

Recommendations on development of project of high-current heavy-ion cw-LINAC for RIB research at JINR

Conclusions of the technical meeting

The technical meeting on conceptual design of prospective high-current heavy-ion cw-LINAC for radioactive ion beam (RIB) research at FLNR, JINR has been held at the FLNR International Conference Hall, on 7–8 February 2019. The technical meeting was conducted in the framework of JINR strategic planning for development over a seven-year period 2024 – 2030 and beyond. Participants of the meeting have come to a conclusion that effective implementation of the competitive scientific program in the Joint institute after the 7-year period 2024 – 2030 demands a next step forward in developing accelerator base of the Flerov Laboratory to keep pace with the world trends.

1. The current scientific RIB research program at FLNR is focused on the lightest ions (lighter than Ca). Modern situation in the world is defined by active upgrade of the existing facilities (GSI→FAIR, NSCL→FRIB, GANIL→SPIRAL2, etc.) and construction of new powerful “RIB factories” (e.g. HIAF in China and RAON in South Korea). These facilities to be put into operation in 2021 – 2027, will deliver RIBs of exceptional intensities in the broad regions of nuclear chart far from “stability valley”. To maintain world-class RIB research program at FLNR it is necessary to expand the research opportunities to comparably broad regions of the nuclear chart. Currently available RIB intensities should be increased by 1-2 orders of the magnitude.
2. For the in-flight method of RIB production, the prerequisite of world-competitive scientific program is availability of broad variety of extremely intense primary heavy-ion beams. The characteristic intensities e.g. 200–300 pμA of Ca, Kr and 20–30 pμA of Xe, Bi, U can be seen as realistic parameters to be aimed.
3. The repair/upgrade program of the U-400M cyclotron in 2019-2020 will provide stable operation of existing facilities for the following 7 – 10 year period. However, the primary beam production will remain confined to lightest ions with energies under 30 – 50 A MeV. Moreover, the attempts to boost intensities or/and energies at U-400M face severe problem of radiation safety in the U-400M hall, which historically was not destined for RIB production. In particular, the radiation protection of the floor and ceiling cannot be further improved. The primary beam intensities exceeding 3 – 4 pμA (~20 eμA) of light ions (e.g. B, O) are therefore not admissible.
4. During the technical meeting the problems of construction of the new “driver” accelerator for the FLNR RIB research program were discussed. The target intensities are expected to be ~3 emA for medium mass ions (e.g. Ca, Kr) and ~1 emA for heavy ions (e.g. Xe, Bi, U). It was concluded that the cw-LINAC, consisting of front-end of ECR ion source plus room temperature (NC) cw-RFQ and superconducting (SC) cavities for main part, will be the optimal choice for generation of diverse (different nuclides and different energies)

heavy-ion beams for the prospective FLNR RIB research program. This development would guarantee long-term world-competitive program of RIB research at FLNR.

5. The SC cw-LINAC with the requested properties can be designed within 1 – 2 years and constructed within 3-5 years for front-end and 7 – 9 years for superconducting cavities, cryomodels, linac and cryogenics structure. The “starting configuration” LINAC-50 (designed to deliver 50 AMeV U beam and correspondingly ~80 AMeV Ca beam) is expected to have approximate budget of 80 MEuro. The opportunity of flawless upgrade to “full configuration” LINAC-100 is seen as necessary feature of the design.

The expert board of the technical meeting recommends to initiate the development of the technical design for the high-current heavy-ion cw-LINAC and fragment-separator DFS conjugated to it. The R&D works for the prospective LINAC “front end” (new generation 28 GHz ECR ion source and RFQ) should be started ASAP as this is the most long-term development in the LINAC construction. It is recommended to conduct simultaneously the conceptual design studies for the prospective storage-ring and collider DERICA facility. The design has to be developed in such a way that guarantee upgradeability of the LINAC-50+DFS to the “full format” of the DERICA facility.

The expert board of the technical meeting recommends to join efforts of three JINR laboratories – Flerov, Baldin-Veksler, and Frank, also in active collaboration with “Kurchatov Institute”-ITEP, MEPhI, INR of RAS – in development of modern linear accelerators with world-class parameters both NC and SC. For this purpose it is necessary to formulate a well coordinated plan of technical developments commonly required by the future linear accelerator projects of these laboratories.

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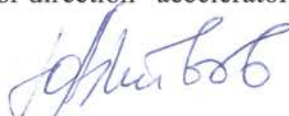
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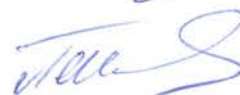
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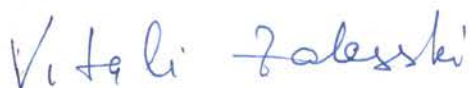
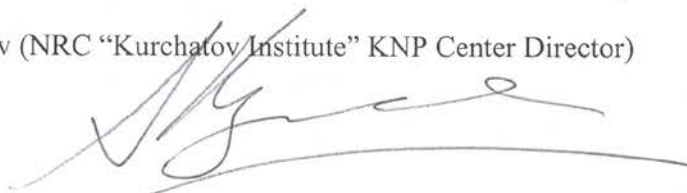
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