“Life on Construction Site of FAIR”

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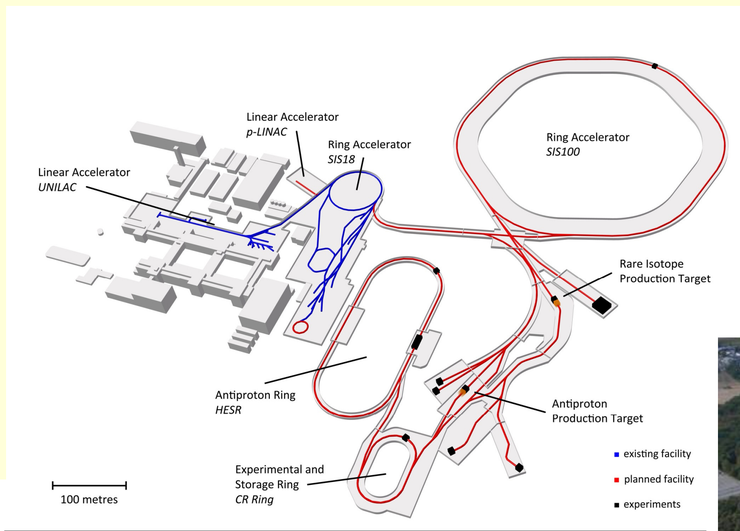
One of the largest accelerator systems in the world as one of Europe's largest research construction projects is being built at GSI Helmholtzzentrum in Darmstadt / Germany. The centerpiece is a ring accelerator with 1100 meters circumference in about 18 meters below ground. From the year 2025 approximately 3000 scientists from all over the world will work at FAIR, the Facility for Antiproton and Ion Research in Europe.

After a period of intensive preliminary work, the groundbreaking ceremony for FAIR took place in summer 2017. Since then great impressive ground work is done, accompanied by surveying activities done by a subcontractor, like monitoring the earth excavation, survey of in-ground pipelines, settlement measurements on existing neighboring GSI facility, control measurements of the surface network and marking main tunnel axes within the deep building pit. Furthermore, work on transfer points is presented, which will already in this status serve as interface between pure construction surveying and precise accelerator alignment.



FAIR is built east of the GSI facility. The existing GSI accelerators are used as pre-accelerators.

The construction of the entire plant is divided into several stages, of which in a first step the large ring accelerator SIS 100 and two smaller accelerator and storage rings as well as the linear accelerator for protons, p-Linac, are built. Later, a further experiment and storage rings are to be added, for which surfaces are already provided on the site.

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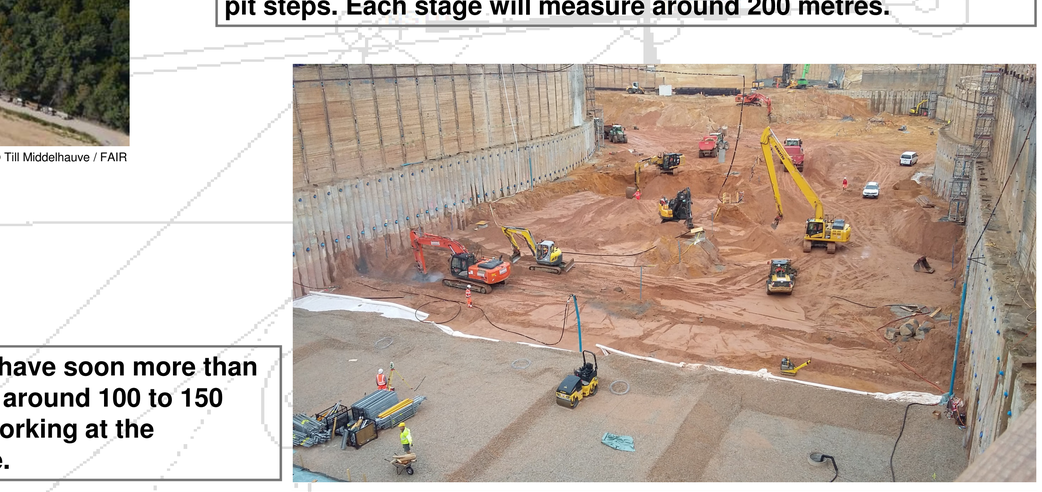
The building area of FAIR with its total of 24 tunnels and buildings is about 20 hectares in size. The finally 62,000 square meters of usable space is for a total of 3.5 kilometers of beam guide pipes, huge detectors and a complex technical infrastructure.

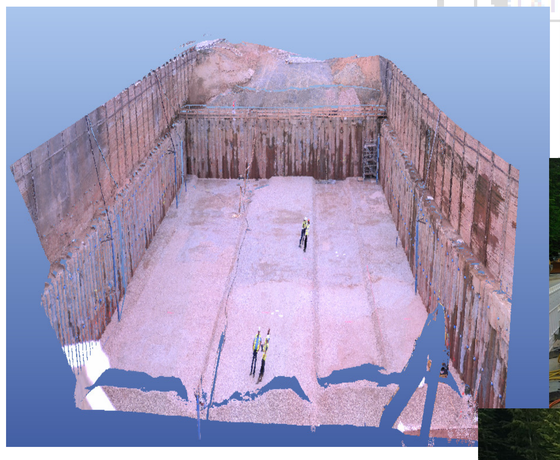


The construction site for the smallest particles is imposing: the pit just for the ring accelerator SIS100 alone is 18 meters deep and up to 40 meters wide.
The 1.1 kilometre tunnel ring will be completed in gradual, open-pit steps. Each stage will measure around 200 metres.

The geodetic surface network with 36 fixed points, distributed all over the existing facility and around the whole construction site, represents the local FAIR coordinate reference frame.
This frame is to be checked annually in a 2D+1D manner and is found stable within ±1mm since 6 years.

It is expected to have soon more than 1000 people and around 100 to 150 trucks per day working at the construction site.

Extensive earth excavation and fillings directly next to the existing, still operating GSI accelerator machines (distance partially < 4m) as well as the lowering of groundwater call for regular settlement measurements at GSI buildings. It is done in 1D at least in spring and fall. Deviation of up to -20mm were found.



Control of the execution of construction work: height of gravel filter layer by scanning, and position of the overlapping bored pile wall with a centering device. Required accuracy: ±5mm.

Each change of the tunnel geometry, following the final machine layout, must precisely be marked. 20% of synchrotron axes were made.

Approximately 100km pipes for sewage, fresh water, cooling water, ventilation and electro must be surveyed directly after each placing into the ground before filled up again. 10% of the effort has already been made.

Even now during the work in the open excavation pit, up to 230 specially designed ground points are installed into the concrete floor, whose coordinates will be related to the GSI machine coordinate system of the existing accelerator system, which again is connected to the FAIR reference frame with an accuracy of < 1cm. These interface points are currently used, among other things, to control the construction of the new building (requirement: ±1mm w.r.t. absolute height) and will later in the closed tunnel serve as 3D points initially only for the absolute orientation of the machine.