At GSI the new international accelerator center FAIR will be built, one of the largest research projects worldwide. Start of construction was in 2017.

**CONSTRUCTION VOLUMES**
- 2 million m³ of earth to be excavated — as much as for 5,000 single-family homes.
- 600,000 m³ of concrete to be used — as much as for eight Frankfurt soccer stadiums.
- 65,000 t of steel to be utilized — as much as needed for nine Eiffel Towers.

**INTERNATIONAL PROJECT**
- Construction of the accelerator center with international shareholders from Finland, France, Germany, India, Poland, Romania, Russia, Slovenia, and Sweden; associated: United Kingdom.
- 3,000 researchers from all over the world are already preparing the scientific program in collaborations and developing the experiments with international partners.

**FACTS AND FIGURES**
- 3,000 scientists from more than 50 countries every year
- Realisation until 2025
- International particle accelerator facility for all elements of the periodic table (ions) and antiprotons
- Existing facility: GSI; future facility under construction: FAIR
- 1,400 employees
- Worldwide cooperation with about 400 institutes from more than 50 countries

FAIR
- FAIR accelerator facility is being built at GSI in Darmstadt via international partnerships
- International limited liability company
- Investments > € 1 billion
- 3,000 scientists from more than 50 countries every year

GSI
- Foundation in 1969
- Mother institute and pre-accelerator for FAIR
- Limited liability company funded by the Federal Republic of Germany and three of its states
- Member of the Helmholtz Association
- Budget € 113 million

**THE UNIVERSE IN THE LAB**
International Particle Accelerator Facility in Darmstadt
In giant planets, stars, and during stellar explosions and collisions, matter is subject to extreme conditions such as very high temperatures, pressures, and densities. FAIR will enable scientists to create such conditions in the laboratory. To do so, they will bombard small samples of matter with particles. These collisions will, for very short periods of time, create cosmic matter at the tiny impact points. The FAIR research is subdivided into four experiment pillars:

**NUSTAR — STARS AND NUCLEI**
How are heavy chemical elements created in stars and stellar explosions?

**CBM — INSIDE A NEUTRON STAR**
In what form does matter exist in neutron stars – the extremely compact remnants of supernova explosions?

**PANDA — ANTIMATTER RESEARCH**
How can antimatter help us understand the mass of matter and the strong force?

**APPA — FROM ATOMS AND PLANETS TO CANCER THERAPY**
Which fundamental symmetries define our universe? What are the properties of the high-density plasmas that occur in the interiors of large planets? How can we use particles to heal diseases, and how can we protect astronauts against cosmic radiation? Can we use ion beams to change specific properties of materials?

At the GSI Helmholtzzentrum für Schwerionenforschung scientists have been experimenting with heavy ions since 1969. Their aim is to gain new insights into the building blocks of matter. The research topics range from atomic, plasma and nuclear physics to materials science and biophysics.

**DISCOVERY OF SIX NEW ELEMENTS OF THE PERIODIC TABLE**
The elements 107 to 112 were produced and detected for the first time at GSI. With the help of a particle accelerator, two chemical elements from the periodic table can be fused together to form a new one.

**CANCER THERAPY WITH HEAVY IONS**
A new form of cancer treatment was developed at GSI. From 1997 until 2008 more than 440 patients who suffered from tumors in the head or neck region were treated with heavy ion beams. Ions selectively damage tumor tissues while sparing the surrounding healthy tissues. By now the therapy is well-established in clinics and meanwhile scientists at GSI are working on its further development.

**GSI**

- UNILAC (120 m length), SIS18 (216 m circumference), Experimental Storage Ring ESR (108 m circumference)
- All elements of the periodic table can be accelerated
- Discovery of six new elements and many exotic nuclei
- Development of a new cancer treatment
- The GSI facility will be the first acceleration stage of FAIR

**FAIR**

- The heart of the future facility is the ring accelerator SIS100 with a circumference of 1.1 km
- Numerous large experiments and storage rings
- Acceleration of all elements of the periodic table and antiprotons
- Up to 99% of the speed of light
- Intensity increased up to 10,000 times
- The highest beam quality and precision

The universe in the lab
For the first time matter that usually only exists in the depths of space will be produced in a lab.

In giant planets, stars, and during stellar explosions and collisions, matter is subject to extreme conditions such as very high temperatures, pressures, and densities. FAIR will enable scientists to create such conditions in the laboratory. To do so, they will bombard small samples of matter with particles. These collisions will, for very short periods of time, create cosmic matter at the tiny impact points. The FAIR research is subdivided into four experiment pillars:

**NUSTAR — STARS AND NUCLEI**
- How are heavy chemical elements created in stars and stellar explosions?

**CBM — INSIDE A NEUTRON STAR**
- In what form does matter exist in neutron stars – the extremely compact remnants of supernova explosions?

**PANDA — ANTIMATTER RESEARCH**
- How can antimatter help us understand the mass of matter and the strong force?

**APPA — FROM ATOMS AND PLANETS TO CANCER THERAPY**
- Which fundamental symmetries define our universe?
- What are the properties of the high-density plasmas that occur in the interiors of large planets?
- How can we use particles to heal diseases, and how can we protect astronauts against cosmic radiation?
- Can we use ion beams to change specific properties of materials?