FAIR — FACILITY, RESEARCH PROGRAM AND STATUS OF THE PROJECT*

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The international Facility for Antiproton and Ion Research (FAIR) in Europe will provide a worldwide science community with a unique and technically innovative accelerator system to perform forefront research in the sciences concerned with the basic structure of matter, and in intersections with other fields. The facility will deliver an extensive range of primary and secondary particle beams from protons and their antimatter partners, antiprotons, to ion beams of all chemical elements up to the heaviest, uranium, with in many respects unique properties and intensities. The paper will include overview of the new facility design and research programs to be carried out there. The current status of the FAIR project will be also presented.

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1. Facility overview

The international Facility for Antiproton and Ion Research (FAIR) [1] will be one of the largest and most sophisticated accelerator centres worldwide. The international agreement has now cleared the way for its realization of the total costs of approx. €1 billion. The participating countries will contribute their technical and scientific expertise to the project, in addition to their financial and in-kind input.

FAIR accelerator centre will be built on the east side of the Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany (see Fig. 1).

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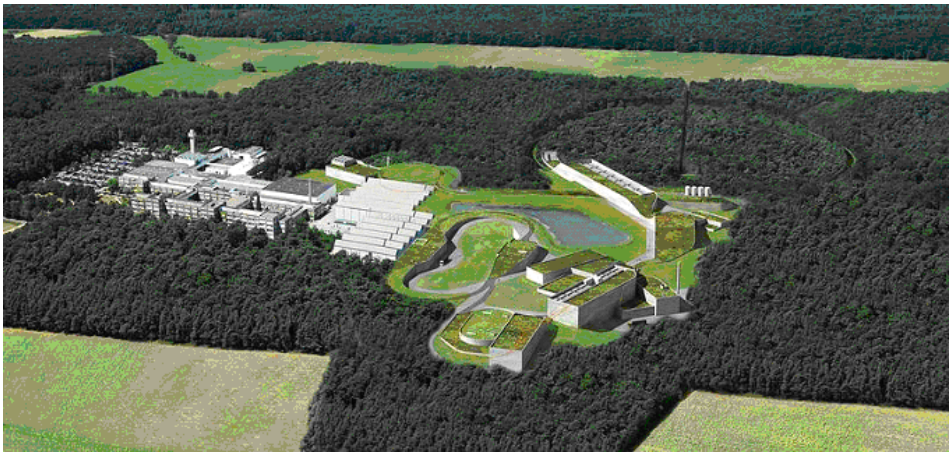

Fig. 1. GSI and FAIR (as a model).

FAIR will generate antiproton and ion beams of a previously unparalleled intensity and quality. When completed, FAIR will comprise eight ring accelerators of up to 1,100 metres in circumference, two linear accelerators and around 3.5 kilometres of beam pipes. The existing GSI accelerators will serve as pre-accelerators for the new facility. The Forschungszentrum Jülich will build the HESR, a storage ring for the research with high-energy antiprotons at FAIR. Figure 2 presents a model of complete version of FAIR complex.

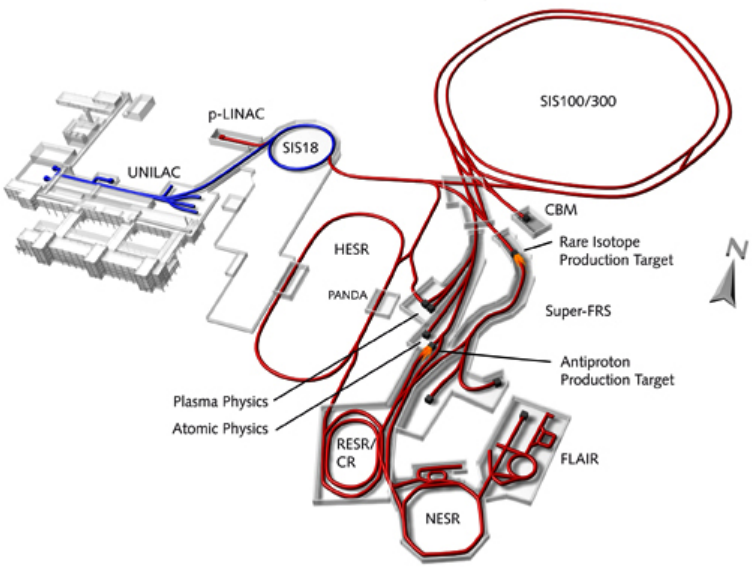

Fig. 2. A model of FAIR complex.

In order to enable an expeditious start of the FAIR construction, the FAIR Joint Core Team (FJCT) and the Scientific and Technical Issues Working Group (STI) prepared a proposal for a start version accounting for currently cost estimates and the firm funding commitments while securing top scientific excellence and the outstanding discovery potential of the facility. For this purpose the start version as agreed upon in 2007 was structured in six modules:

Module 0:	Heavy-Ion Synchrotron SIS100 — basis and core facility of FAIR — required for all science programmes.
Module 1:	CBM/HADES cave, experimental hall for APPA and detector calibrations.
Module 2:	Super-FRS for NuSTAR.
Module 3:	Antiproton facility for PANDA, providing further options also for NuSTAR ring physics.
Module 4:	Second cave for NuSTAR, NESR storage ring for NuSTAR and APPA, building for antimatter programme FLAIR.
Module 5:	RESR storage ring for higher beam intensity for PANDA and parallel operation with NuSTAR, $p+$ beam line.

Based on recent cost estimates and the firm commitments on funding of FAIR Member States the new Start Version is comprised of Modules 0–1–2–3.

Strictly speaking, in year 2007 the project was divided into two phases (phase A and B). Splitting into the Modules was implemented in year 2009. Later on in 2010, the Module 6 (SIS300 + BIOMAT Hall, HESR cooler, EC ring) was smoothly added.

Modules 4, 5 and 6 are scientifically highly desirable and obvious upgrades of the Modularized Start Version further strengthening the long-term potential and scientific viability of FAIR.

2. Research program

The main thrust of FAIR research focuses on fundamental questions of the evolution of the Universe, the structure of matter and its building blocks. Roughly 3,000 scientists from more than 40 countries are already working on the planning of the experiments. FAIR will make it possible to conduct a wider range of experiments than ever before and will be a new and fascinating opportunity for qualified science under international cooperation. The FAIR research programme has been approved by the International Steering Committee of FAIR (ISC) in 2006. It includes 14 initial experiments, which form the four scientific pillars of FAIR[1]:

[1] In alphabetical order.

APPA:	Atomic and plasma physics, and applied sciences in the bio, medical, and materials sciences.
CBM:	Physics of hadrons and quarks in compressed nuclear matter; hypernuclear matter.
NuSTAR:	Structure of nuclei, physics of nuclear reactions, nuclear astrophysics and radioactive ion beams (RIB).
PANDA:	Hadron structure and spectroscopy, strange and charm physics, hypernuclear physics with anti-proton beams.

3. Status of the project

On October 4, 2010 in Wiesbaden nine countries (Finland, France, Germany, India, Poland, Romania, Russia, Slovenia and Sweden) signed the Convention on the construction of FAIR. FAIR will be built!

The establishment of the company "FAIR GmbH" [2], which was also a part of the international agreement, was likewise completed. The FAIR GmbH will coordinate the construction of the accelerator and experiment facilities. Excavations for the first buildings of FAIR will start in winter of 2011/2012 and readiness for operation is expected in 2018.

REFERENCES

[1] FAIR Baseline Technical Report, `http://www.gsi.de/fair/reports/btr.html`

[2] `http://www.fair-facility-for-antiproton-and-ion-research.org/FAIR-GmbH.251.0.html`