super-FRS-HEB (Early Science-ES), SIS100 (First Science-FS) and CBM (First Science+)) would be the most appropriate starting scenario to achieve world leading science.
  - FAIR Council approved it (FS budget guaranty)



until 2028

after 2028

Estimated accelerator expenditure to realise FS+

Technology	Estimated expenditure in Million EURO (Million INR)
Magnets & injection/extraction	28 (2,501)
Power	20 (1,786)
Vacuum	23 (2,054)
Cryogenics	5 (446)
Control and beam diagnostics	15 (1,340)
RF	15 (1,340)
Installation	37 (3,305)
Remote handling	7 (625)

Website:
https://www.gsi.de/en/start/business_industry

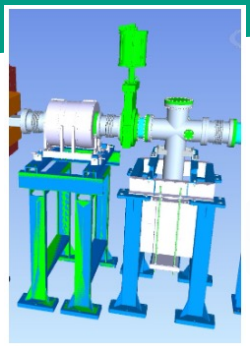
Current procurements

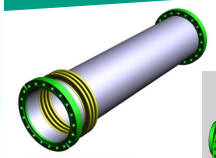
In parallel each started tender will be reported to the Shareholder via **Email**:

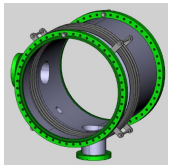
- to the AFC (finance commitee) member of India
- to the ILO (Industry Liaison Officer) of the Bose Institute

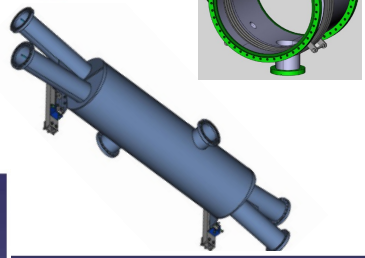
“Short” term opportunities
(Business, economics, procurements)

Vacuum:
Chambers, Pipes, Stands, Bellows, Specials

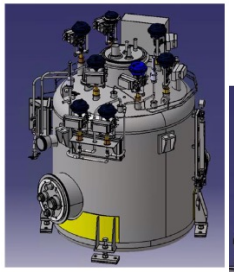


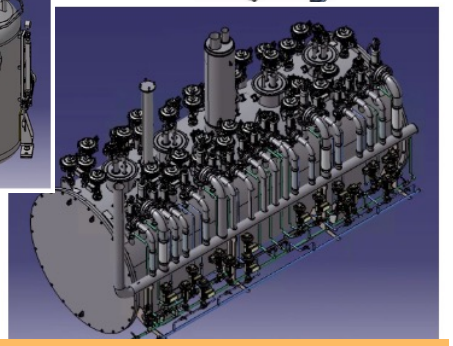






Cryogenics:
Pipes, Feed boxes, Transfer Lines

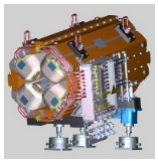


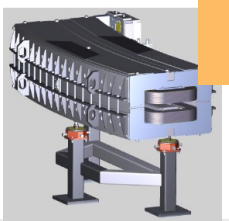


SCAN ME

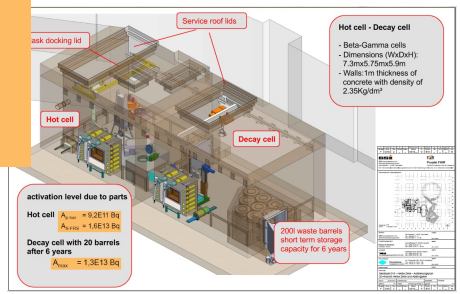
Website:
.../technology_transfer/innovations_products_and_services

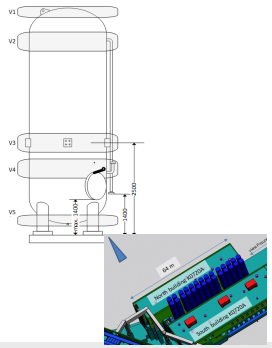
NC Magnets:
Pipes, Feed boxes, Transfer Lines





More…:
S-FRS Hot Cell parts, Installation support, Assembly support (Technicians, Engineers), gas He storage tanks and …





Construction Dimensions

2 Mio. m^3
Ground
will be moved

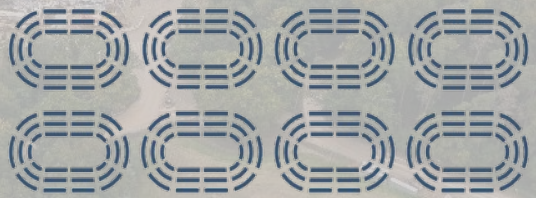
600.000 m^3
Concrete
will be installed

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

Chiller system for heating/cooling system of FAIR infrastructure

FAIR in Construction

December 2022

FAIR in Construction

March 31st 2023

Visit of the **Indian Ambassador,** Harish Parvathaneni,
Consul General, Dr. Amit Telang, and
Science Attaché, Dr. Madhusudan Nandineni, @FAIR

@ place defying German weather conditions

in the ringtunnel

Embassy delegation with Indian physicists, engineers and students working @GSI and FAIR

Embassy delegation in discussion with the FAIR/GSI Technical Management Director

Finding a vision for future collaboration

- FAIR has exciting procurement opportunities in technologically challenging fields
- It's easy to do business with FAIR, as the next presentation will show
- We are looking for development collaborators as well as suppliers
- We have upstream and downstream innovation opportunities for ambitious companies
- Our technical and procurement experts are ready to get in contact with you
- FAIR relies on companies, cooperation and institutes like you to help us bring the **universe into the laboratory**
- I wish us all a successful event doing good business together!

FAIR Industry Meet

12-13 April 2023
Bose Institute

Thank you for your attention!

आपके ध्यान देने के लिए धन्यवाद!