

Letter of intent: proposal template

TA2GSI/FAIR

Please specify an acronym, a project title and the name(s) of the project leader(s)

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In the sections below, please provide details on (2 pages max.):

1. Research objectives

Description of the infrastructure:

Name of the infrastructure: **GSI Helmholtzzentrum für Schwerionenforschung, FAIR - Facility for Antiproton and Ion Research**

Location (town, country) of the infrastructure: GSI and FAIR are both located at: Darmstadt, Germany

Web site address: <https://www.gsi.de>, <https://fair-center.eu/>

Description of the infrastructure:

GSI is operating a large accelerator complex consisting of the linear accelerator UNILAC, the heavy-ion synchrotron SIS18 and the experimental storage and cooler ring ESR, which are offering both stable ion beams and relativistic radioactive ion beams.

With the UNILAC, ions of all chemical elements from protons up to and including uranium can be accelerated up to 11 MeV/u, at SIS-18 up to ~2 GeV/u for Carbon and 4.2 GeV for protons. In the ESR, equipped with powerful stochastic and electron cooling devices, stable or radioactive ion beams can be stored and cooled up to energies of ~560 MeV/u (for uranium). The accelerator facility allows for up to seven parallel experiments. FAIR, the Facility for Antiproton and Ion Research, **an ESFRI landmark for nuclear and hadron physics**, is presently under construction close to GSI. The CYRING, a Swedish in-kind contribution to FAIR, is already operational at the ESR of GSI. CRYRING offers cooled primary and secondary beams of 4 MeV/u down to 10 keV/u. It is equipped with internal ion sources for stand-alone experiments with stable beams.

The existing GSI accelerator facilities are being upgraded towards higher beam intensities to serve as injectors for the FAIR facility. A transfer beamline will connect the existing SIS18 with the heavy-ion synchrotron SIS100 and the Super-FRS of FAIR. The Super-FRS is planned to be available with SIS18 beams for first experiments end 2027. SIS100 will provide high intensity beams of U^{28+} (5×10^{11} /cy up to 2.7 GeV/u) and U^{92+} (4×10^{10} /cy up to 10 GeV/u).

State-of-the-art equipment dedicated to nuclear, atomic, biophysics and applications at the UNILAC are: The velocity filter SHIP and the gas-filled separator TASCA for the separation and detection of super-heavy elements, SHIPTRAP, a Penning trap at SHIP for super-heavy nuclei/atoms; the M-branch for materials science and a laser facility for generating hadron beams (protons and neutrons) up to 40 MeV/u.

SIS18 is serving the HADES (High Acceptance Dilepton Spectrometer) set-up with direct beams and secondary beams for experiments and provides direct beams for various experimental stations:

- Experimental stations dedicated to materials research and biophysics for irradiation experiments combined with in-situ characterization of materials and/or biological specimen;
- Multipurpose test stations, e.g. for tests of electronic components, or of detectors built for particle/nuclear physics and also for space missions.

The fragment separator FRS for production and in-flight separation of exotic nuclei serves a number of experimental sites for research on nuclei at and beyond the driplines. In particular, the storage ring ESR is a unique experimental facility at GSI/FAIR and provides:

- Schottky mass spectrometry as well as isochronous time-of-flight mass spectrometry, an internal

gas-jet target for atomic spectroscopy and nuclear reaction studies;

Dedicated experimental equipment for nuclear structure investigations at FRS@GSI and later at Super-FRS@FAIR are:

- The R3B nuclear reaction set-up with dipole magnet GLAD to study collective states and complete kinematics reactions is available for experiments
- Ion Catcher facility for experiments with thermalized exotic nuclei for mass measurements and isomer studies with a multiple-reflection time-of-flight mass spectrometer, for decay spectroscopy;
- High-resolution Ge detectors and fast-timing arrays for atomic and nuclear spectroscopy experiments;

The Super-FRS of FAIR will allow for unprecedented experiments with exotic nuclear beams at relativistic energies; its large acceptance and higher primary intensities makes experiments possible, which cannot be performed at GSI today..

SIS100@FAIR will deliver high intensity primary beams to the CBM experiment, dedicated to study baryonic matter at highest densities created in heavy-ion collisions.

In addition, equipment and projects dedicated to other or multidisciplinary research are:

- Highly energy-efficient computing center “Green IT-Cube”, currently equipped with close to 54.000 cores and 400 GPUs, and 70 PB disk storage for data analysis and simulations;
- For atomic physics, the chain of trapping and storage facilities for heavy, highly-charged ions (HITRAP, CRYRING, ESR) all equipped with a broad variety of dedicated instrumentation;
- High power density beam bunches and various equipment for plasma physics research and the Kilojoule/Petawatt Laser PHELIX with the opportunity of plasma accelerated hadron beams;
- Several experimental stations dedicated to materials research and biophysics for irradiation experiments combined with in-situ characterization of materials and/or biological specimen;
- Multipurpose test stations, e.g. for tests of electronic components, or of detectors built for particle/nuclear physics and also for space missions.

Services currently offered by the infrastructure:

GSI-FAIR is a user facility open to national and international user groups. The beam time application procedure is described at

www.gsi.de/en/work/organisation/scientific_boards/user/beam_time/applying_for_beamtime.htm

On top of the wide breadth of services described above, all experimental facilities including electronics, computing, etc. are provided free of charge to research groups with approved experiments.

Total number of users from the nuclear and hadron physics community: 1380, thereof 93 % external. Total number of users from the atomic physics, biophysics and materials science community: 450 users / year thereof 91 % external.

Description of work:

Modality of access under this proposal:

The beam time is granted in shifts (of 8 hours each). A written project proposal has to be submitted to the GSI/FAIR scientific director, which is then reviewed by the international program advisory committee. Applications for TA have to be submitted separately. A user selection panel is evaluating those applications and attributing budget for T&S.

Support offered under this proposal:

A contact person is assigned to each experimental project. This person provides scientific, technical and logistical support to set-up and to perform the experiment. Further support provided by GSI includes:

- office space and access to the GSI computing facilities;
- training courses and briefings on the general safety regulations at GSI and on the specific regulations at the experimental facilities;
- access to the GSI detector and target laboratories, as well as access to a maintained workshop

- for experimentalists and assistance from the GSI general mechanics shops;
- the GSI Welcome Office is providing logistic support with regard to accommodation, travel and payments;
- bus shuttle from the nearby train and tram stations from Mon. to Fri.; limited lodging facilities in walking distance from the institute

2. Connection to Transnational Access infrastructures (TAs) and / or Virtual Access projects (VAs)

3. Estimated budget request

Summary of trans-national/virtual access provision (table 3.2c)

Access provider short name	Short name of infrastructure	Installation		Installation Country code	Type of access	Unit of access	Unit cost (UC) (€)	Min. quantity of access to be provided*	Access costs		Estimated number of users*
		Nr	Short name						On the basis of UC	As actual costs	
GSI	GSI	1	SIS18	DE	TA-uc	Hour	150,00	2.556	x		290

* To be filled in only for trans-national access, not for virtual access.

Other direct costs' items (table 3.4 b)

GSI	Cost (€)	Justification
Travel and subsistence for trans-national access (if	462.500	3050 person days (90 Euro/day), 470 travel (400 Euro/Travel)
Total direct costs	462.500	
Indirect costs (25% of direct costs)	115.625	
TOTAL travel and subsistence costs	578.125	

TOTAL Transnational access costs

Access costs (€)	383.400
Total Travel and subsistence costs (€)	578.125
TOTAL Transnational Access costs (€)	961.525

4. Participating and partner institutions

In the last calls for proposals, users from 330 international institutions and universities were participating, of which more than 150 institutions and universities are in the EU or EU associated countries. Some of the main strategic partners of GSI are in Germany

- DESY (Hamburg), Helmholtzzentrum Berlin (HZB), Karlsruhe Institute for Technology (KIT) and Helmholtzzentrum Dresden-Rossendorf (HZDR), Forschungszentrum Jülich (FZJ)
- European XFEL (Hamburg)
- Max-Planck Institute for Nuclear Physics (MPIK, Heidelberg)
- Physikalisch-Technische Bundesanstalt (PTB, Braunschweig)

and international

- CERN (Switzerland)
- GANIL (France)
- INFN Catania and Legnaro (Italy)
- Riken (Japan)