Dubna **E**lectron-**R**are **I**sotope **C**ollider f**A**cility DERICA:

Step by step towards understanding of nuclear shapes and origins of nuclei in the Universe

Executive Summary

Within this long-range program, JINR looks at another Nuclear Physics program, heavily promoted in the world of nuclear physics in the last 3 decades. Beams of rare isotopes far off the line of nuclear stability would be complementing the study of superheavy elements pursued in JINR Flerov laboratory FLNR, and would guarantee JINR staying at the forefront of nuclear physics and providing state-of-the-art research in nuclear physics for the member-states of JINR and the international nuclear physics community.

The aim of the Rare Isotope Beam (RIB) studies is to provide full knowledge of the nuclear chart from nuclear-stable isotopes to the limits of nuclear structure existence. The information obtained from rare isotope studies is indispensable to resolve fundamental problems of nuclear physics (structure, reactions, origins of the nuclear forces) and nuclear astrophysics (nucleosynthesis, properties of the neutron matter).

Encouraged by leading international scientists of the NUSTAR community, JINR has decided to develop and to build a powerful RIB facility DERICA (**D**ubna **E**lectron – **R**are **I**sotope **C**ollider f**A**cility) covering a broad range of modern nuclear physics aspects (new isotope synthesis and production, determination of its masses, lifetimes and decay modes, studies of nuclear reactions and spectroscopy). The **DERICA concept** combines in-flight production of RIBs by projectile fragmentation technique (primary beams up to uranium with energy ~100 AMeV), stopping RIBs by gas catcher, reacceleration by LINAC-synchrotron combination, and usage of reaccelerated RIBs for reaction studies. The emphasis of the project is **storage ring physics** with ultimate aim of **electron-RIB scattering studies in the collider experiments.**

Elastic and inelastic electron scattering provides a powerful tool for examining nuclear structure. The most reliable evidence how nuclei actually looks come from electron scattering. However, up to now, the electron scattering studies are limited to stable isotopes. The aim of the DERICA project is to extend this powerful method, which has already provided enormous amount of information about the structure of stable nuclei, to the study of nuclei outside the “valley of stability”. DERICA will be a unique and unprecedented tool for nuclear spectroscopy of rare isotopes, i.e., nuclei far from stability. For achieving that goal, the front-end of the accelerator complex needs to produce beams of highest intensities. The strong R&D project initiated by JINR has been launched several years ago to push the limit of beam intensities to much higher values than available now.

Empowered by the superheavy element research “SHE Factory” of FLNR and later by DERICA, JINR will become a worldwide unique facility complementing those top nuclear physics facilities as FAIR (GSI) in Germany, RIBF (RIKEN) in Japan, FRIB (MSU) in the USA and SPIRAL2 (GANIL) in France.

Introduction

In 2012 the 100 year "anniversary of atomic nucleus" – the discovery of Ernest Rutherford – was celebrated. Although studied for more than century, nuclear physics and nuclear astrophysics are today vibrant and still have many unanswered fundamental questions. Some of them are listed below:

- Can we explain the nucleon-nucleon force by the underlying QCD structure?
- There are powerful theoretical methods for studies of different aspects of nuclear structure (ab-initio, density functional, shell model). Could there be a unified theory of nuclear structure and nuclear reactions?
- Symmetries and phases of the nuclear matter and nuclear many-body systems are to be understood.
- New magic numbers emerge when passing away from the nuclear *stability valley*. How is the shell structure changing far away from stability? Does it actually persist at all?
- Where are the limits of *existence of nuclear systems*? Even beyond the limits of the nuclear system existence (nuclear stability) certain aspects of the nuclear structure may persist in continuum. Where are the limits of *existence of nuclear structure*?
- Study of exotic short-lived nuclei away from *stability valley* is very far from complete. New forms of nuclear dynamics arise far from the stability line, for example, proton/neutron halos and skins. Related questions about open quantum systems and few-body correlations arise here.
- What are the origin of the heavy elements? How does the synthesis of the elements take place in astrophysical environments?
- Physics of stellar explosions (core-collapse, thermonuclear supernovae, nucleosynthesis…): studies of these phenomena need extensive information about nuclei far from the stability valley.
- Emergence of the new collective modes far from stability line and their relation to nuclear matter and neutron star properties remains a challenging issue.

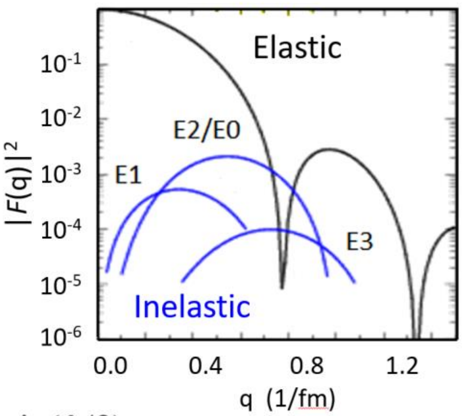
As part of the long-term program, JINR intends to open another program in nuclear physics, supplementing the study of superheavy elements. Actively promoted in the world of nuclear physics in the last 3 decades, **Rare Isotope Beam (RIB) facilities** have been and are being built worldwide as the key tools for studying nuclear properties up to the limit of stability. The ultimate aim of the RIB studies is to provide full coverage of the nuclear chart for nuclear-stable isotopes and to advance our knowledge to the limits of the nuclear structure existence. The information obtained in the RIB studies is indispensable to resolve fundamental problems of nuclear physics (masses, radii, structure, lifetimes, reactions, origins of the nuclear forces) and nuclear astrophysics (nucleosynthesis, properties of the neutron matter). Elastic and inelastic electron scattering provides a powerful tool for examining nuclear structure. The most reliable evidence of how the nucleus actually looks comes from electron scattering. However, up to now, the electrons scattering is restricted to stable isotopes.

Masses and the radial quantities are the most important characteristics of the nuclei. Just a bit more than 100 years ago a variety of odd speculations were produces by scientists on the way to understand where from the stars take the energy for their shine. When the masses of nuclei were precisely measured, this knowledge immediately emerged as granted. The "mass defect" in the nuclearsynthesis reactions was only of the order 10^{-3} from the participant masses. However, according to Einstein's relation $E = Mc^2$ these tiny values were converted into formidable amounts of radiative energy.

$$M_1 + M_2 \rightarrow M_3 + \gamma$$

$$M_1 + M_2 - M_3 = \Delta M \qquad \Delta E = \Delta M\, c^2$$

It required essentially more time to get reliable knowledge about radial properties of the nuclei. In 1961 Robert Hofstadter got the Nobel prize "for his pioneering studies of electron scattering in atomic nuclei and for his consequent discoveries concerning the structure of nucleons...". The major idea of the approach is simple and elegant: electron interacts with nuclear matter *relatively weakly* (only electromagnetic interaction) and thus can easily penetrate in the nuclear interior. The electromagnetic probe is the best studied theoretically and thus it allows straightforward interpretation of the experimental data. Moreover, this is not just charge radius r_{ch}, which is measured, but electromagnetic form-factors $F_{ch}(q)$. They contain detailed information both about charge density distribution $\rho_{ch}(r)$ and about nuclear excitations (so-called inelastic form-factors).



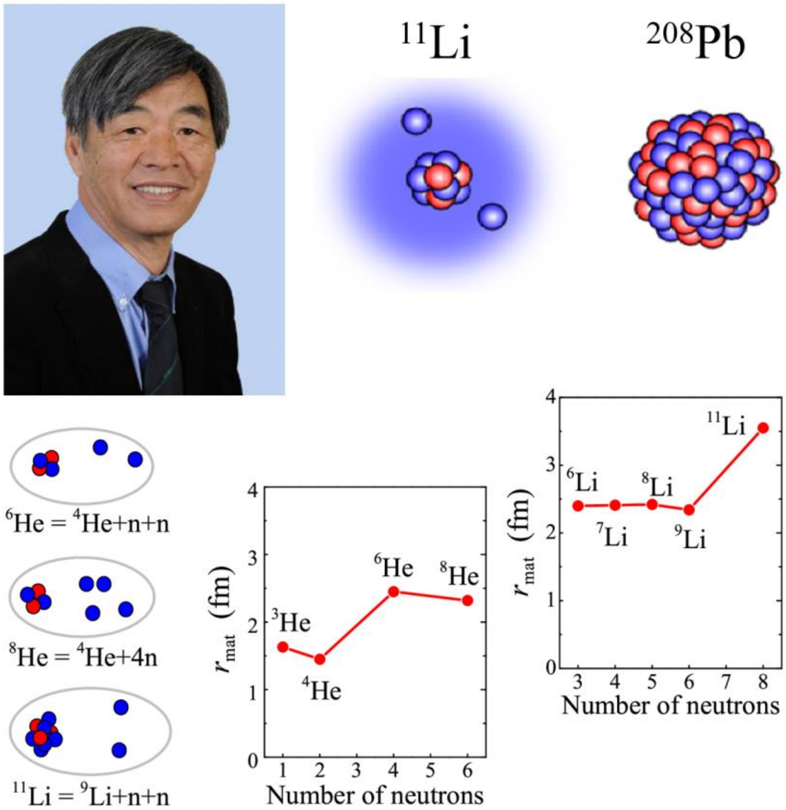
$$q = 2k\sin(\theta/2)$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{\rm PWBA} = \frac{\sigma_M}{1+(2E/M_A)\sin^2(\theta/2)}|F_{\rm ch}(q)|^2$$

$$F_{\rm ch}(q) = 4\pi\int_0^\infty dr\,r^2 j_0(qr)\rho_{\rm ch}(r)$$

$$F_{\rm ch}(q)/Z = 1 - \frac{q^2}{6}\langle r^2_{\rm ch}\rangle + \cdots$$

When Isao Tanihata measured the nuclear radii in the lightest isotopic chains in 1988 at the BEVALAC in Berkeley – this was a kind of shock. It appeared that near borderlines of nuclear stability – just where a turnover happens from "ordinary" isotopes to "exotic" ones – the mean radius of the nucleus grows abruptly. Such a behaviour was in a sharp contrast with the routine idea about nuclide as a droplet of "nuclear liquid" with the radius which is well approximated by a "liquid drop" expression $r = r_0 A^{1/3}$. Theoreticians, however, have already had an explanation at hand: such nuclides are analogous to planetary systems with dense "core" (central sun) and 1 – 4 nucleons (planets), orbiting at large distances from the core. For example, in the "classical" halo nucleus ^{11}Li the size of such "valence orbitals" is comparable to the size of much heavier lead nuclei containing 208 nucleons. This was the emergence of the concept of "halo nuclei".



In his experiment Tanihata used very "simple instrument" – the nuclear absorption. How to apply the precision approach of Hofstadter electron scattering to exotic nuclei far from stability valley? Two issues are important here. (1) It is difficult to make a target of exotic nuclei (their lifetimes are typically too short for this). (2) What was the main advantage of electron scattering – small cross sections for interaction with nucleons – here becomes an important obstacle: exotic nuclei are simply not available in significant quantities. The solution to both problems is to use an electron-ion collider. The relativistic exotic nuclei are kept in orbit in a storage ring, forming the target for electron scattering, and each exotic ion returns to the collision point approximately 500000 times per second (~0.5 MHz). Thus, once produced, each exotic ion is multiply "reused" in the collider compensating for the small electron-ion cross section.

For the first time this idea was considered in the USSR: the "K4-K10" storage ring complex was a large-scale modernization project of the JINR Flerov Laboratory. This development was to bring FLNR to a short-list of the world-leading facilities in the field of exotic nuclei. However, it was 1990 and, in the following, "turbulent" years these plans could not be implemented. The "Fallen Banner" was taken up in 2003 by Tanihata – a pioneer of the exotic nuclei radii studies – the basic idea of the electron-RIB collider MUSES at RIKEN was inherited from Russian colleagues. Politically the MUSES project "lost" to projects, that could be implemented in a shorter time frame and, thus, were expected to pay "scientific dividend" faster. The idea of an electron-RIB collider was revived in the ELISE project at FAIR in 2007. However, the FAIR facility is currently very and is now focused only on the first-stage (so-called Modularized Start Version) experiments. Thus, the future constructions of all second-stage projects of FAIR (including ELISE) has become uncertain.

At JINR, beams of rare isotopes far from the line of stability would be complementing the study of superheavy elements pursued at FLNR, and allow JINR staying at the forefront of nuclear physics and providing state-of-the-art research in nuclear physics for the JINR member-states and for the international nuclear physics community.

Encouraged by leading international scientists of the FAIR NUSTAR community, JINR has proposed to develop and to build a powerful RIB facility DERICA (**D**ubna **E**lectron – **R**are **I**sotope **C**ollider f**A**cility) covering a wide range of modern nuclear physics aspects (new isotope synthesis and production, measurements of its masses, lifetimes and decay modes, nuclear reactions and spectroscopy).

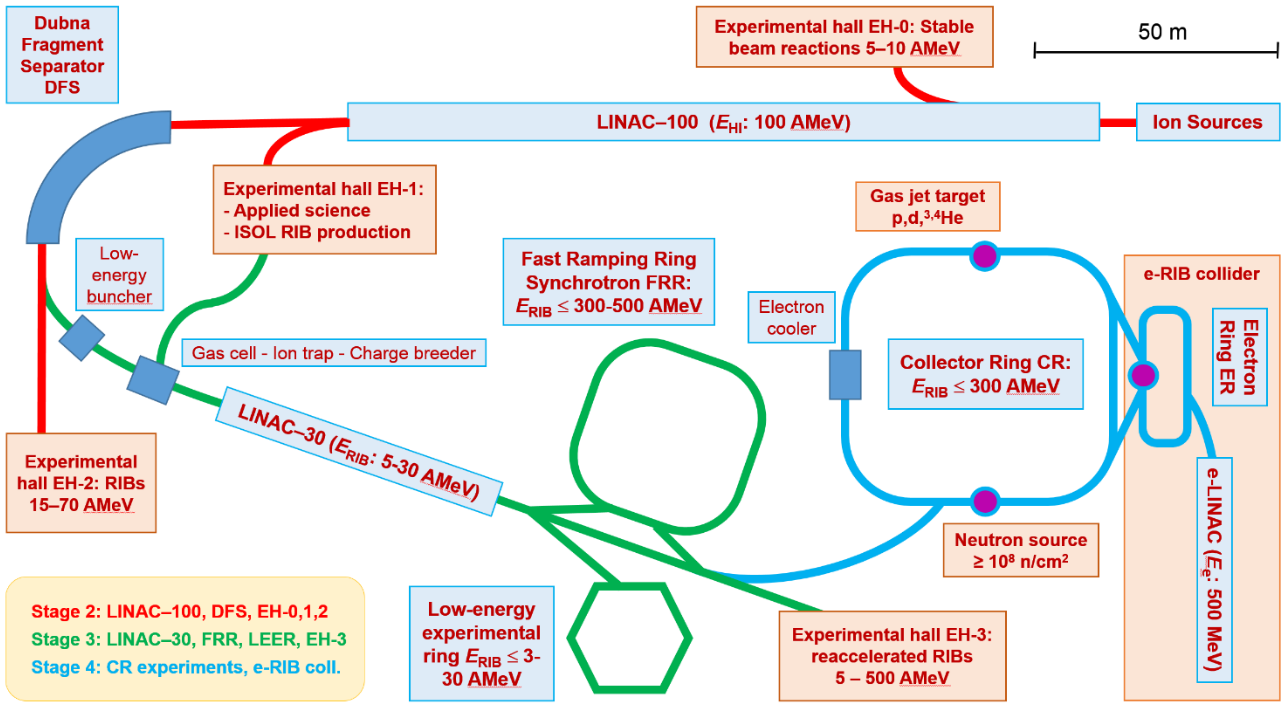


Figure 1. DERICA project, stages 2 – 4. Colours of the beamlines correspond to the stages of the project. ***Stage 2*** *(red): low-energy reactions with stable beams (in Experimental Hall EH-0), applied studies with stable 25 – 100 AMeV beams in EH-1, and direct reaction studies with intermediate energy (20 – 70 AMeV) RIBs in EH-2.* ***Stage 3*** *(green): reaction studies with reaccelerated (5 – 500 AMeV) RIBs in EH-3, experiments in low-energy storage ring.* ***Stage 4*** *(blue): storage ring experiments in high-energy storage ring CR and e-RIB collider experiments.*

DERICA concept

DERICA concept (see Figure 1) is based on a combination of the most advanced technologies in nuclear physics experiments. It combines in-flight production of RIBs by projectile fragmentation technique (primary beams up to uranium with energy ~100 AMeV) with ISOL-type technique of stopping RIBs in gas catcher and charge breeding, followed by reacceleration in LINAC-synchrotron combination. Sophisticated usage of reaccelerated RIBs for reaction studies and for storage ring experiments (experimental areas of the low-energy ring LERing and Collector Ring CR) is foreseen. DERICA's ultimate challenge is to operate the e-RIB collider. This collider mode demands extremely high luminosity of the collider, which requests highest intensities of secondary ion beams generated in the fragment separator DFS. This instrument should be specifically adapted to preparation of clean RIBs for stopping in the gas cell. The request for high-intensity of the resulting RIB is obviously translated into a request for high-intensity of the primary heavy-ion beam. Therefore, a heavy-ion superconducting "continuous wave" LINAC-100 with record intensities (e.g. from 3 emA of Ca to 1 emA of U, ~ 1 MW power in the primary beam) is planned.

The ultimate goal of the DERICA project is to extend the powerful method of electron scattering on nuclei, which has already provided a wealth of information about the structure of stable nuclei, to the study of nuclei outside the valley of stability using its electron-RIB collider. Thus, DERICA will be a unique and unprecedented tool for nuclear spectroscopy of rare isotopes, i.e., nuclei far from stability. For achieving that goal, the front-end of the accelerator complex has to produce beams of highest intensities. To this end, R&D project was launched several years ago to push the limits of beam intensities to highest values. The beam intensity of any linear accelerator is limited by the intensity which is generated by the ion source and preserved by the low-velocity transport system before injection into LINAC. The DERICA concept foresees the development and construction of world-class LINAC "front end", consisting of a highly efficient electron-cyclotron resonance (ECR) ion source, dedicated low-energy beam transport line, and large-acceptance RFQ accelerator (see Figure 2). The success of the entire DERICA facility depends on the requested "record" front end performance, which is planned to be demonstrated in 2020-2023. Based on this demonstration and on R&Ds for the other key components of the project, the feasibility of the whole DERICA scheme should be demonstrated in the preparatory phase in 2021-2024.

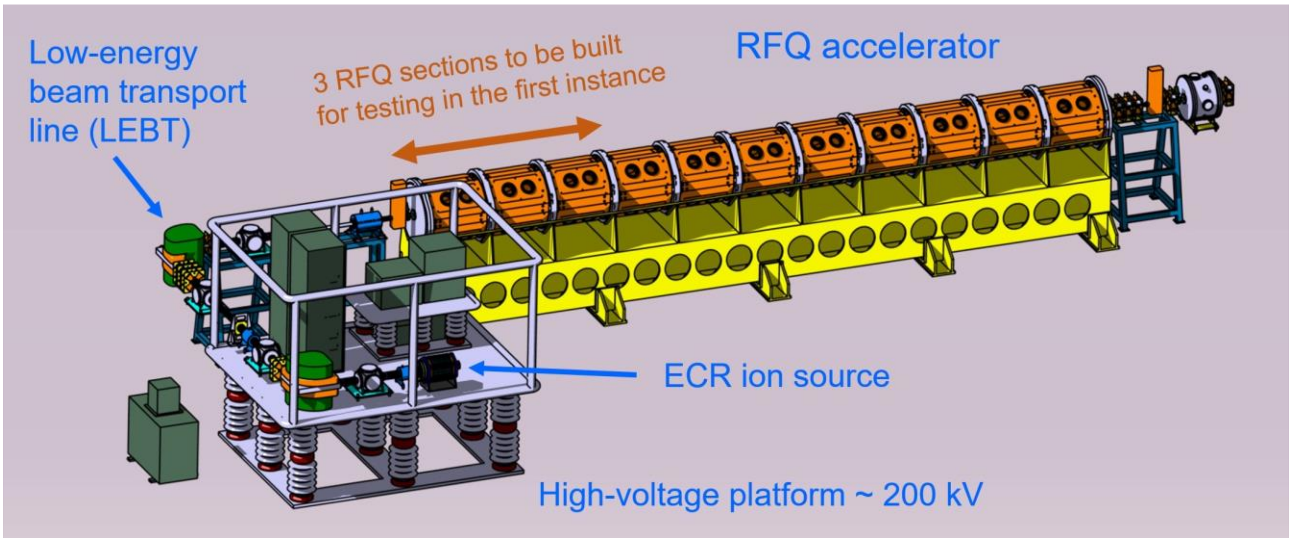


Figure 2. Schematic view of the prototype front end of the prospective heavy-ion cw-LINAC.

DERICA in JINR will be able to become a world-wide unique facility complementing top nuclear physics facilities at FAIR (GSI) in Germany, RIBF (RIKEN) in Japan, FRIB (MSU) in the USA and SPIRAL2 (GANIL) in France.

DERICA project time line

Timeline for development of the DERICA facility includes four major stages during the years 2020-2035, see Figure 1. New scientific opportunities are arising on each stage with an interval of few years. The first scientific/application results can be expected in around 5 years after construction start: they are connected with operation of the low-energy (less than 7 AMeV) normal-conducting section of LINAC-100.

– **Stage 1.** Development of the prototype front end for LINAC-100: the ability to build super-high-current continuous wave acceleration to be confirmed. CDR for LINAC-100, CDR for fragment separator DFS, CDR for Ring Branch. TDR for LINAC-100 building. 2020-2023.

– **Stage 2.** New facility buildings are constructed; "driver" accelerator LINAC-100 (~ 100 AMeV acceleration for $A/Z = 6$ ions) and fragment separator DFS are installed, see Figure 3. Low-energy reactions with stable beams (~ 6–7 AMeV, experimental hall EH-0), applied studies (experimental hall EH-1), and intermediate-energy RIBs (~ 20 – 70 AMeV, experimental hall EH-2).

(i) LINAC-100(6) starting configuration begins low-energy operation (6 AMeV room temperature resonators only, experimental hall EH-1, 2023-2027.

(ii) LINAC-100(50) advanced configuration for intermediate-energy operation. Fragment separator DFS starts operation in the low-intensity regime (50 AMeV, experimental hall EH-2), 2027-2030.

(iii) LINAC-100 is installed in full configuration. Fragment separator DFS is ready for operation in the full-intensity regime (100 AMeV, experimental hall EH-2), 2031-2033.

– **Stage 3.** System for RIB reacceleration (gas cell – ion trap – ion source/charge breeder – LINAC-30) are installed in experimental hall EH-2. Together with fast ramping ring synchrotron FRR the reaccelerated RIBs in the range ~ 5 – 300 AMeV are available (experimental hall EH-3 and low-energy storage ring). 2026-2033.

– **Stage 4.** Construction of storage rings. Experiments, including electron-RIB collider studies, can be conducted in three experimental areas of the Ring Branch. 2027-2035.

Expected construction time ~ 16 years and facility cost ~ 300 M$. The facility should employ about 200 staff members.

Scientific challenges of the DERICA project

The development of electron collider with exotic radioactive ions is the ultimate goal of the DERICA project. However, that goal will be attacked only after the successful launch of several world-class experiments of the DERICA project, after their functionality will be reliably confirmed, and after they will begin to produce excellent scientific results.

Within the DERICA project the topic of electron collider with exotic radioactive ions will be addressed, but in a new technological framework. Both the layout and the timeline of that project avoid a "trap" which hampered the previous projects in this field. Namely, the approach to building modern RIB factories with a very comprehensive research program appears to be very expensive and slow. On the other hand, it is certainly unacceptable to develop "facility for one experiment", and certain compromise becomes inevitable. The development of DERICA is organized in such a way, that well-defined technical stages allow solving various scientific problems of global interest and importance.

Already at the very first stage of the project LINAC-100 + DFS combination will ensure the production of secondary RIBs of record intensity for the energy range 20 – 70 AMeV. This energy range is optimal for studies of exotic nuclei in direct reactions – and this approach remains the most universal to date.

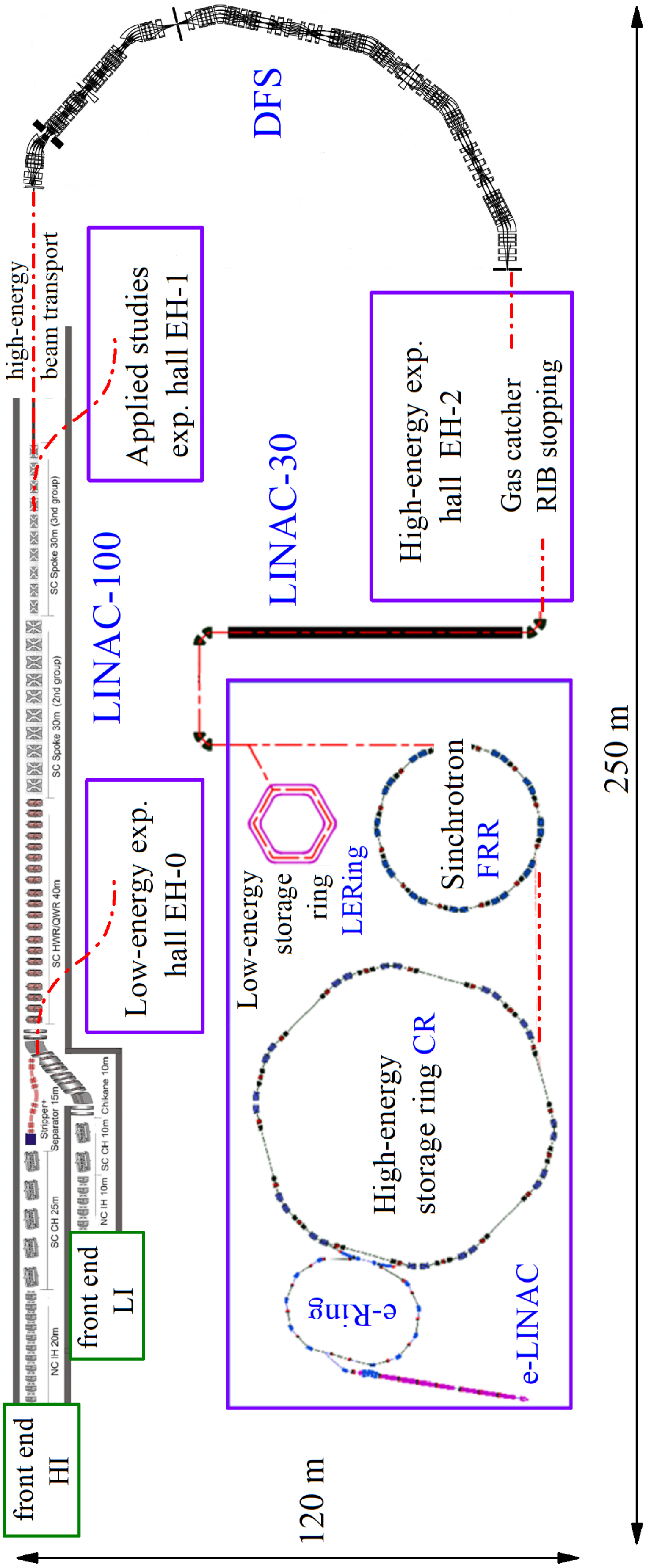


Figure 3. Preliminary schematic layout of the DERICA facility. The designs of LINAC-100 with one universal front end or with separate front-ends for heavy ions (HI) and light ions (LI) are under consideration. The length of the high-energy beam transport line depends on the foreseen energy upgrade options.

In the next stage the technology of the post-accelerated RIBs will be developed. Intensities of post-accelerated RIBs fall by about order of the magnitude. However, for high-intensity secondary beams this technology can lead to the expansion of experimental opportunities. The point is that ordinary technology of using of "hot" RIBs from fragment separators works "event-by-event", which allows intensities of not more than 10^6 particles per second. Thus, for primary intensities exceeding 10^6 particles per second the usage of post-accelerated beams is a natural solution for the intensity issue.

Construction of storage rings opens the next chapter of the DERICA project. Even without collider, storage rings are extremely powerful tools. First of all, storage ring is very high resolution spectrometer for mass measurements. Storage rings can also preserve high ionization states of heavy ions that mimic the situation of nuclear astrophysics – behaviour of hot matter in the Universe. The astrophysical “curriculum” also includes the studies of radiation capture reactions. In the storage rings such reactions can be studied using the “windowless” (gas jet) targets, getting rid of the background processes. Extreme dilute character of the gas jet target is compensated in this case by the multiple “reuses” of exotic ions circulating in the storage ring. Absolutely unique topic for research can be unification of storage ring with free neutron target. The neutron concentration in such a target can be provided by a powerful neutron source, surrounded by layers of moderators and reflectors. Again, the dilute character of such a target is compensated by the revolution frequency of ions in the storage ring.

Hot topics of the modern nuclear physics expected to be tackled by DERICA

Below the most important problems, which can be solved in DERICA experiments are listed briefly.

Nuclear structure. Quest for the limits of existence. Halos, Open Quantum Systems, Few Body Correlations. Changing shell structure far away from stability. Skins, new collective modes, nuclear matter, neutron stars. Symmetries and phases of the nuclear many body systems. Unified theory of nuclear structure (ab-initio, density functional, shell model). Pave way for theoretical framework with predictive power for nuclei beyond experimental reach. Underlying QCD structure → complex nucleon-nucleon force. Study of exotic short lived nuclei far off stability valley (proton/ neutron skins or halos, new magic numbers...). At what ratio of protons to neutrons can nuclei exist? What are the limits of the nuclear structure existence?

Astrophysics. Origin of elements – how are elements heavier than iron formed? Physics of stellar explosions (core-collapse, thermonuclear supernovae, nucleosynthesis). Compact objects and the explosions on their surfaces (x-ray bursts).

Cross-disciplinary and applied aspects of the DERICA project

The use of the DERICA facility is not limited to nuclear physics. DERICA may be helpful in solving the following cross-disciplinary issues:

– High intensity heavy-ion irradiation for volumetric modification of massive materials and development of high-performance technology for irradiating multilayer targets. Material science with intense beams of highly charged ions.

– Simulation of a heavy ion component in cosmic ray spectrum in testing of the microelectronics elements used in the space industry by irradiation of multilayer targets.

– DERICA as a neutron source. For operation with intense heavy (e.g. U) beam the target and beam dump areas for DFS are expected to generate above $5x10^{14}$ neutrons per second in 4π-geometry. For DFS this is unwanted background to be suppressed. Continuous neutron flow from the beam dump and possibly for pulsed regime with extracted beam pulses are demanded in neutron scattering experiments.

Cross-laboratory cooperation

The most important cross-laboratory synergy aspects of the DERICA project development are:

– The development of the front-end for the LINAC-100 accelerator in the framework of DERICA project is strongly based on the world-class experience of high-intensity ion sources development in JINR Flerov Laboratory FLNR. The program of the prospective a 28 GHz ECR ion source development is recently started in FLNR having in mind operation of the reconstructed U-400 (or U-400R) cyclotron with heavier ion beams, up to U. However, the full potential of such an ion source can be realized as an integral part of the modern linear accelerator.

– The development of the low-energy normal-conducting part for the LINAC-100 accelerator and the entire LINAC-30 accelerator in the DERICA project is a natural continuation of the inter-laboratory and inter-institutional collaboration established during the development of RFQ injector of light ions LU-20 for NICA project. This collaboration involves the leading accelerator experts both from JINR (LHEP and FLNR), Russian institutions (ITEP, MEPhI, BINP, VNIITF, INR RAS), and from leading foreign nuclear physics centers (GSI, LNL-INFN, MSU, etc.). In the framework of the DERICA project the technologies of high-intensity heavy-ion accelerators with a high duty cycle (potentially – with continuous wave regime) will be developed.

– Superconducting resonators are one of the key components for development of the driver accelerators in several important modern fields: spallation neutron sources, free electron lasers, radioactive ion beam production. The R&D for radio-frequency superconductivity in Russian Federation the last 25 years has been stalled. Over the past 5 – 7 years these works were reanimated at JINR LHEP in collaboration with MEPhI, PTI (Minsk), NPI BSU (Minsk). This activity is aiming at prospective superconductivity upgrade of the NICA injector complex. The dedicated scientific research program in the framework of Union State of Russian Federation and Belarus Republic was prepared and is now being finalized. Development of technology of superconducting resonator construction should become the basis for future accelerator projects in Russian Federation and the DERICA project can be foreseen as the next (after NICA) “principle consumer” of this technology.

– The beam dump for the intense primary beam at DFS fragment separator of DERICA project is a powerful source of neutrons. They are produced by stopping, for example, 100 AMeV primary Uranium beam in (according to different ideas) liquid lead or lead-tin eutectics. Neutron flux above $5x10^{14}$ 1/sec can be expected. Being unwanted background within DFS operation, those neutrons can be interesting “product” for studies within scientific program of the JINR Frank Laboratory LNF. Scientific opportunities of use of neutrons at DERICA DFS beam dump are under investigation at LNF.

International collaboration

Modern powerful “RIB factories” are in different stages of construction in the world: FAIR (Darmstadt, Germany), SPIRAL2 (GANIL, France), FRIB (East Lancing, USA), HIAF (Huizhou, China), RAON (Daejeon, Korea). The DERICA project is intended to be in this row of the world-leading RIB facilities. Modern linear accelerator programs for RIB research are active at LNL-INFN (Legnaro, Italy), TRIUMF (Vancouver, Canada), ISOLDE (CERN), SPIRAL2, FRIB, HIAF, RAON. Modern storage ring complexes for RIB physics are functioning and planned at FAIR, IMP (Lanzhou, China), HIAF. Expertise transfer in the field of accelerator, fragment-separator, and storage ring design and operation from Legnaro, CEA (Sacle, France), and FAIR to DERICA can be foreseen.

Highly upgradable facility design

The preliminary LINAC-100 layout suggests long high-energy beam transport line before DFS, see Figure 3. This enables possible extension of driver accelerator to LINAC-200. The DFS design should also be versatile enough to include the opportunity to upgrade to higher primary beam energies. The target and beam dump areas should be constructed to withstand the highest radiation load foreseen for the facility. The possibility to use the target area as a neutron source and the possibility to augment the target area with ISOL-type facility are to be considered and reflected in the prospective design.

DERICA status

After having drafted the design of DERICA in a worldwide collaboration, the JINR (Dubna) and BINP (Novosibirsk) submitted in April 2018 a joint proposal for the construction of an accelerator and storage ring radioactive ion beam facility DERICA to the Russian Ministry of Education and Science within the call for proposals of “megascience”-class facilities to be constructed in the Russian Federation. In September 2018 the proposal has successfully passed assessment in the Russian Academy of sciences and is now on a short list of the recommended projects.

Letter-of-Intent for DERICA project is published in [L.V. Grigorenko *et al.*, Physics-Uspekhi **62** (2019) 675-690, http://derica.jinr.ru/pdf/publications/2019-Grigorenko-UFN_DERICA_en.pdf]. Status of DERICA project and the most recent information can be obtained at http://derica.jinr.ru.

Conclusion

The e-RIB collider of DERICA and all the facilities upstream are demanding forefront technologies at the edge of technical capabilities of modern accelerators. These technologies should provide record precision, selectivity, resolution for shortest lifetimes of investigated exotic nuclei. The development of DERICA project should become a strong driver for development in Russian Federation and in JINR member states of a number of key technologies, such as radio-frequency superconductivity, high-intensity acceleration of electrons and ions, high-vacuum technology and power RF technology. The collider expertize in Russian Federation is now concentrated in Novosibirsk and is focused on *electron colliders*. With the development of NICA project at Dubna the rise of the new center of expertize in *ion colliders* can be foreseen at JINR and DERICA project fits well in this line of development. In certain sense, the DERICA project is not an isolated initiative with the well-defined start- and end-points, but a long-term vision of development strategy of the fundamental low-energy nuclear physics in Russian Federation and in JINR member states for decades ahead.