Status of Rare Isotope Science Project (formerly KoRIA) in Korea

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on behalf of RISP members

Institute for Basic science, Korea

RISP

ibs 기초과학연구원 Institute for Basic Science

Institute for Basic Science (IBS) and Heavy-Ion Accelerator Facility

Institute for Basic Science

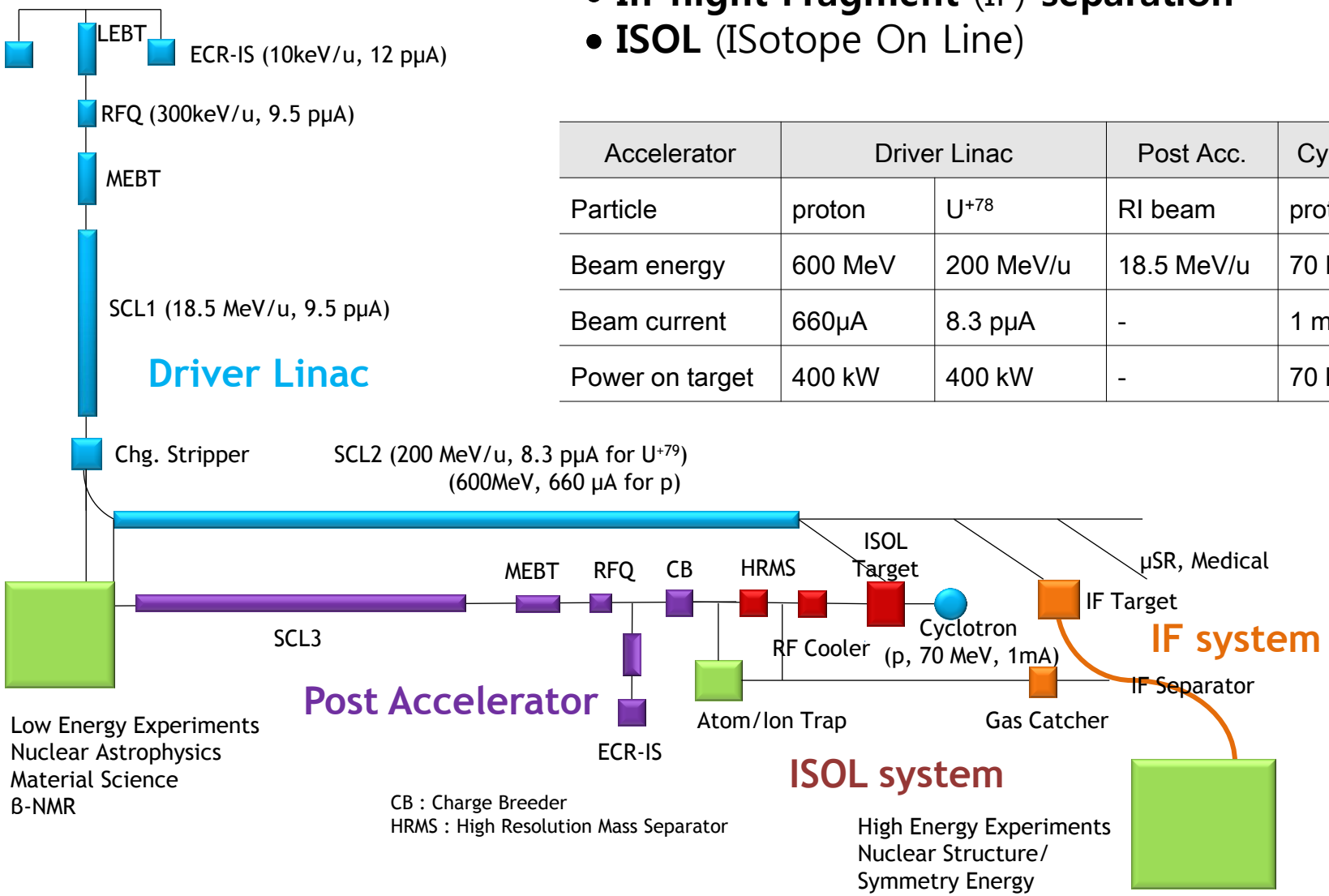
Layout of Institute for Basic Science and Heavy-Ion Accelerator Facility

Conceptual Layout of the Accelerator Complex

Two methods of isotope beam production

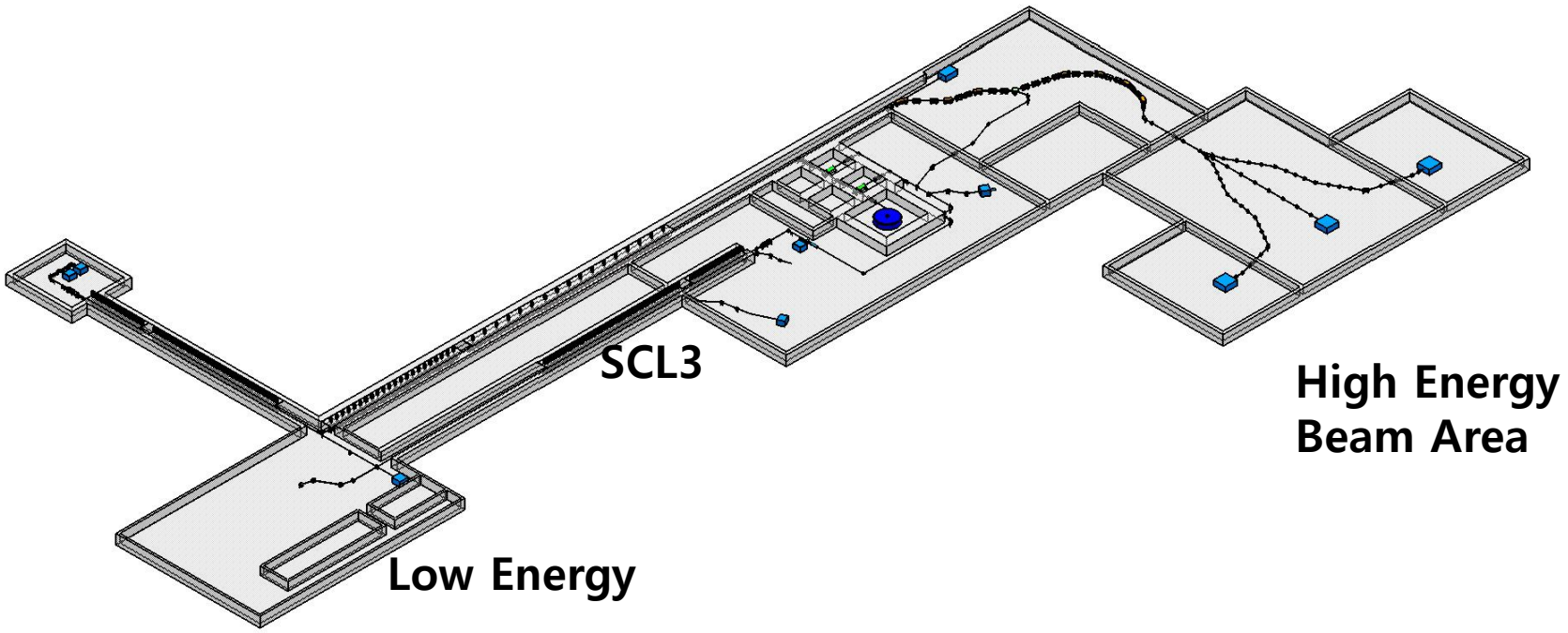
- **In-flight Fragment** (IF) **separation**
- **ISOL** (ISotope On Line)

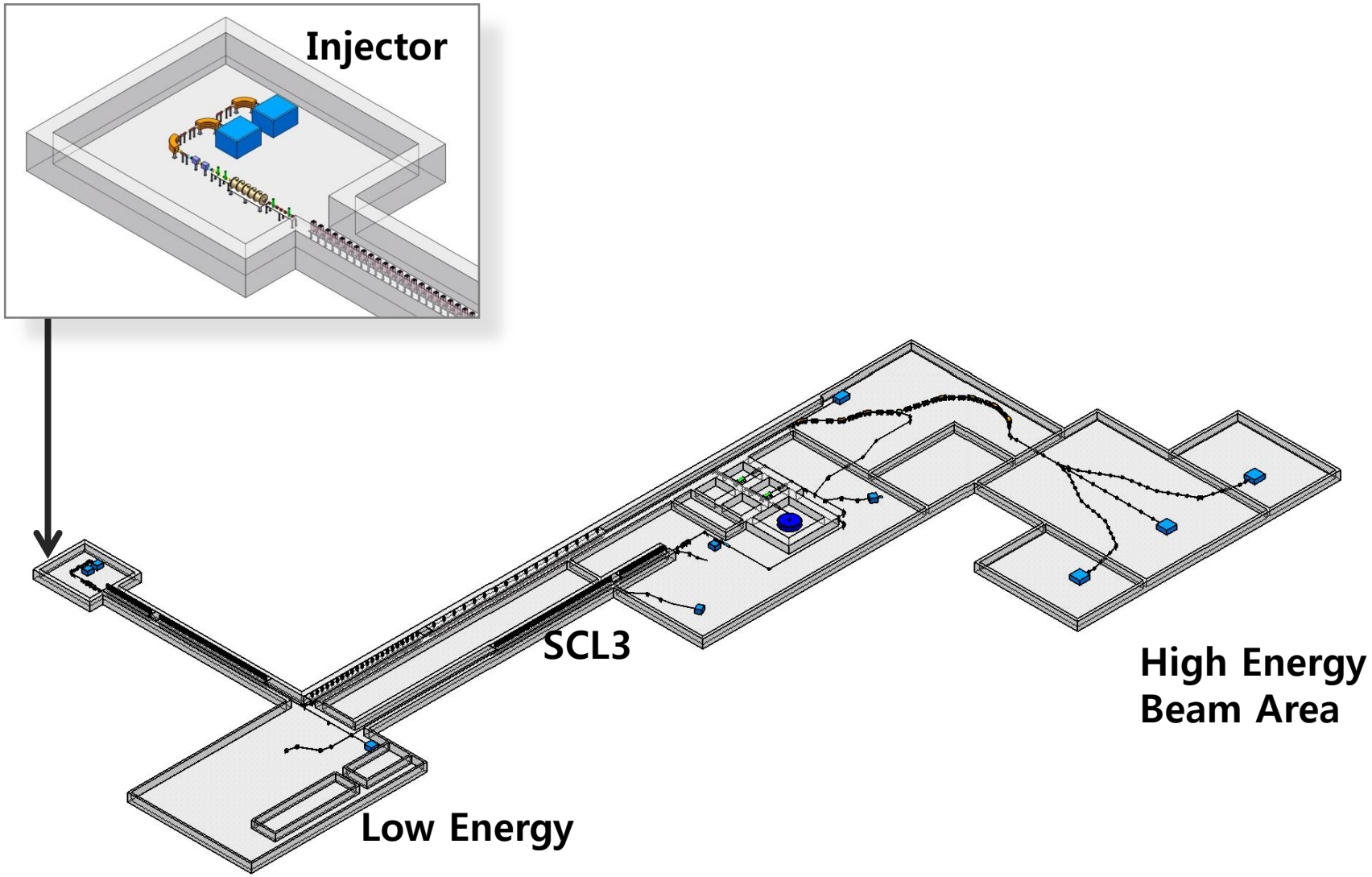
Accelerator	Driver Linac		Post Acc.	Cyclotron
Particle	proton	U^{+78}	RI beam	proton
Beam energy	600 MeV	200 MeV/u	18.5 MeV/u	70 MeV
Beam current	660μA	8.3 pμA	-	1 mA
Power on target	400 kW	400 kW	-	70 kW

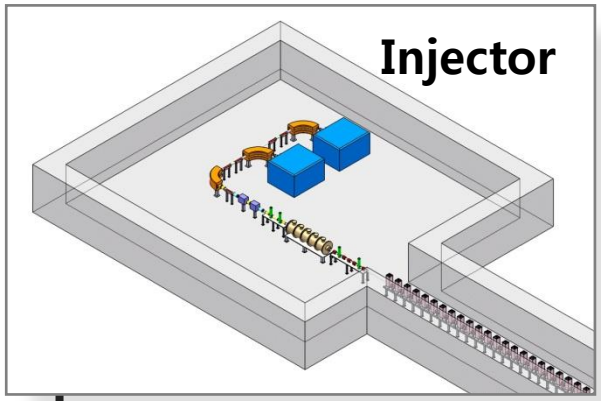


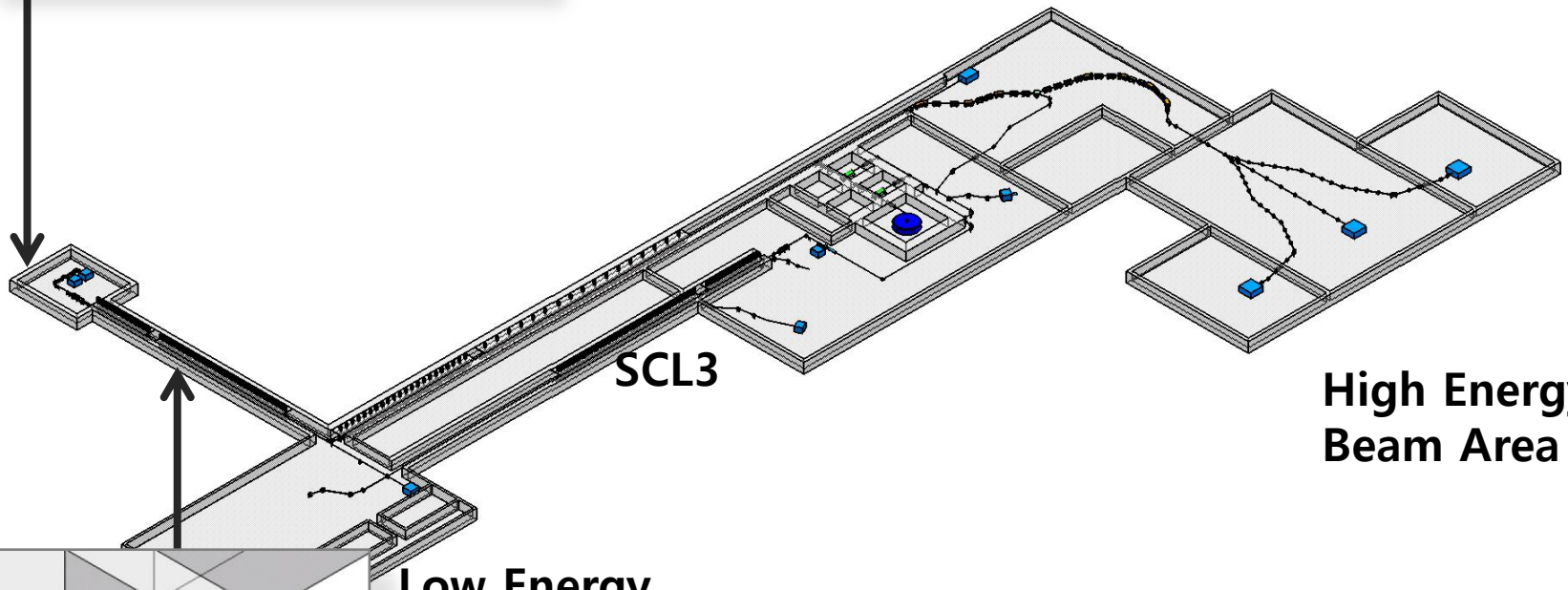
Bird's-eye View of the Accelerator Facility Design

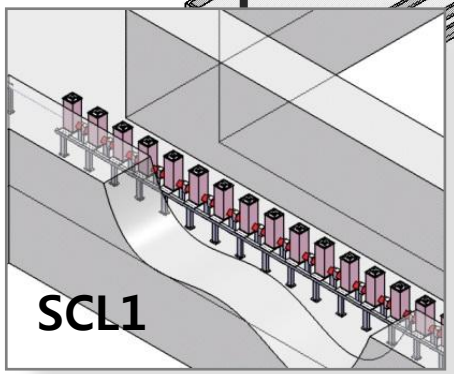
June 2012

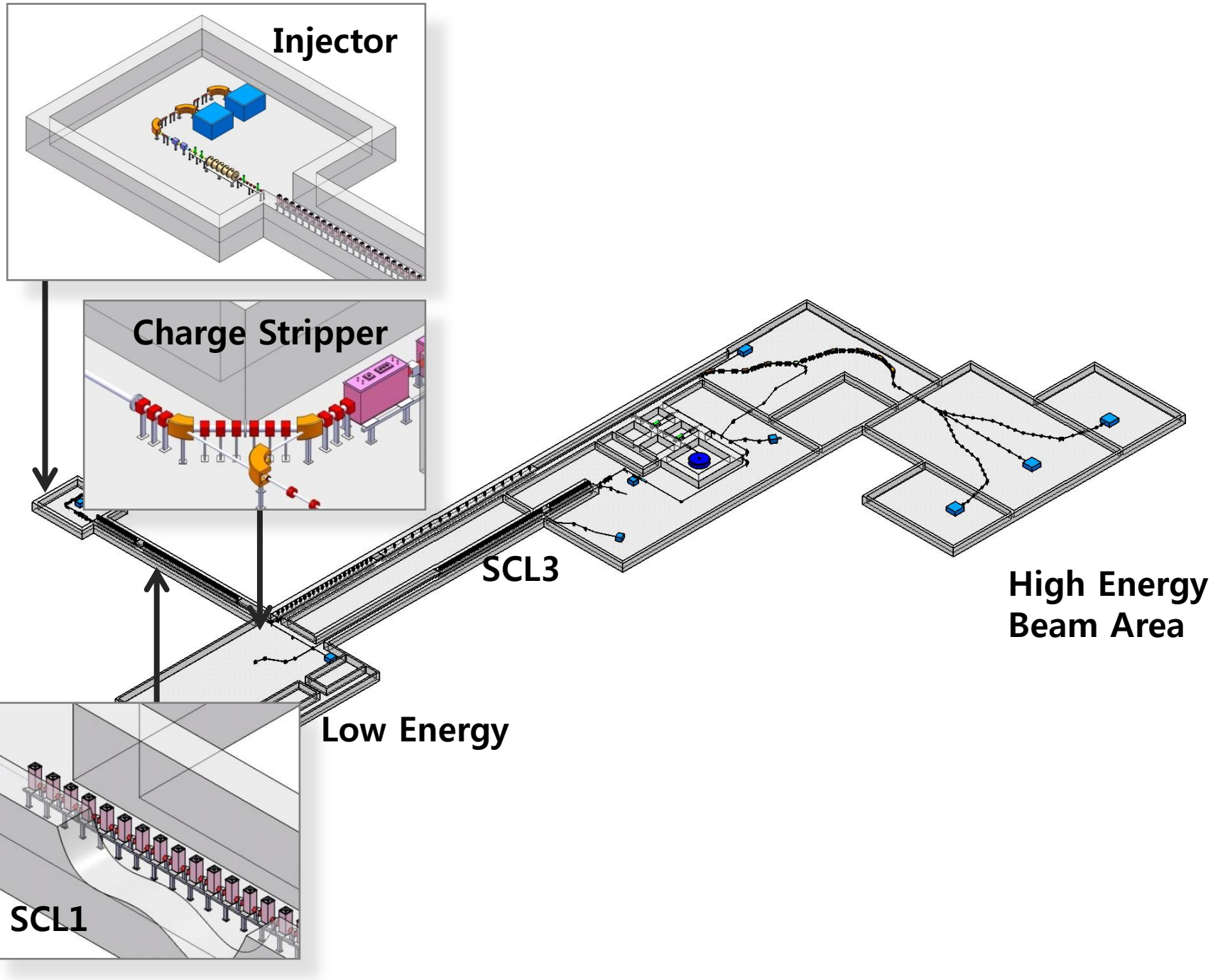

SCL3
High Energy
Beam Area
Low Energy

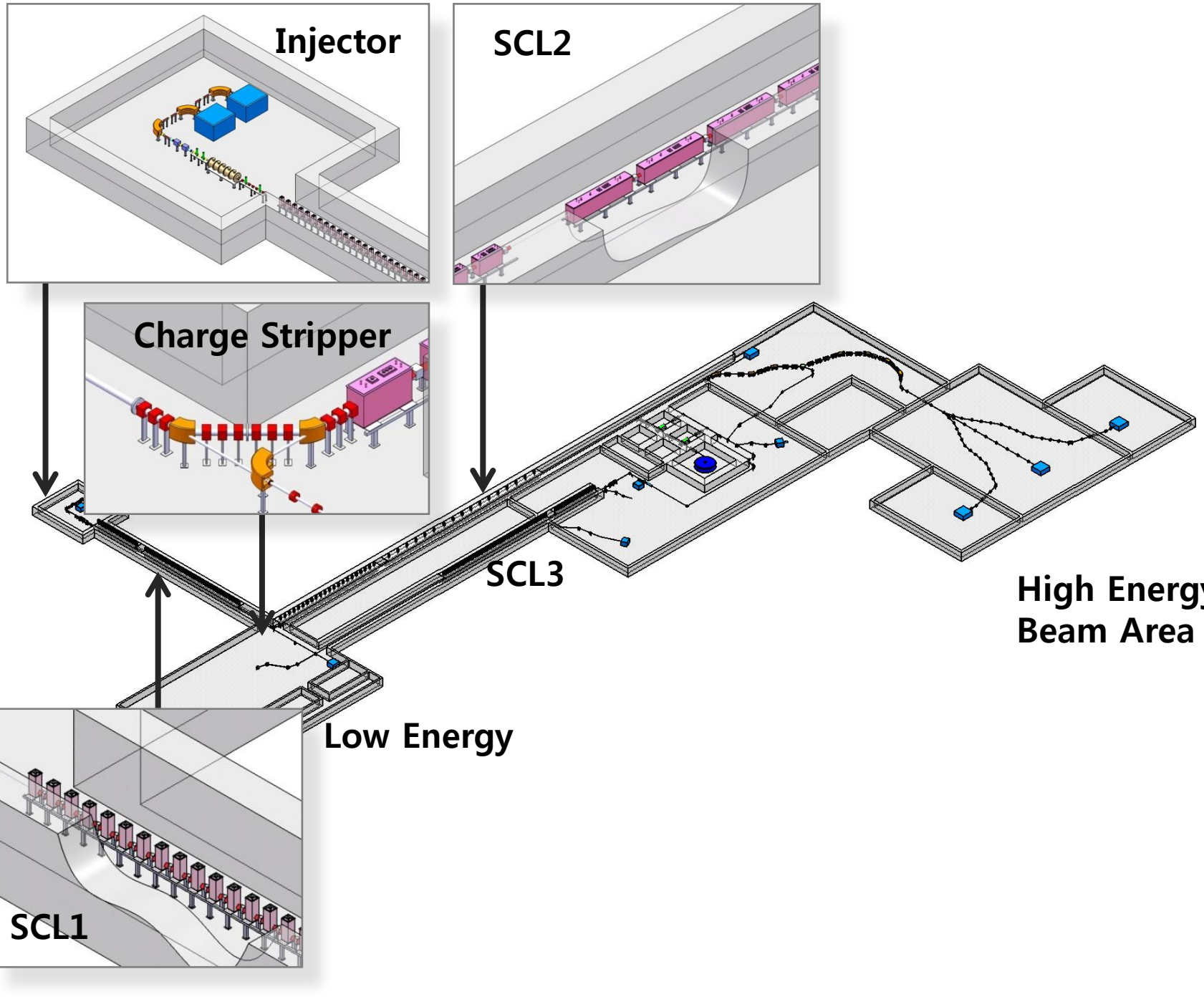

Injector
SCL3
High Energy
Beam Area
Low Energy

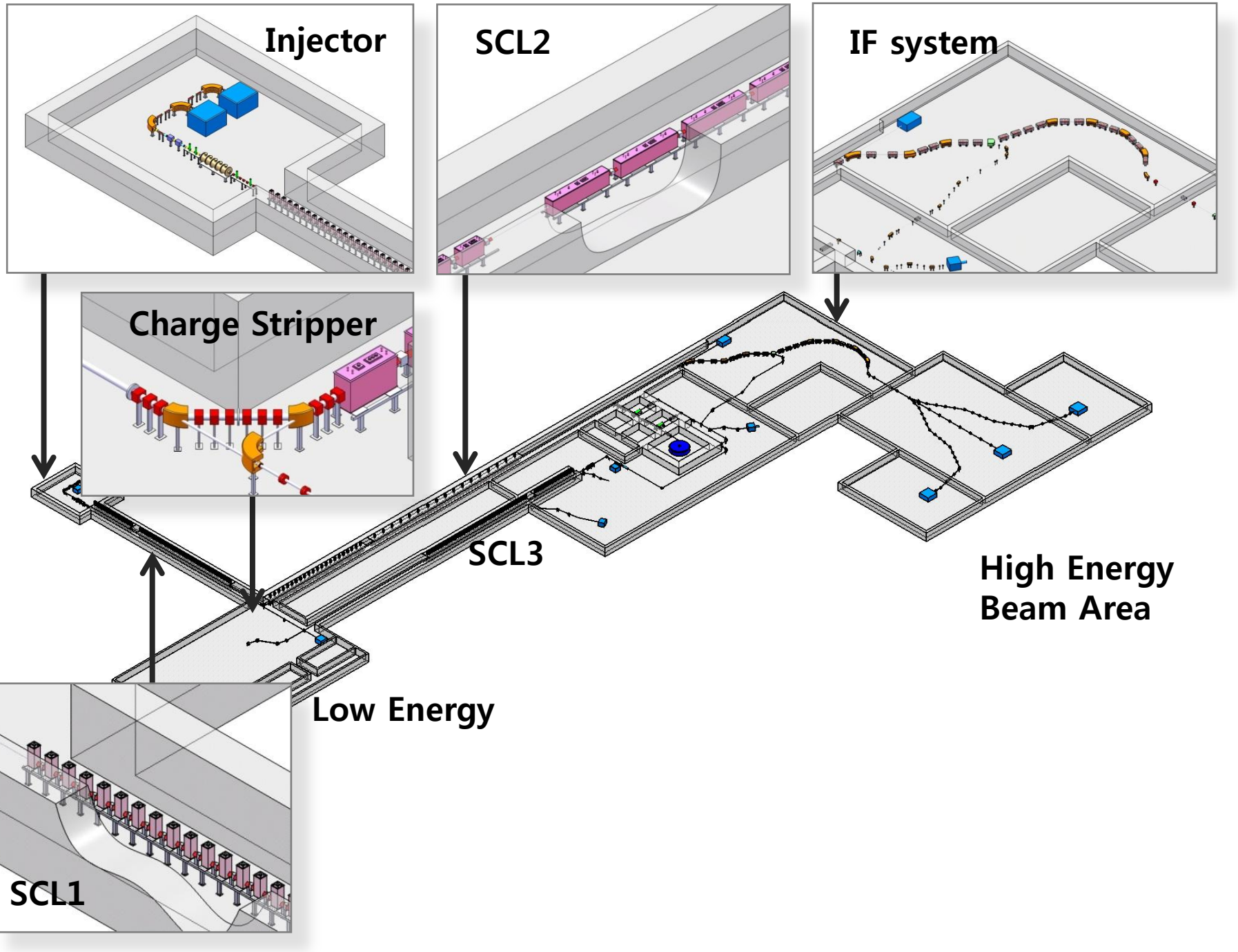

Injector

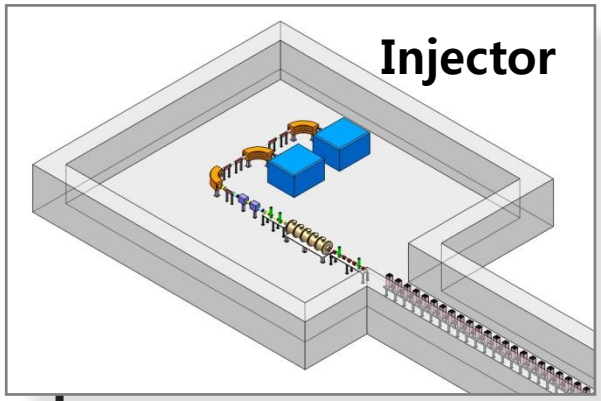

SCL3
High Energy
Beam Area
Low Energy


SCL1


Injector
Charge Stripper
SCL3
High Energy
Beam Area
Low Energy
SCL1


Injector
SCL2
Charge Stripper
SCL3
High Energy
Beam Area
Low Energy
SCL1


Injector
SCL2
IF system
Charge Stripper
SCL3
High Energy
Beam Area
Low Energy
SCL1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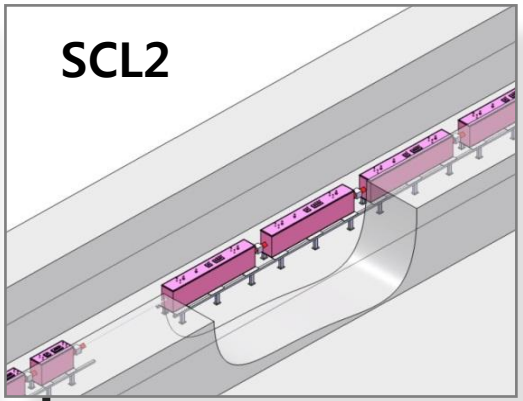
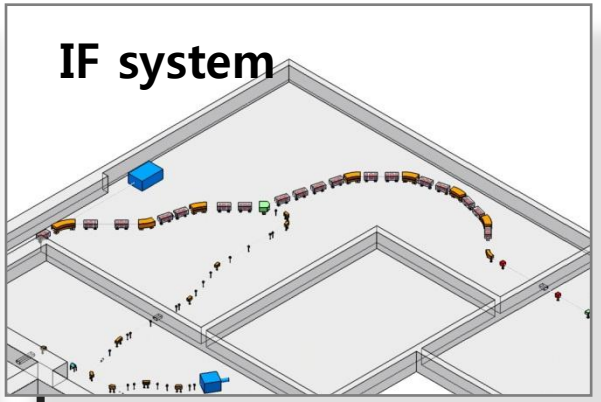
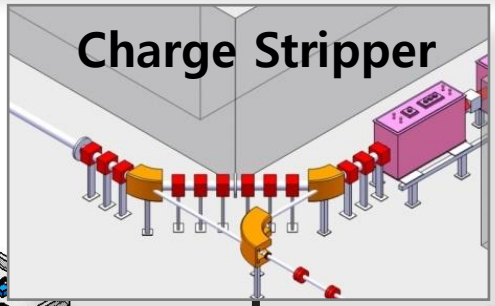
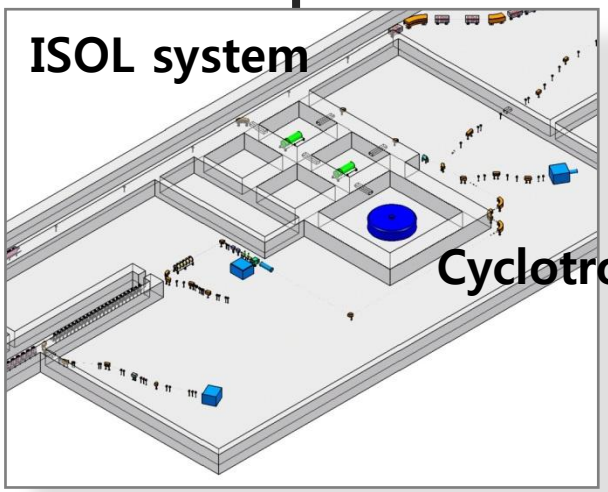
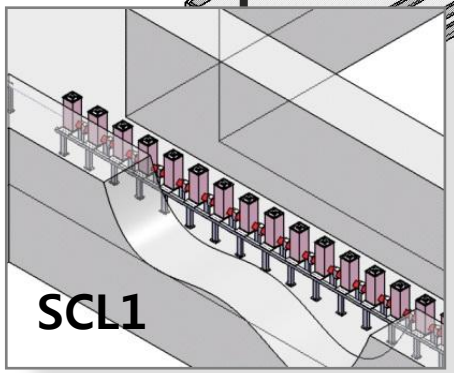

SCL2


IF system


Charge Stripper

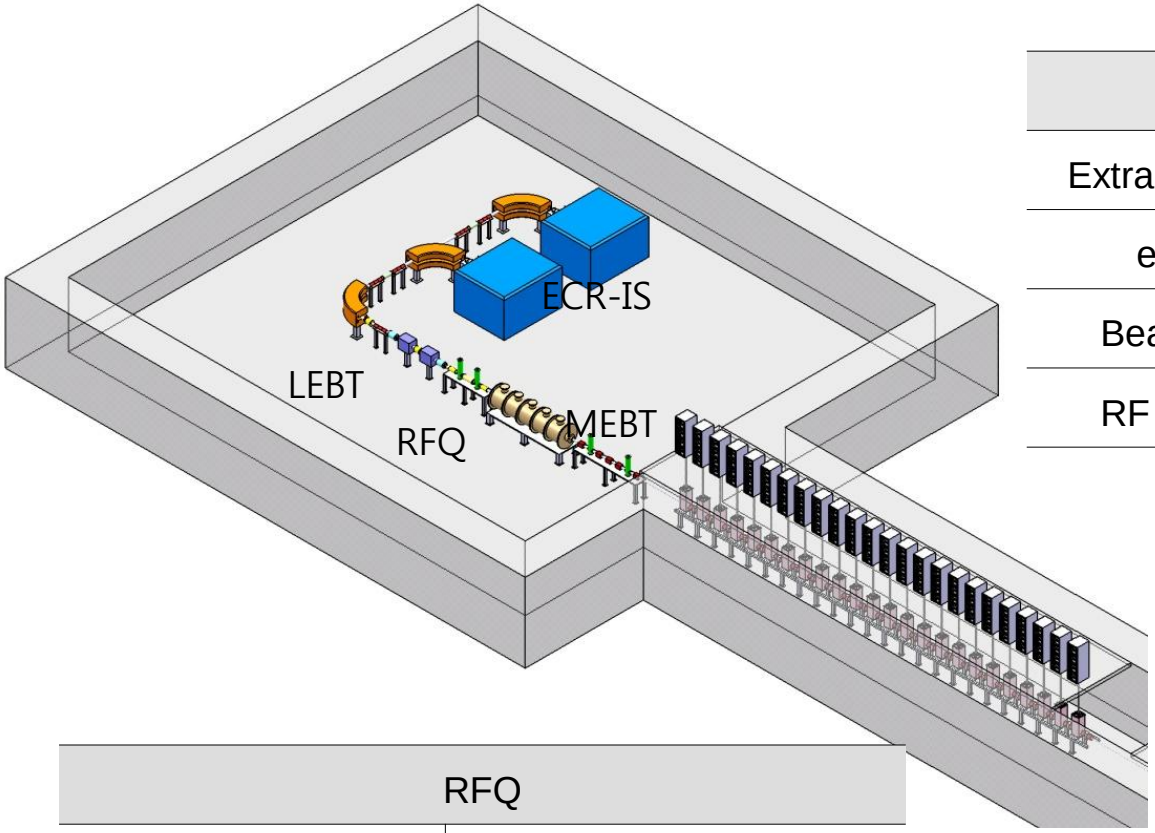
SCL3
High Energy
Beam Area


ISOL system
Cyclotron


SCL1

Low Energy

Ion sources and injection line for sc-linac



ECR-IS	
Extraction energy	10 keV/u
emittance	0.1π mm-mrad
Beam current	400 euA ($^{238}U^{33+}$, $^{238}U^{34+}$)
RF frequency	28 GHz

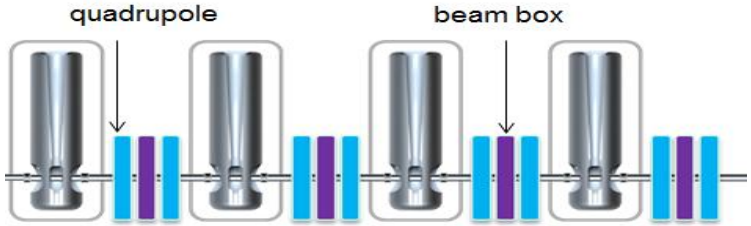
RFQ	
Extraction energy	300 keV/u
emittance (rms)	0.12 πmm-mrad
f	81.25 MHz
Two charge states	33, 34 (Uranium-238)
Transmission	> 80%

Arrangement of cavity and cryomodules

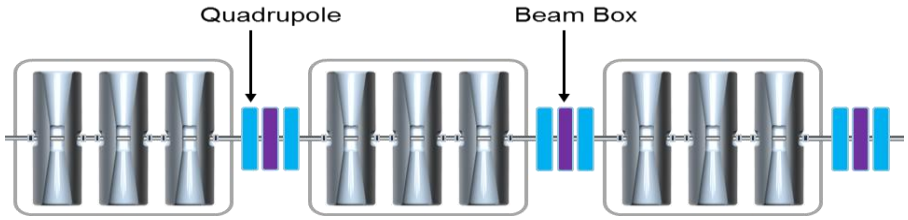
SCL1, SCL3

Poster: TUPB030

QWR
β = 0.047
f = 81.25 MHz



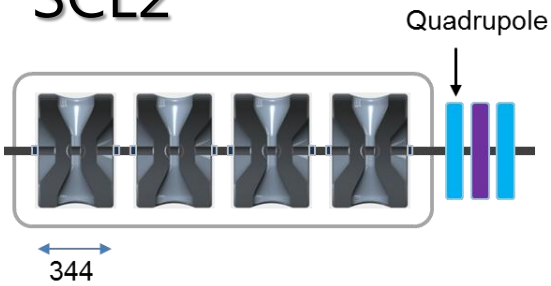
HWR
β= 0.12
f = 162.5 MHz



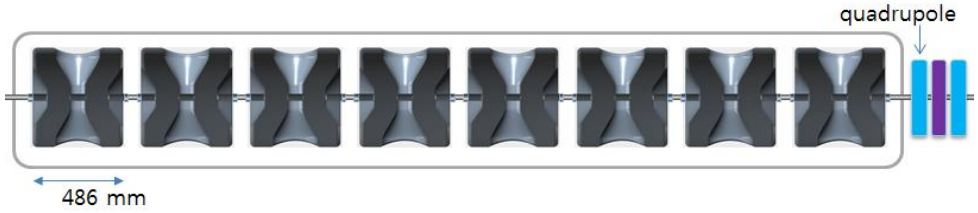
Two kinds of cryomodules
3 HWR+1 QD
6 HWR+1 QD

SCL2

SSR
β = 0.30,
f = 325 MHz



SSR
β= 0.53,
f = 325 MHz



Main parameters of sc-linac segments

Parameters	SCL 1			SCL 2	
	Segment 1	Segment 2		Segment 3	Segment 4
β_g	0.047	0.12		0.30	0.53
Energy at exit [MeV/u]	2.5	18.5		70.9	200
Length [m]	25.5	71.0		66.0	101.8
# of cryomodule	24	14	16	22	17
# of cavity/ cryomodule	1	3	6	4	8
# of quadrupole	48	60		44	34

Research Topics with Rare Isotope Beams

➢ Nuclear Physics
- Exotic nuclei near the neutron drip line
- Superheavy Elements (SHE)
- Equation-of-state (EoS) of nuclear matter

Origin of Elements

Stellar Evolution

➢ Nuclear Astrophysics
- Origin of nuclei
- Paths of nucleosynthesis
- Neutron stars and supernovae

➢ Nuclear data with fast neutrons
- Basic nuclear reaction data for future nuclear energy
- Nuclear waste transmutation

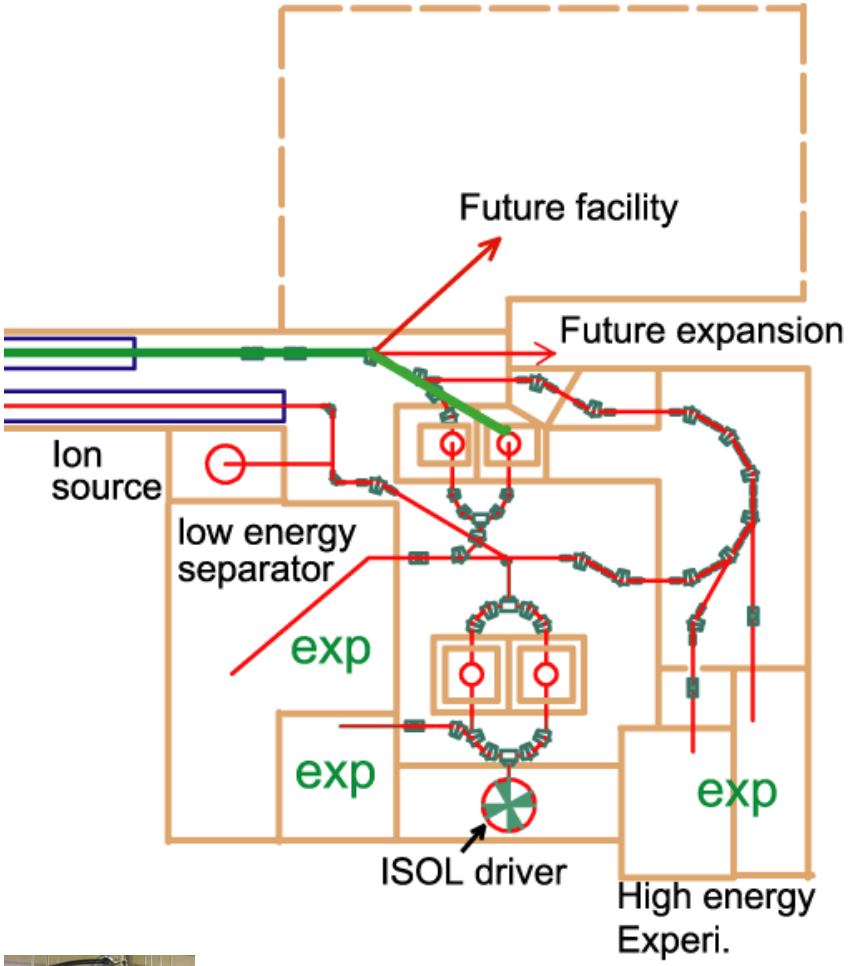
➢ Atomic/Particle physics
- Atomic trap
- Fundamental symmetries

➢ Material science
- Production & Characterization of new materials
- β-NMR / μSR

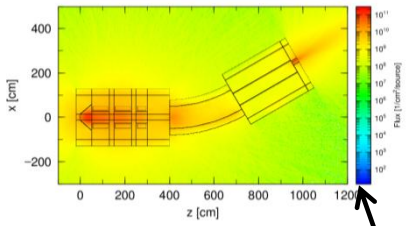
➢ Medical and Bio sciences
- Advanced therapy technology
- Mutation of DNA
- New isotopes for medical imaging

Application of Rare Isotopes

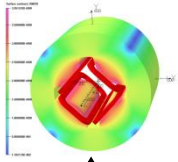
Area of ISOL facility and IF fragment separator

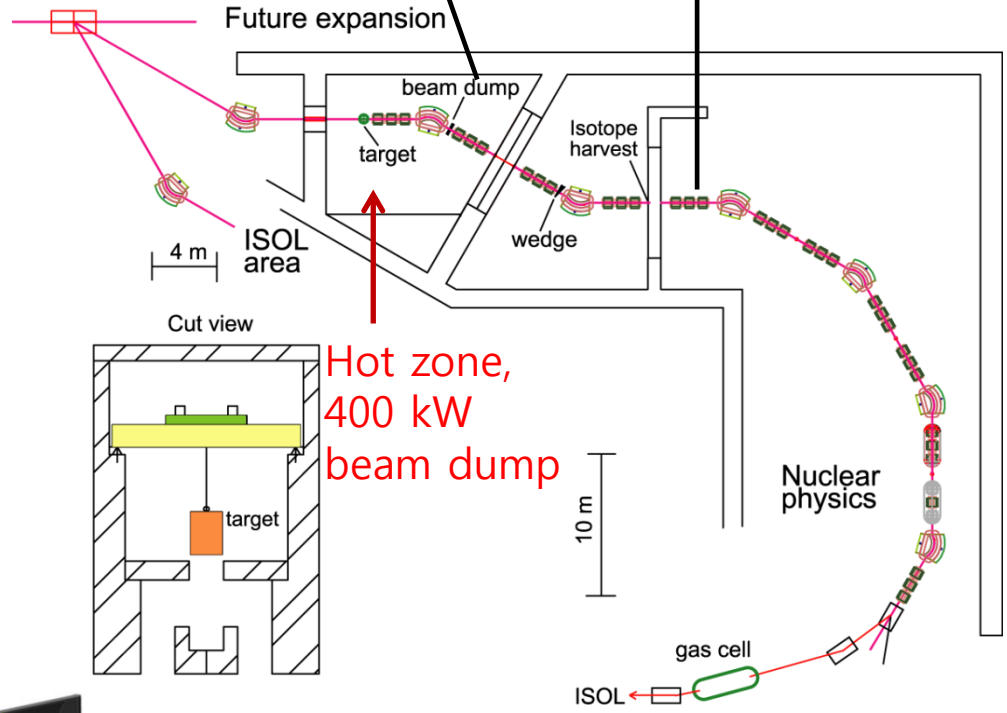


Radiation heating in target area



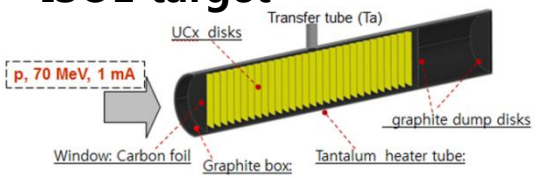
Large-aperture superferric quadrupole



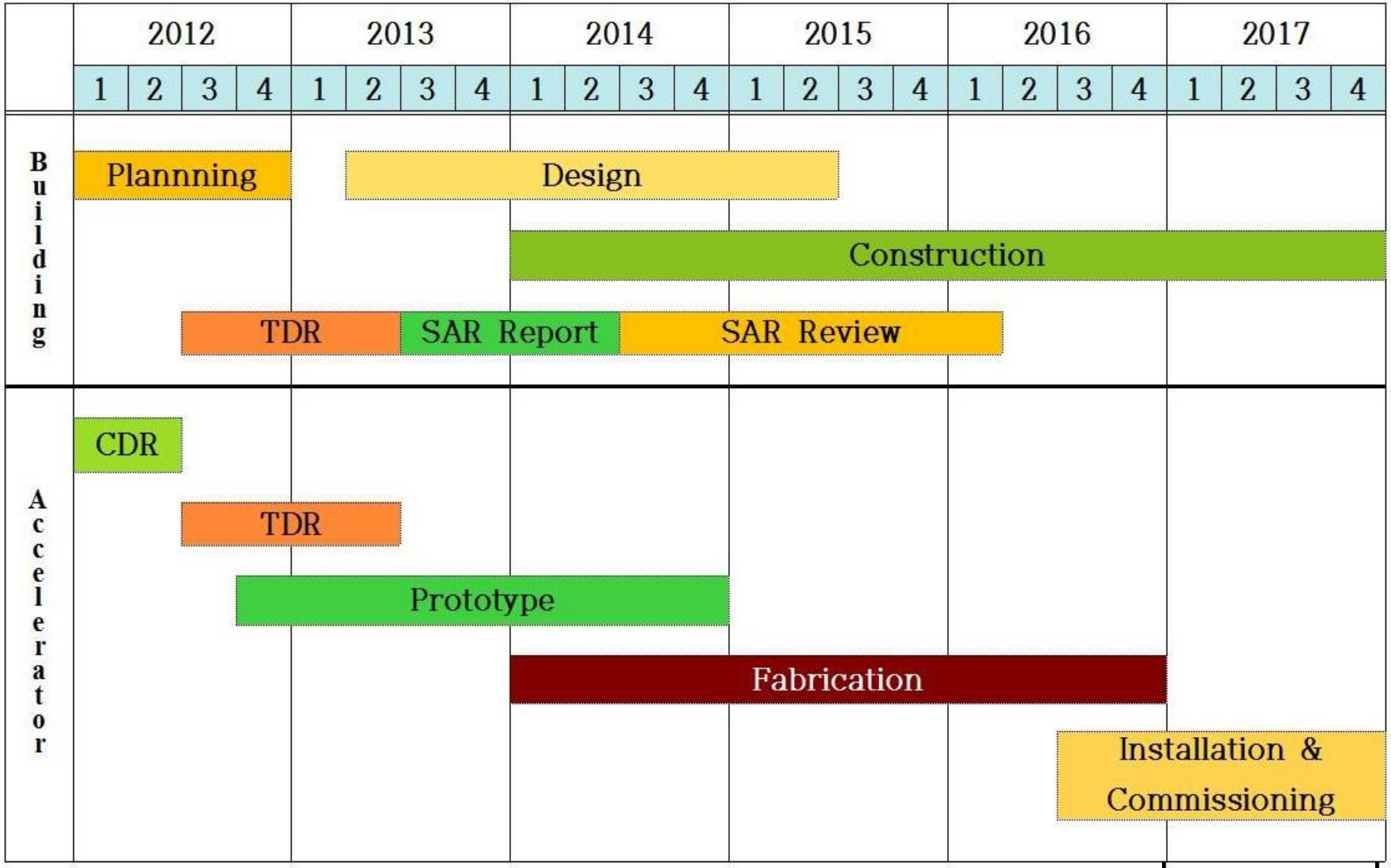


70 MeV, H- Cyclotron

ISOL target



Schedule



SAR: Safety Analysis Review
CDR: Conceptual Design Report, TDR: Technical Design Report

Cyclotron beam for ISOL

Sc-linac beam for IF