

Highlights from South Korea

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Center for Exotic Nuclear Studies, IBS

Contents

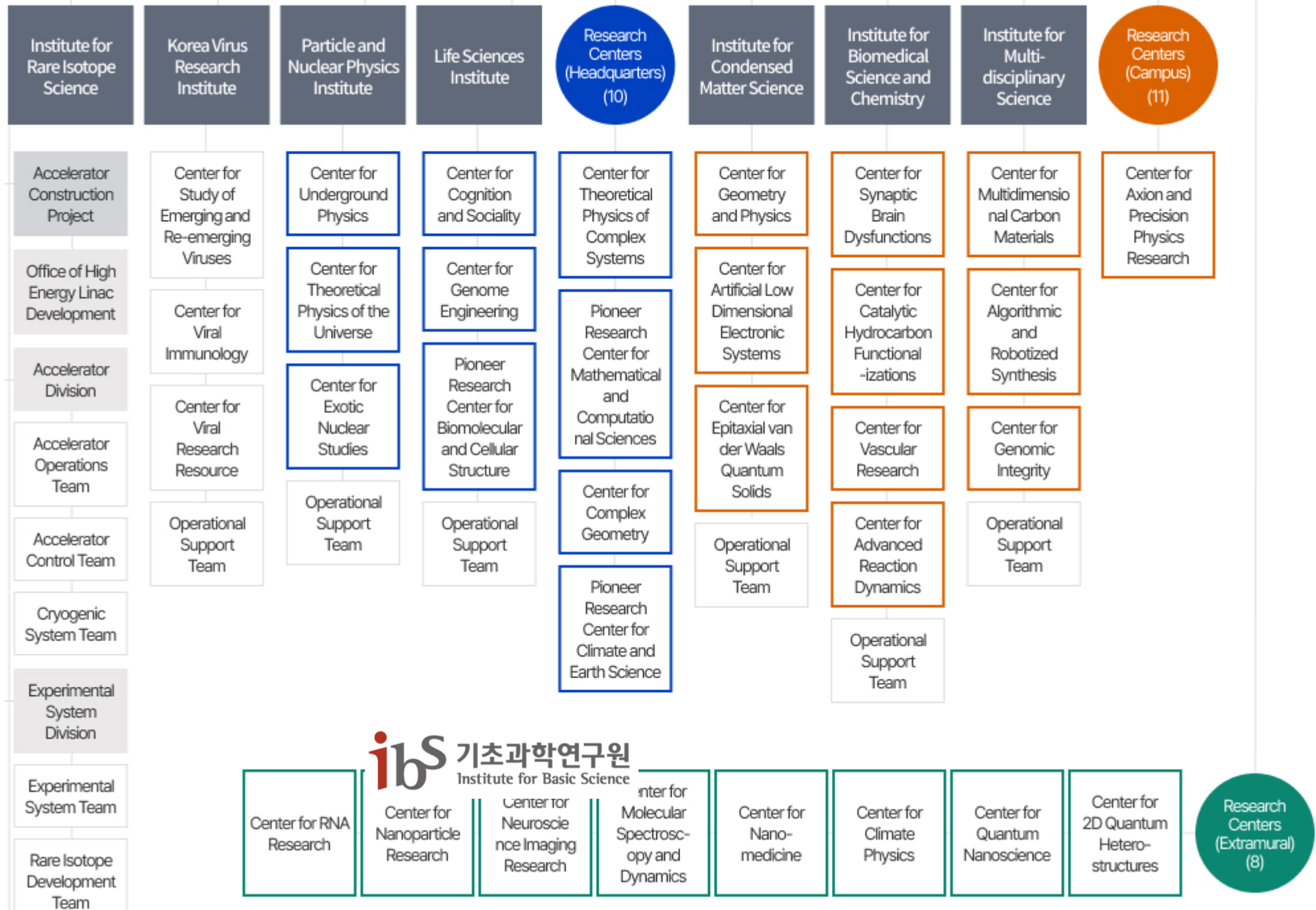
- Research institutions for nuclear and particle physics
 - IBS: Particle and Nuclear Physics institute,
IRIS (Institute for Rare Isotope Science) for RAON
 - KIAS
 - SRC: CENuM (Center for Extreme Nuclear Matters),
CPNR (Center for Precision Neutrino Research)
 - On-campus research institute: OMEG institute

- International collaborations

Research institutions for nuclear and particle physics

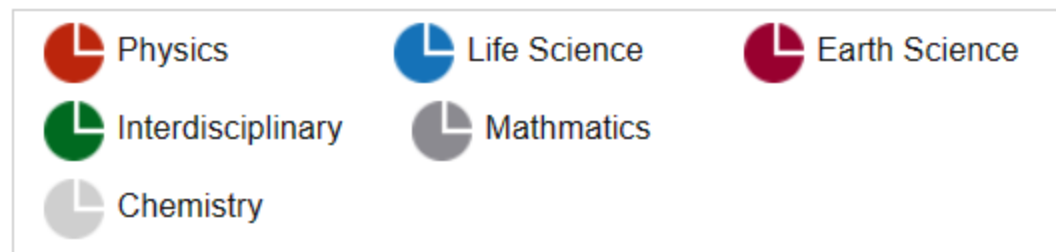
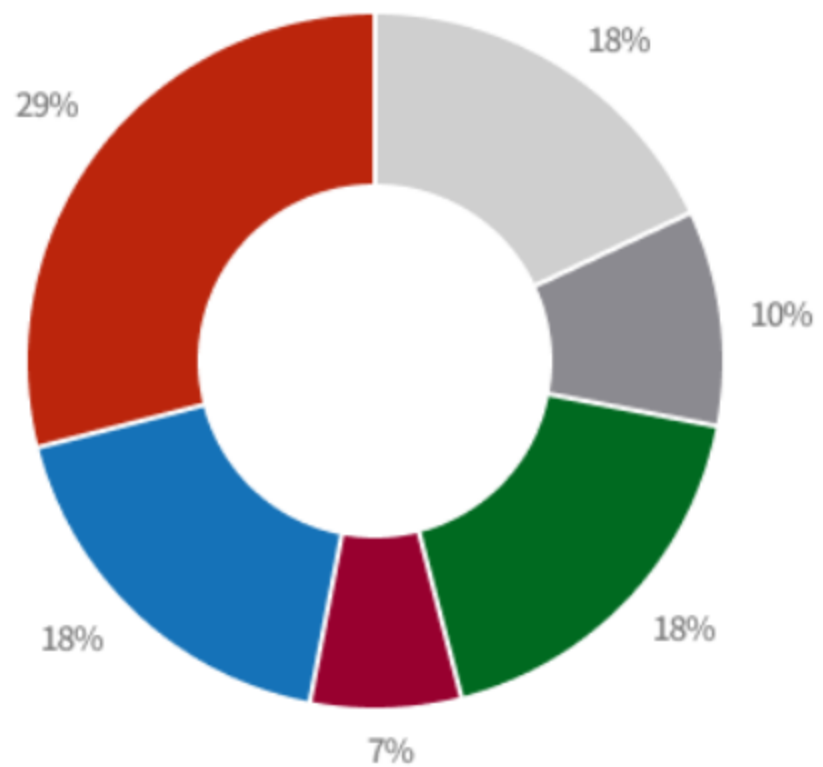


➤ IBS: Nov. 2011



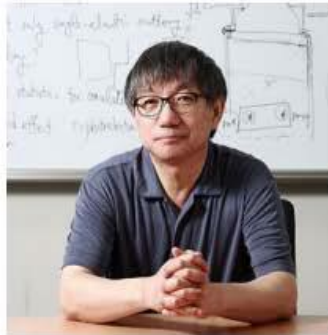
IBS Research Centers

The Number of Research Centers(Research Area)



IBS Institute for Particle and Nuclear Physics

Center for
Underground Physics



Yeongduk Kim

Center for
Exotic Nuclear Studies



Kevin Insik Han

Center for Theoretical
Physics of the Universe

- 1) Particle Theory & Cosmology
- 2) Cosmology, Gravitation & Astroparticle Physics



Kiwoon Choi

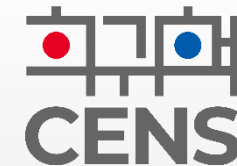
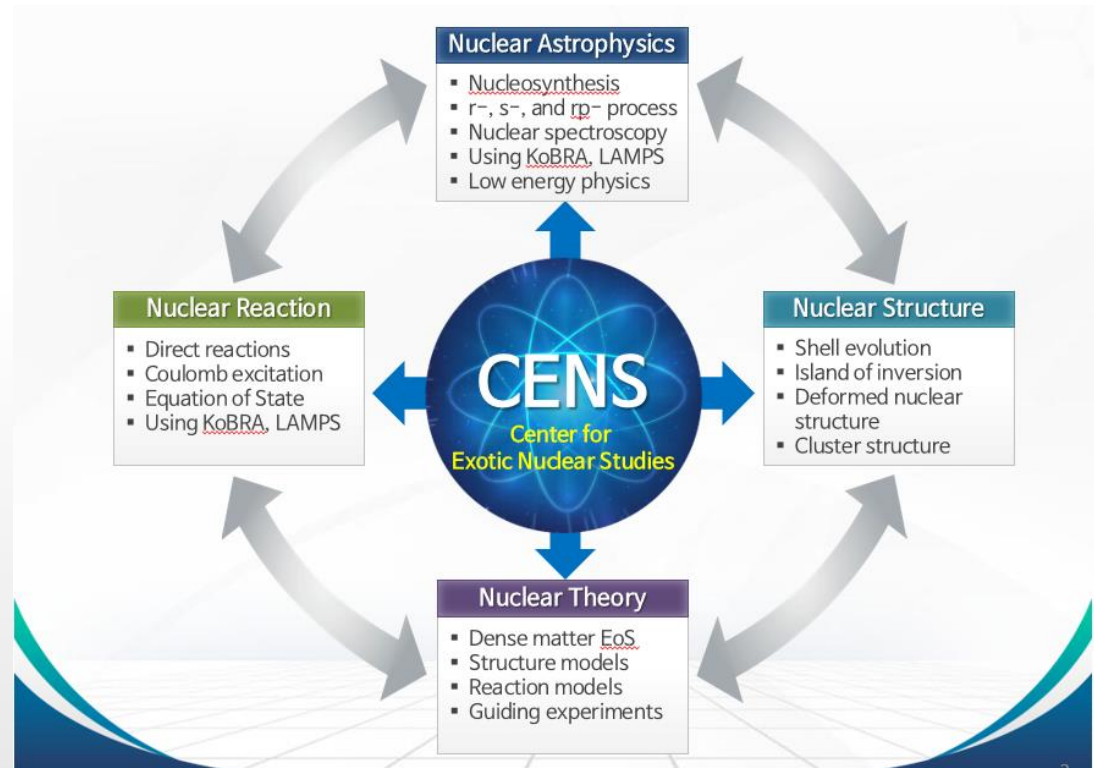


Masahide Yamaguchi

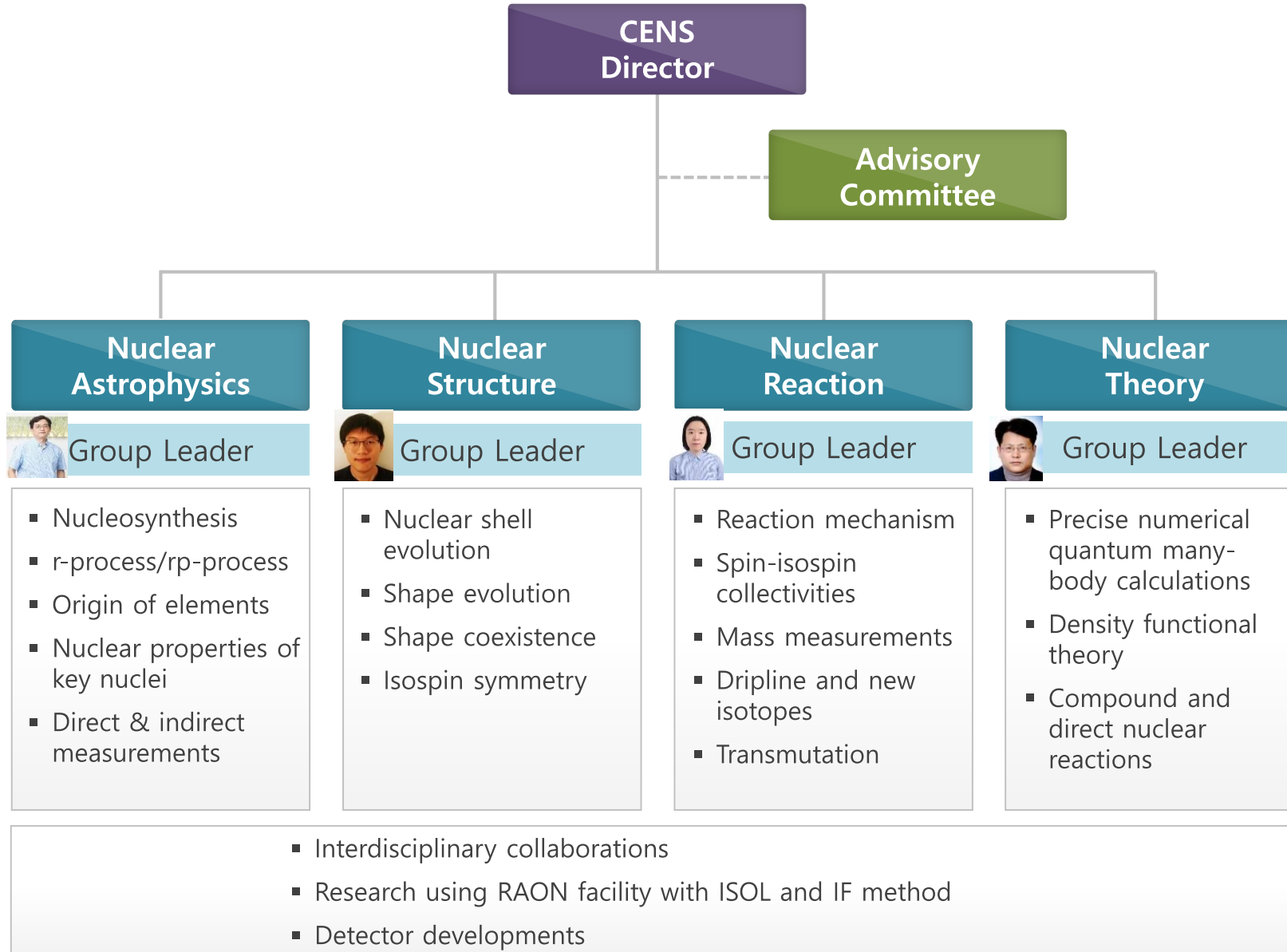
* Cluster of the three IBS research centers

To study properties of exotic nuclei and origin of heavy elements in the universe

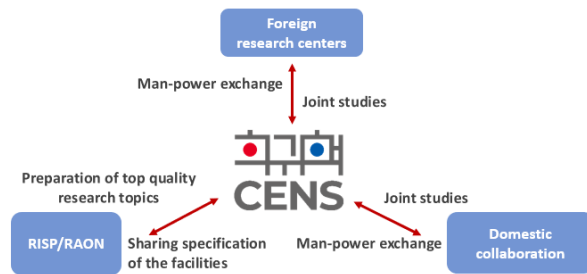
- The Center for Exotic Nuclear Studies (CENS) was launched in December 2019.
- We have about 40 members (researchers and Ph.D. students).



Organization of CENS



Connect the community internationally with CENS

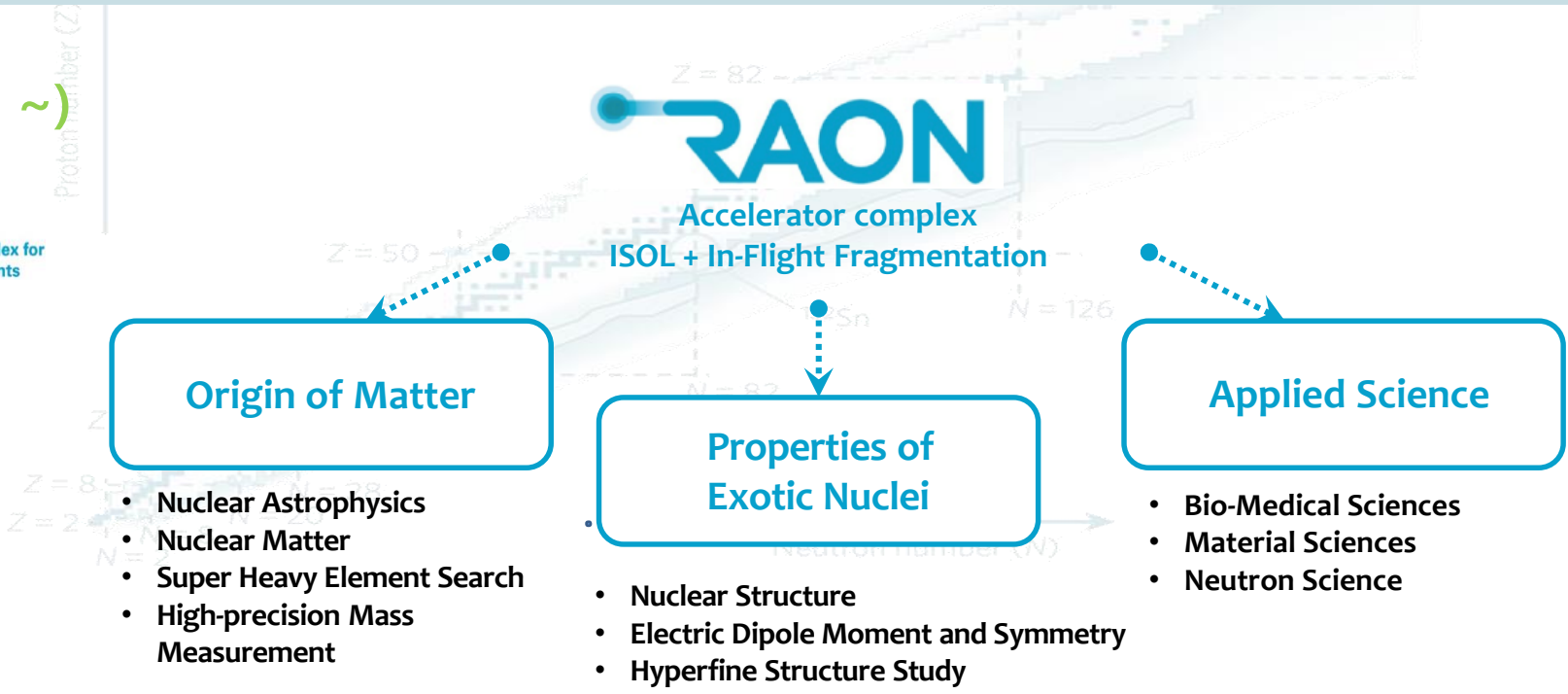


Rare Isotope Science Project (RISP) until June 2022

Goal	To build a heavy ion accelerator complex RAON for rare isotope science research
Period	1 st Phase: 2011.12 - 2022.12 R&D for the 2 nd Phase: 2022.12 - 2025.12
Budget	~\$ 1.4 B (Facilities ~ \$ 0.5 B; Land, Bldgs & Utilities ~ \$ 0.9 B) * includes initial experimental apparatus

IRIS (July 2022 ~)

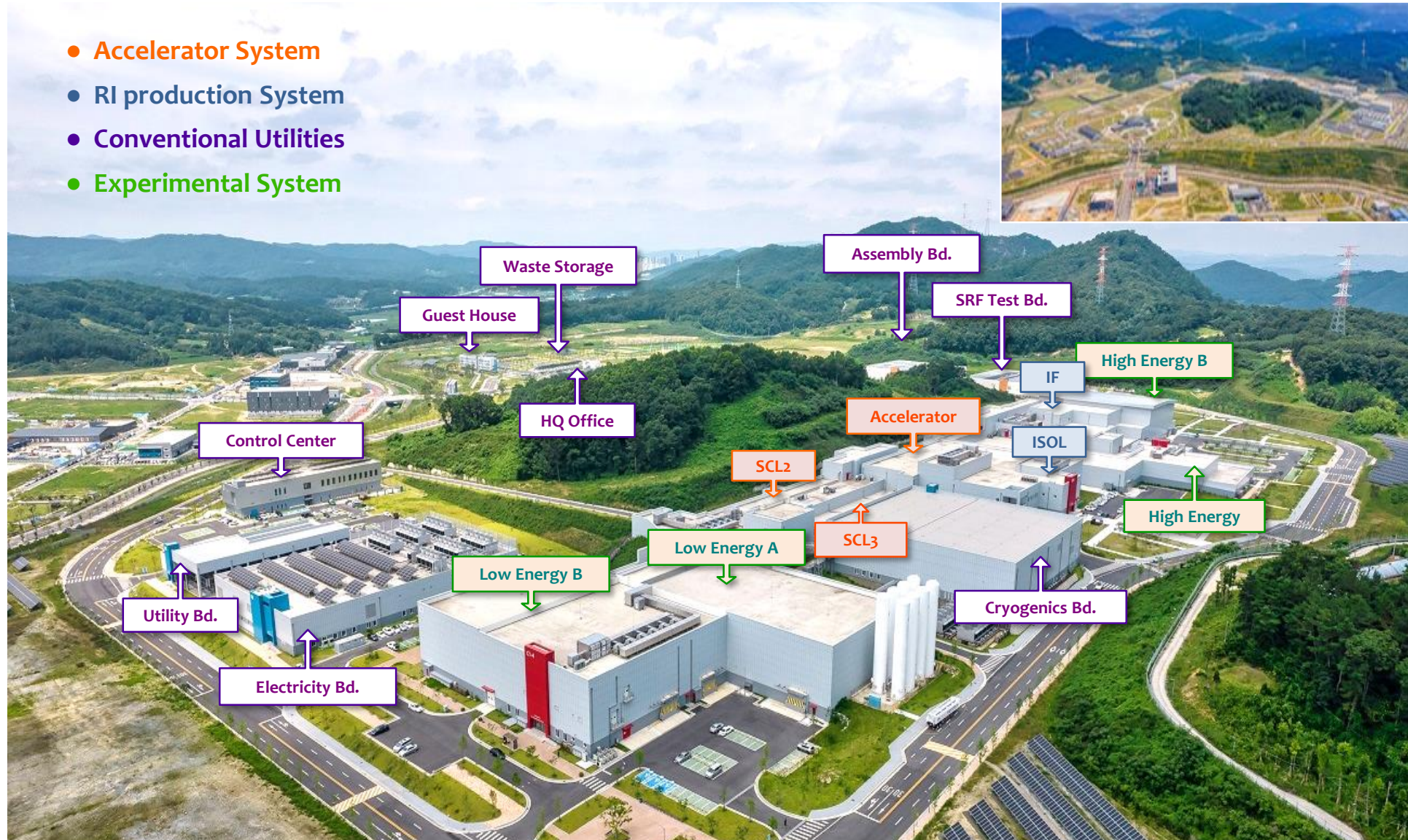
RAON Rare isotope Accelerator complex for ON-line experiments



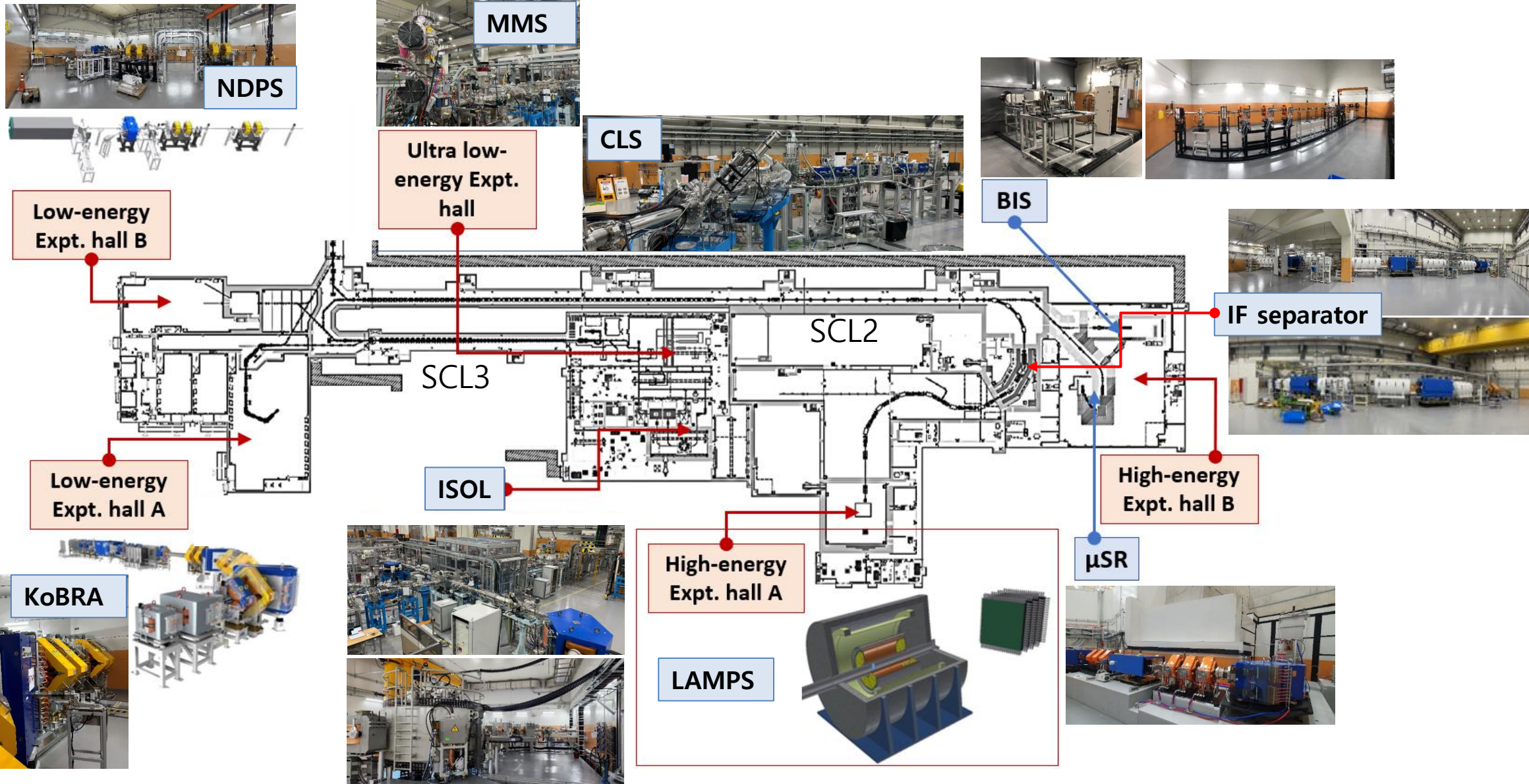
라온 -> RAON -> Rare isotope Accelerator complex for ON-line experiments

Bird's-eye-view of RAON

- Accelerator System
- RI production System
- Conventional Utilities
- Experimental System



Overview of Experimental Systems



KoBRA Spectrometer

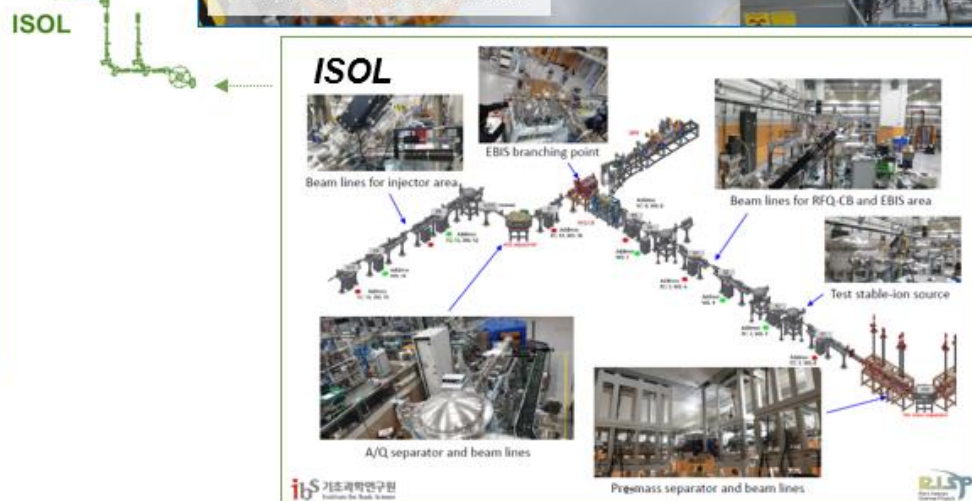
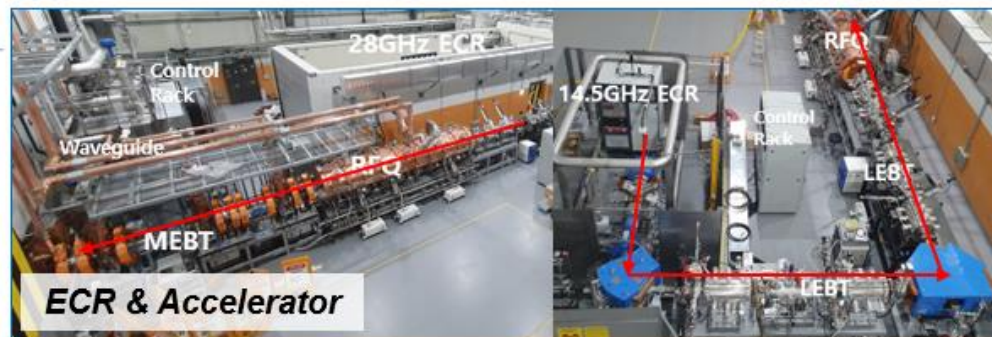
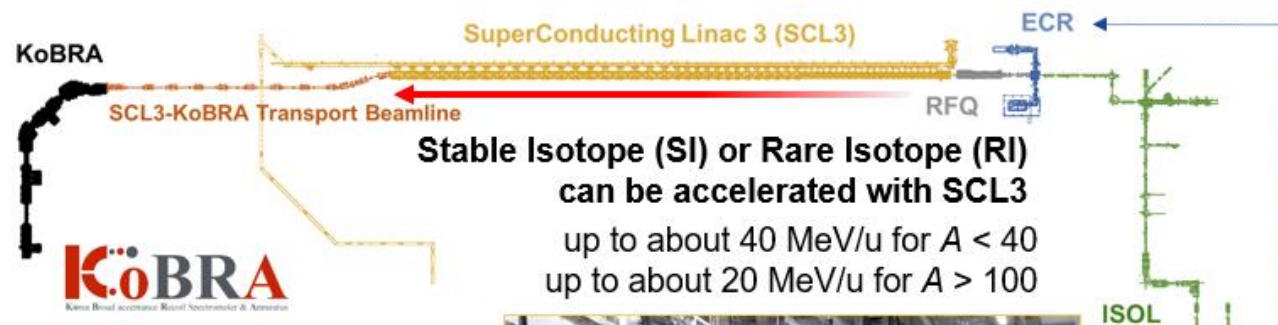
KoBRA

Korea Broad acceptance Recoil Spectrometer & Apparatus

Multi-purpose experimental instrument using stable/rare isotope beams at **low energy of 1 - 40 MeV/u** including **Fermi energy regime** for the purpose of nuclear physics studies such as **nuclear structure/astrophysics, and multi-nucleon transfer reaction**

- ✓ (Current) RI beam production at a few MeV/u or at about 20 – 40 MeV/u with stable or rare isotope beams using ECR source or ISOL system
- ✓ (Future extension*) Recoil mass separator for experiments requiring very precise mass resolution (mass resolving power, $m/\Delta m \approx 750$)
 - Such as direct measurements of radiative-capture cross sections at less than a few MeV/u

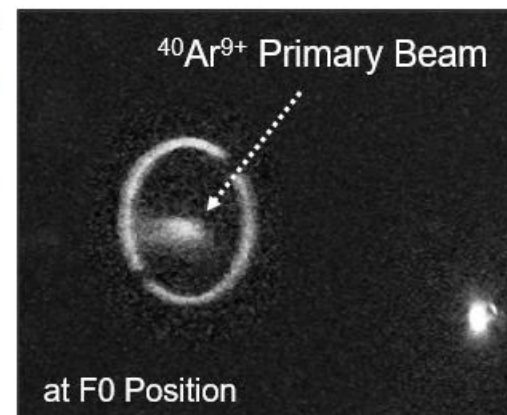
※ Under discussion for detailed concept with RAON Users Association



KoBRA Spectrometer

First Beam Commissioning of KoBRA (2023.05.31 - 06.02)

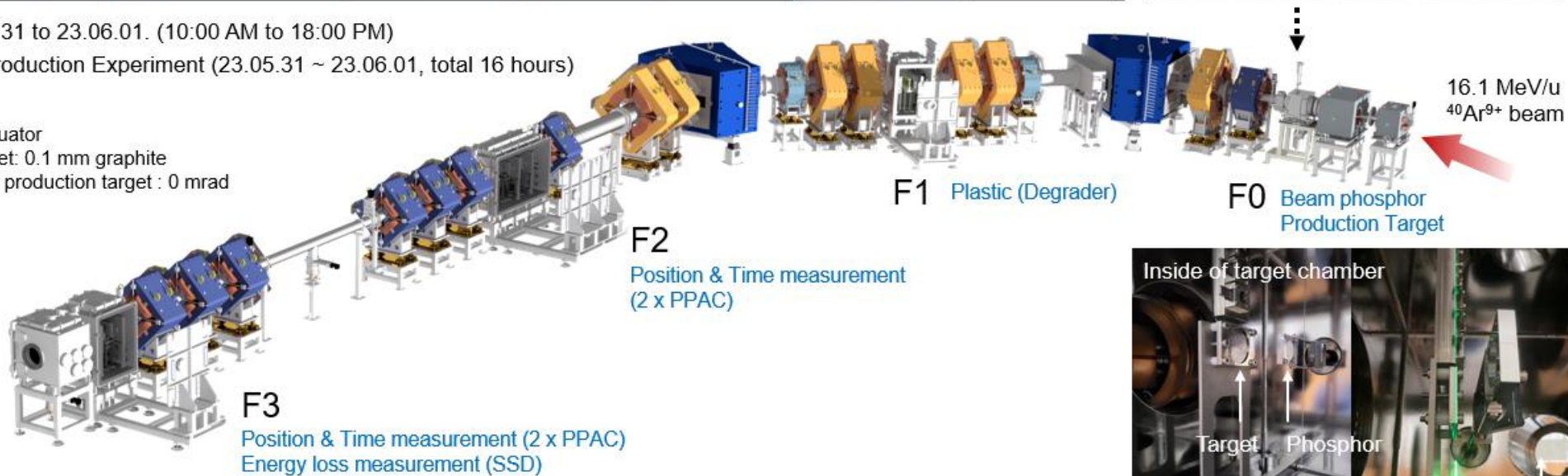
F0 Phosphor at KoBRA



Beam time: 23.05.31 to 23.06.01. (10:00 AM to 18:00 PM)

1. Rare Isotope Production Experiment (23.05.31 ~ 23.06.01, total 16 hours)

- No use of attenuator
- Production target: 0.1 mm graphite
- Swing angle on production target : 0 mrad

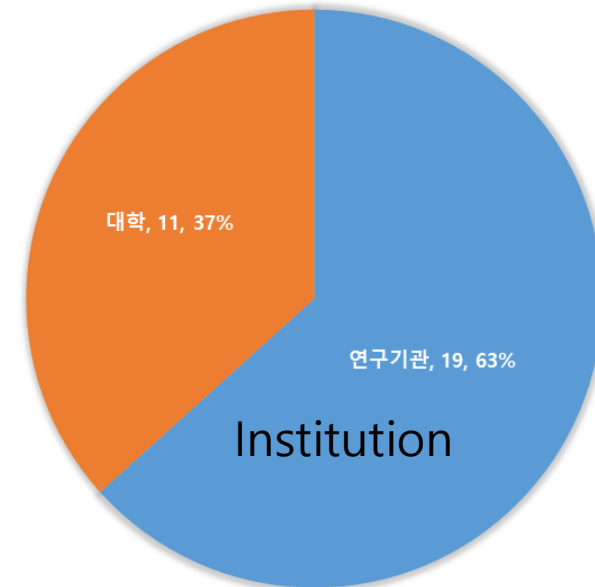
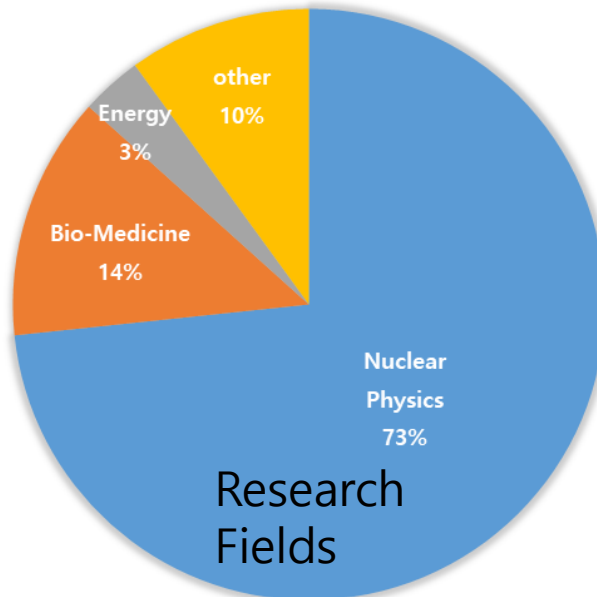
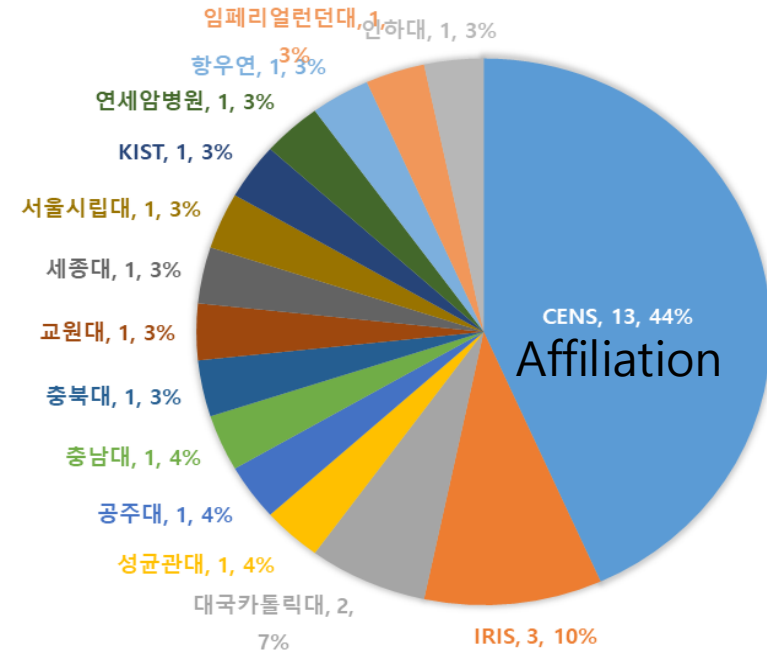
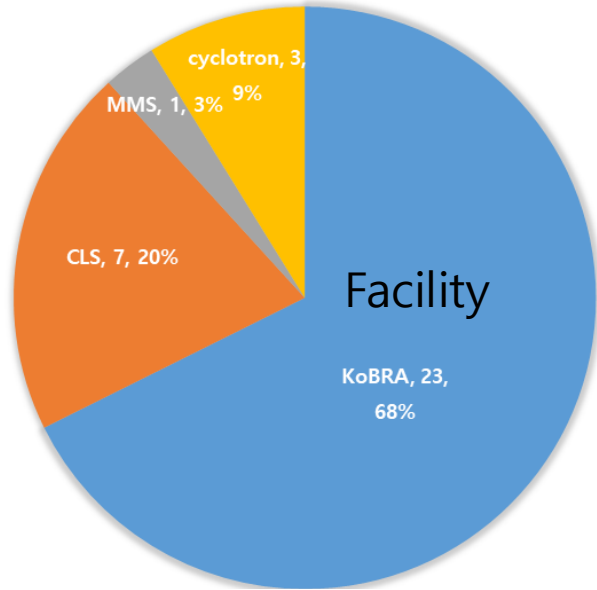




December 12, 2023 to January 19, 2024
Institute for Rare Isotope Science

Call for Proposals of Low-Energy Beam at RAON

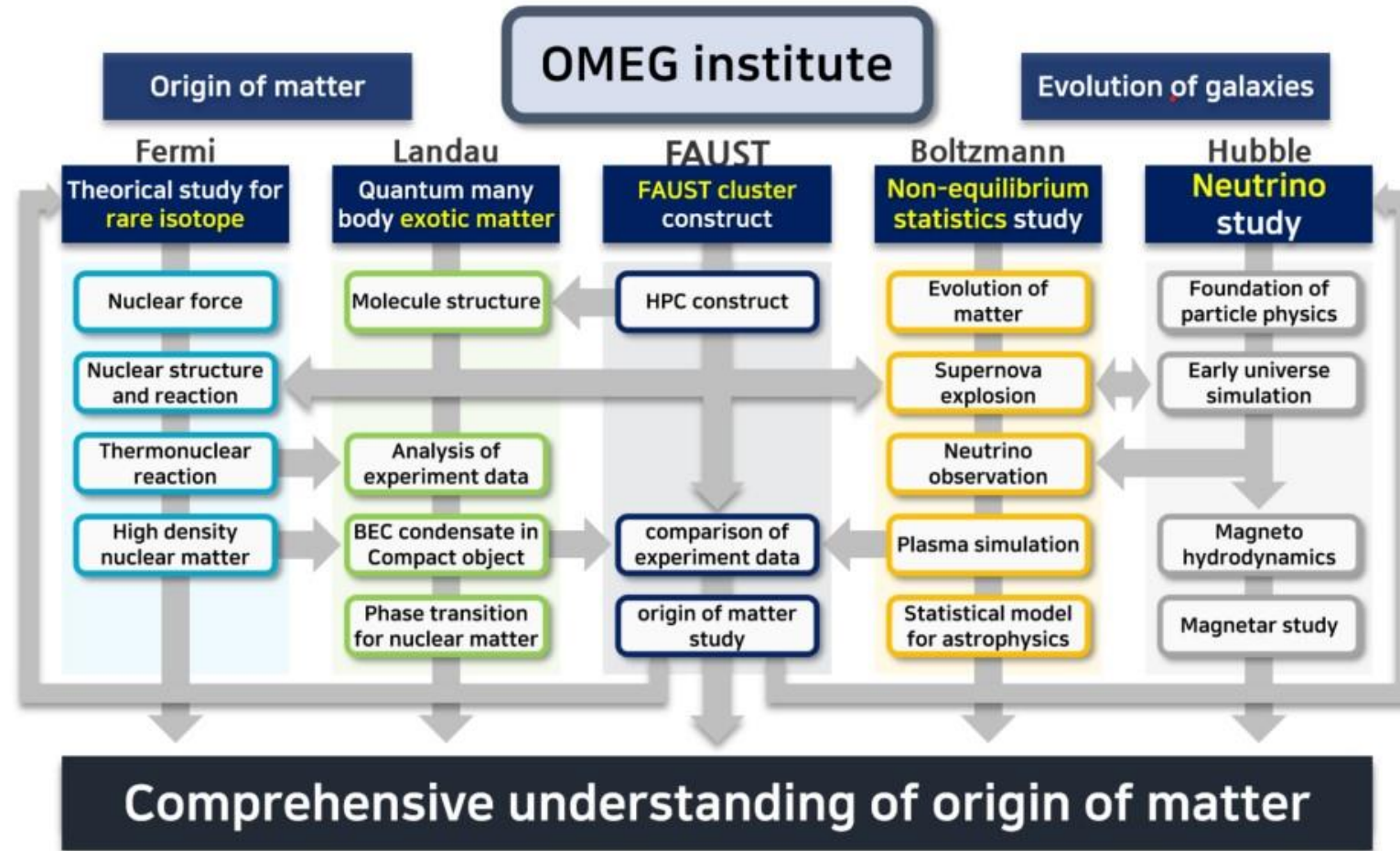
('23.12.12~'24.1.19)





- **Title: Center for Extreme Nuclear Matters**
- **Supported by the SRC (Science Research Center) program of National Research Foundation of Korea, Ministry of Science and ICT, Korea**
- **Importance: 1st government support research center for nuclear physics in Korea (not for major hardware construction, but more for supporting research activities for individuals and groups)**
- **Period: 2018-2025 (7 years)**
- **Organization**
 - **Director: Byungsik Hong (Korea University)**
 - **Groups**
 - **Group 1: High-energy heavy ion collisions (leader: Byungsik Hong)**
 - **Group 2: Hadron physics (leader: Hyunchul Kim @ Inha University)**
 - **Group 3: Rare isotope nuclear matter (leader: Kevin Insik Hahn @ Ewha Womans University)**
- **Goal: Development of**
 - **Effective theory for non-perturbative QCD**
 - **Providing the relevant experimental data**

Closed collaboration between individual studies



OMEG Institute started as an on-campus research institute from the second half of 2005. It is a university-affiliated research institute specialized in origin of matter research. In 2015, Professor Kim Chang-bae as the first head of institute. Professor Lee Tae-hoon (2016), the second director of the research institute, and Professor Cheoun Myung-Ki has been the head of the research institute since 2017.

International collaborations

Korea-CERN collaboration



➤ Theory activities:

- Korean Government signed an MOU with CERN theory division in Aug. 2009.

CERN-Korean summer student program

📅 26 Jun 2023, 08:00 → 8 Jul 2023, 10:00 Europe/Zurich

📍 4/2-011 - TH common room (CERN)

👤 Hyung Do Kim (Seoul National University (KR))

- Co-host CERN TH insititue : “Exotic approaches to naturalness”
(01.30.2023-02.03.2023: CERN)
- Co-host CERN-CKC workshop : “Physics beyond the SM “
(June, 2022, Jeju island)
“String Phenomenology” (June, 2023, IBS)

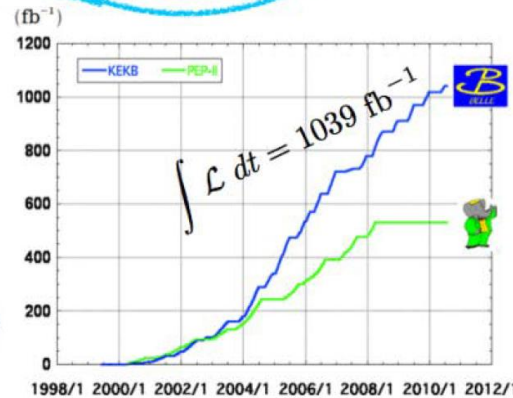
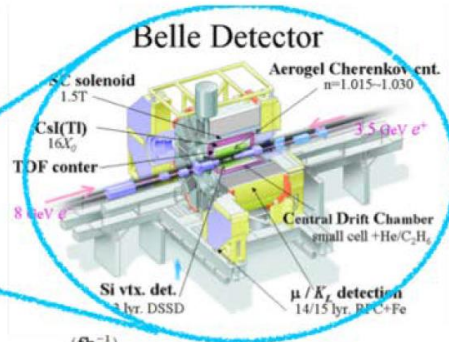
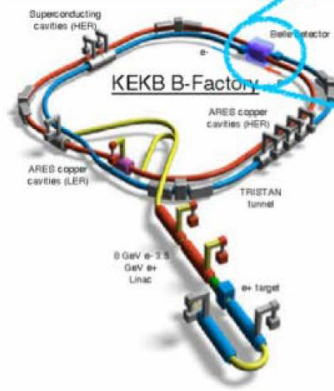
Belle collaboration (K-Belle)



KEKB & Belle


 22 개국
 ~110 기관
 ~450명 참여

$$\mathcal{L}_{\text{peak}} = 21.1 \text{ nb}^{-1} \text{ s}^{-1}$$



- Participated in Belle from 1994
- **KNU, CU, KSNU, Korea U, SNU, Soongsil U, Yonsei U, KISTI, CNU, Hanyang U.**

> 1 ab⁻¹
On resonance:
 Y(5S): 121 fb⁻¹
 Y(4S): 711 fb⁻¹
 Y(3S): 3 fb⁻¹
 Y(2S): 25 fb⁻¹
 Y(1S): 6 fb⁻¹
Off reson./scan:
 ~ 100 fb⁻¹

~ 550 fb⁻¹
On resonance:
 Y(4S): 433 fb⁻¹
 Y(3S): 30 fb⁻¹
 Y(2S): 14 fb⁻¹
Off resonance:
 ~ 54 fb⁻¹

DUNE collaboration



Member Institutes: CAU, KISTI, JBNU, and UNIST

- 2017 ~ 2018 ProtoDUNE L-Ar TPC Single Phase
Cold Electronics Module test
- 2018 ~ 2021 3DST Working Group,
3DST (3-dim Scintillator Tracker) for SAND/ND
- Joint consortium with T2K SuperFGD Group
- Prototype LANL Neutron beam test 2019 & 2020
- 2022 ???
- 2023.01 ~ ProtoDUNE HD Data Analysis
ProtoDUNE VD Cold Electronics
- ProtoDUNE II: Closing TCO in 2022.11, filling LAr in early 2023, OPS for
2023.06 to 2024.07



- 미국 : Brookhaven-RHIC (PHENIX/sPHENIX, STAR) & EIC (ePIC)
Jefferson Lab (CLAS, CLAS12)
- 유럽 : CERN-LHC (ALICE & CMS), GANIL (FAZIA)
- 일본 : JPARC & KEK, RIKEN (SAMURAI 등), CNS, Spring-8
- 그 외 북미, 유럽, 중국 : 여러 대학 및 연구소 etc

