**Description of the infrastructure**

Name of the infrastructure (and its installations, if applicable): ISOLDE CERN

Location (town, country) of the infrastructure: Geneva, Switzerland

Web site address: https://isolde.cern/

Annual operating costs (excl. investment costs) of the infrastructure (€): 4.6 MEuros (10.1 MEuro if including manpower) – might be updated (ERINS number)

Description of the infrastructure: *Give a brief general description of the infrastructure to which access is offered. Illustrate, in particular,* ***its state-of-the-art equipment and services offered to users that make it rare or unique in Europe.*** *Outline the* ***areas of research normally supported by the infrastructure, as well as new areas opening to users,*** *if any. If the infrastructure is composed of several installations, describe these including their specific features. If parts of the infrastructure are still under construction, specify the starting date of construction and indicate the date when access can realistically be made available.*

ISOLDE is the radioactive ion beam (RIB) facility at CERN. The isotopes are made through a 1.4 GeV proton beam from the PS-Booster (2 μA) impinging thick targets. The high proton energy and the accumulated target and ion-source knowledge gathered over more than 50 years of operation, allows for the extraction and separation of more than 1200 different isotopes/isomers of more than 74 elements.

The facility provides low energy (30-60 keV) and post-accelerated radioactive beams. The latter are produced by combining the normal conducting REX- and superconducting HIE-ISOLDE linear accelerators, providing accelerated beam energies between 2.8 and 9.2 MeV/u for A/Q=4.5 and up to 11 MeV/u for A/Q=3.5. Lower energies are available at discrete values: 0.5, 1.2, 1.55, 1.8 and 2.2 MeV/u. Typical beams accelerated in 2018 illustrate the accessible range of elements, intensities and energies: 28Mg, 9.5 MeV/u, 1.2 106 pps, 206Hg, 7.4 MeV/u, 1.8.106 pps.

***Beam delivery:*** radioactive beams are delivered from two target and ion source units, using 20 different types of targets and five types of ion sources. For 70% of the experiments, the RILIS lasers ion source is used, providing element selective and efficient ionization for more than 20 elements. Two mass separators with resolving powers M/M = 2000 (GPS) and 5000 (HRS) for isobaric separation allow to deliver two beams in parallel. Behind the HRS a radiofrequency gas filled Paul trap (ISCOOL) can be used in transmission mode, or to produced bunched beams with a user-defined bunch/release time. The central beam line can receive a beam from both separators (not in parallel yet), which is distributed to more than 15 experimental devices (including HIE-ISOLDE and its 3 experimental stations). In parallel, a beamline from GPS can provide beams to set-ups for materials research, for isotope collections or to a ‘traveling set-up’.

***Research topics:*** about 60% nuclear structure research, explored via measurements of ground state properties (mass, radii, moments) and decay studies or Coulomb excitation and transfer reaction studies. A small fraction is devoted to nuclear astrophysics and fundamental physics (10%), while about 25% of the beam time is given to solid state physics and life sciences with broad societal benefits.

***Research instrumentation***: the ISOLDE users have access to an electronics pool, radiation detectors, multi-parameter data acquisition systems, chemistry and radioactive laboratories, liquid nitrogen and liquid He (in dewars). Dedicated shielded collection points and laboratories for (off-line) materials research using long-lived radioactivity (hours to days) are available. Permanent experimental set-ups are owned, maintained and operated by “external” collaborations, both at the low- and high-energy beam lines. Small set-ups can be coupled for a single experiment to the low-energy branch or at the HIE-ISOLDE post-accelerator.

The HIE-ISOLDE post-accelerator has 3 beam lines:

• at XT01 the MINIBALL highly efficient germanium array is coupled. It is used for Coulomb excitation measurements, and in combination with a Si-Array T-REX also for transfer reaction studies. It can also host a plunger for lifetime measurements of short-lived excited states. Since 2015, an electron conversion spectrometer, SPEDE, has been added for spectroscopy studies on actinides. This detector can also be used in the versatile decay spectroscopy set-up (IDS) with low-energy beams.

• at XT02, the ISOLDE superconducting solenoid (ISS), provides a magnetic field up to 2 T. Its room temperature bore diameter of nearly 1 m can host two types of detectors: a Si array and an active target (SPECMAT). First successful experiments with the Si array were performed in 2018.

• at XT03, a multipurpose scattering chamber is available for users to mount their own detection systems (inside or behind).

The low-energy part of ISOLDE hosts a suite of permanent experimental set-ups:

• The fluorescence detected collinear laser spectroscopy set-up (COLLAPS) and collinear resonance ionization laser spectroscopy set-up (CRIS) are used to determine ground-state and isomeric state charge radii, spins, magnetic and quadrupole moments. CRIS can also be used for decay studies on isomerically pure samples, using dedicated a- and b-decay detection set-ups.

• The ISOLTRAP setup with Penning traps and an MR-TOF spectrometer is used for high-precision mass measurements.

• The ISOLDE Decay Station (IDS) includes efficient gamma detection, beta-detection and tape station, neutron array, LaBr3(Ce) for lifetime measurements, SPEDE detector for electron conversion detection.

• A dedicated beam line for studies with laser-polarized beams and beta-NMR studies, with applications in material science, biology, fundamental interactions, …

• A Total Absorption Spectrometer (TAS) for beta decay studies.

• For material and biochemical studies, there are online (at the low-energy branch) and offline (in building 508) Emission-channelling set-ups, several spectrometers for perturbed angular correlation (PAC) studies and Mossbauer spectroscopy studies, a photoluminescence system and a fume hood.

Services currently offered by the infrastructure:

• Radioactive beams are provided up to the switchyard towards the experimental beam line.

• All ISOLDE users have access to the standard CERN services, including computing, library 24h, a small store, electronics pool, restaurants, housing service, hourly bus transfer to/from airport … etc.

• A new class C laboratory is available for the users since 2014. It hosts an extended laboratory for condensed matter and bio-physics with a separate chemistry laboratory, as well as two large laser laboratories, a mechanical workshop, and a new detector laboratory. The top floor of the new building is accessible for visits and includes data acquisition rooms for the different collaborations, a visitors’ area, the ISOLDE control room, and a kitchen and meeting area.

ISOLDE presently provides about 4500 hours of beam time per year for about 50 experiments with the leading and participation of more than 600 external users. The scientific output from ISOLDE can be found on the web (isolde.cern/publications) and includes an average of 80 publications per year, many in high-impact journals (PRL, PRX, PBL, Nature, Nature Physics, Nature Communications, …).

**Description of work**

Modality of access under this proposal: The majority of ISOLDE users is coming from outside of CERN. Beam time is granted based on a scientific proposal submitted to an international advisory panel, the INTC (ISOLDE and n\_TOF Committee <https://committees.web.cern.ch/intc>), which meets 3 times per year (February, June, November). A Technical Advisory Committee, composed of ISOLDE and CERN experts in beam production, RP, safety, etc., advises the INTC about the feasibility of the proposed experiments. New users are recommended to contact the Physics Coordinator or the spokesperson of an experimental device (https://isolde.cern/experimental-setups) prior to submitting a proposal. Proposals are selected based on their scientific merit, and beam time is recommended for approval to the CERN Research Board. The beam time is granted in ‘shifts’ (access unit = 1 shift = 8h).

The access to the radioactive beams is defined by the CERN operational schedule (typically from end of March to mid December) whereas other infrastructures of the ISOLDE facility are continuously available for all users. The work is done on-site during 3-15 days depending on the project, typically accompanied by further measurements and/or data analysis performed in the users’ home institutes.

The ISOLDE physics coordinator schedules approved experiments according to the users’ request and technical constraints, trying to maximize the scientific output of the facility. Some experiments can be performed in parallel operation, using protons on both target stations, coupled to respectively the HRS and GPS mass separators.

Support offered under this proposal: An ISOLDE support office as well as the CERN Users Office are available to users for administrative, logistic and organizational problems. The ISOLDE and CERN websites provide information on access, experiments, schedules, safety, lodging, etc.. All new users are fully integrated into the scientific environment via seminars, lectures, etc. and access to libraries and computing facilities. Both internal and external transport services for material exist. The so-called “team accounts” are provided to assist collaborations in managing their finances at CERN. The ISOLDE technical teams are comprised of some of the world-leading technical experts in radioactivity handling, in high-temperature target technologies, ion sources, and radioactive beam production. This gives excellent possibilities for users to discuss and optimize related aspects of their proposals and experiments. The physics group hosts CERN PhD students and post-doctoral fellows, as well as several external users who stay on-site for longer periods (months to years). This guarantees the necessary support and allows for continues development at the experimental stations.

Outreach to new users:

Information for new users is published through the web page (http://isolde.cern), where calls for TA support are also announced. E-mail lists of experiment spokespersons and of all users are employed to ensure efficient communication. All users have to be registered via CERN’s users office (registration valid up to few months to 3 years). This allows to follow up on the amount of (new) users, and since TA has been available to ISOLDE, the amount of users has increased from about 400 in the nineties to more than 1300 in 2018. That also resulted in more new set-ups and collaborations (e.g. CRIS, IDS and VITO are collaborations that were initiated in the last decade).

A yearly ISOLDE Users Meeting and Workshop is organized in December, typically attended by more than 140 persons (153 in 2018), where results from the last year and new experimental possibilities are presented. The ISOLDE facility, and the possibilities it provides for new users, is presented frequently at international meetings by the ISOLDE physics group leader or the Collaboration Spokesperson.

Transnational access funding helps new users to establish their own scientific programmes at ISOLDE. This is particularly important for cross-disciplinary work and for users from Eastern Europe. The funding is crucial to give young researchers access to an international scientific environment at an early stage of their career.

Review procedure under this proposal: After approval of an experiment by the INTC and CERN research board, and once the experiment has been scheduled by the Physics Coordinator, the spokespersons are invited to request for transnational access support for the participants to their experiment. A User Selection Panel meets typically three times per year to decide on TA financial support to be granted. As a rule, all approved experiments that fulfil the TA eligibility criteria receive some degree of funding. The level of funding per experiment is chosen to be proportional to the number of beam hours scheduled. Priority is given to new users of ISOLDE, to young researchers and to researchers with limited funding for pursuing their research program at ISOLDE.

The procedure using in previous TA projects: https://isolde.cern/ensar2-financial-support