Announcement for Designated Research Areas for Rare Isotope Sciences

□ Purpose

○ With the aim of establishing world-class research centers, the Institute for Basic Science (IBS) has identified and designated areas that require mid- to long-term research, as well as selected IBS directors for those areas since October 2012.

○ Designated research areas for mathematics, theoretical physics, as well as science of global and regional environmental changes are posted on the IBS website. In addition to these research areas, IBS announces the designated research areas for rare isotope sciences for the utilization of a rare isotope accelerator and invites world-leading scientists to join IBS as directors.

□ Role of Director

○ Conduct creative and internationally competitive research that is unlike any other research currently conducted at overseas accelerators, by utilizing the rare isotope accelerator

○ Pursue close cooperation with the Rare Isotope Science Project to construct a one-of-a-kind and competitive rare isotope accelerator

○ Explore new research areas by utilizing the rare isotope accelerator

○ Contribute to fostering talent, establishing an infrastructure and pursuing international cooperation to promote collaborative research in rare isotope sciences

※ You must include details with regard to fostering talent, establishing an infrastructure and pursuing international cooperation in your research plan.

□ Rare Isotope Sciences

○ Designated research areas for rare isotope sciences are categorized into two groups: Nuclear physics and applied RI sciences.

※ Applicants in designated research areas for rare isotope sciences must apply for HQ research centers.

※ In principle, a research center in applied RI sciences must have multiple directors.

Category	Research Area	
Designated Research Area	Rare Isotope Sciences	**Nuclear Physics** Structure Astrophysics Reaction Theory **Applied RI Sciences** Condensed Matter Physics Radiation Biology / Oncology and Medical Physics Nuclear Energy / Nuclear Data Atomic and Molecular Physics Other RI Sciences

※ Refer to <Attachment 1> for more details regarding each research area.

□ Notes

○ For further information, please refer to the recruitment announcement for IBS research center directors. Submit your applications via the IBS website (http://www.ibs.re.kr/apply).

※ Applications are accepted on a rolling basis throughout the year. The IBS directorial selection procedures in designated research areas for rare isotope sciences are the same as those procedures stated in the current recruitment announcement.

<Attachment 1> Details of the Designated Research Area

○ Rare Isotope Sciences

[Nuclear Physics]

Nuclear physics has been one of the key fields in physics, covering fundamental particles to the Universe. Nuclear physics in RI (rare isotope) sciences is to investigate the fundamental interactions of nuclei and their constituents as well as structures of stable and unstable nuclei. Going deeply into the uncharted regime of exotic nuclei far from the stability regime can probe the structure of nuclear forces such as novel aspects of tensor forces and many-body forces. Experimental nuclear physics with RI beams, in close collaboration with theoretical studies, is critical for the success of the rare isotope accelerator in Korea.

- *Structure: Structures of radioactive isotopes and stable isotopes, new rare isotopes, drip lines, new magic numbers, tensor forces*
- *Astrophysics: Origin of the elements, nuclear reactions in the r-process, evolution of stars, elemental abundance ratios in stars, structure of neutron stars*
- *Reaction: Equation of state for asymmetric matter, symmetry energy, level densities of nuclear matter, fusion, fission, direct reactions*
- *Theory: Fundamental symmetry, framework of describing structures of nuclei and their interactions, equation of state for dense matter, reaction mechanisms*
- *Including but not limited to the above areas of study*

[Applied RI Sciences]

□ Condensed Matter Physics

The convergence of condensed matter physics and nuclear physics provides new powerful tools to study materials. The application of extremely sensitive methods and devices developed by nuclear physicists has been shown to be advantageous for investigating the electromagnetic properties of materials. Among them are μSR (muon Spin Rotation, Relaxation or Resonance) and β-NMR (beta-radiation-detected Nuclear Magnetic Resonance), which are considered to be main facilities for material science research at the rare isotope accelerator in Korea.

This area is to study the nature of materials by using μSR or β-NMR. A plan for training experts through fundamental researches or applications in the broad area of condensed matter physics should be established for the success of the rare isotope accelerator in Korea.

☐ **Radiation Biology / Oncology and Medical Physics**

This area is to study the biological responses and mechanisms of living things and tumors when exposed to heavy ion beams, including RI beams. Principles, methodology, and practical dosimetry of heavy ion irradiation are prerequisites. Research topics include biological responses and mechanisms when exposed to heavy ion beams, relative biological effectiveness of heavy ion beams, significance of heavy ions in cancer treatment, calculation and verification of heavy ion absorbed dose, precisely tumor-conformal heavy ion irradiation, as well as in-beam imaging of heavy ion irradiation. However, the topics are not limited to the above. The studies of radiobiology and medical physics should be co-operative and integrated. The outcomes achieved in this area will be useful to understand the responses of living things when exposed to heavy ion beams and to treat intractable cancers.

☐ **Nuclear Energy / Nuclear Data**

Fast nuclear reactor systems are proposed worldwide as a candidate for future sustainable nuclear energy systems to solve the problems of spent nuclear fuels. In order to realize such systems, development of an experimental facility for a subcritical fast reactor system and systematic studies for accurate data of relevant nuclear reactions are needed.

This area is to develop an experimental facility for a fast reactor system as an application facility of RAON optimized for consistent integral neutronics experiments and precise measurements of the required reaction channels. Experimental measurements and theoretical investigations are to be performed for obtaining reliable nuclear cross sections and decay data of radioactive isotopes which are still largely unknown to improve the accuracies of the existing nuclear data with covariances for enhancing the safety and integrity of fast reactor systems.

☐ Atomic and Molecular Physics

This area is to study fundamental properties such as masses, lifetimes, hyperfine structures and isotope shifts of atoms by using heavy ion beams, including RI beams. The rapid advance in the fields of heavy ion accelerators, as well as experimental techniques of EBIT (electron beam ion trap), laser cooling, and collinear laser spectroscopy makes it possible to investigate atomic structure and properties of stable or radioactive isotopes. Collisional and radioactive processes can be investigated with RI beams. Information on the charged states and nuclear charge distribution of an atom or an isotope as well as its level structures are crucial in the analysis of collisional and radiative interactions. Such analysis requires relativistic theoretical treatment as well. Precision EDM (electric dipole moment) measurements of rare isotopes can reveal the influence of nuclear structure on atomic properties, which will allow us to test physics beyond the standard model.

☐ Other RI Sciences

Other sciences using the RI accelerator facility that are not covered above should be included.