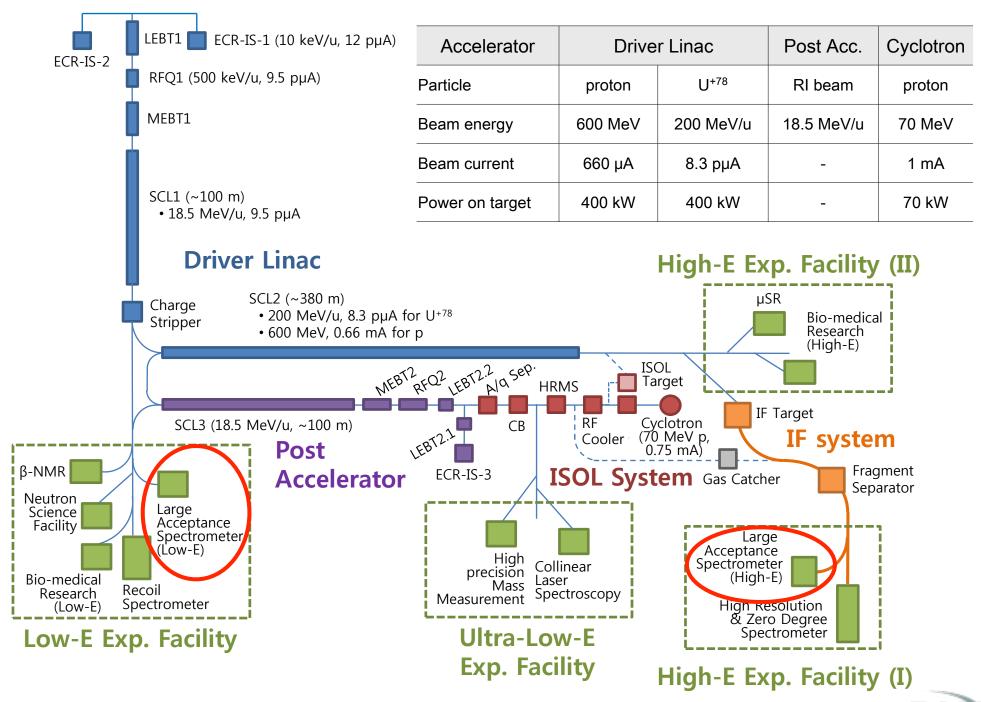
Large Acceptance Multi-Purpose Spectrometer (LAMPS) Schedule, Budget, & Collaboration

Taeksu Shin

High Energy Nuclear Science Team Rare Isotope Science Project Institute for Basic Science LAMPS Review March 31st, 2014

RAON Accelerator & Experimental Facilities



RAON

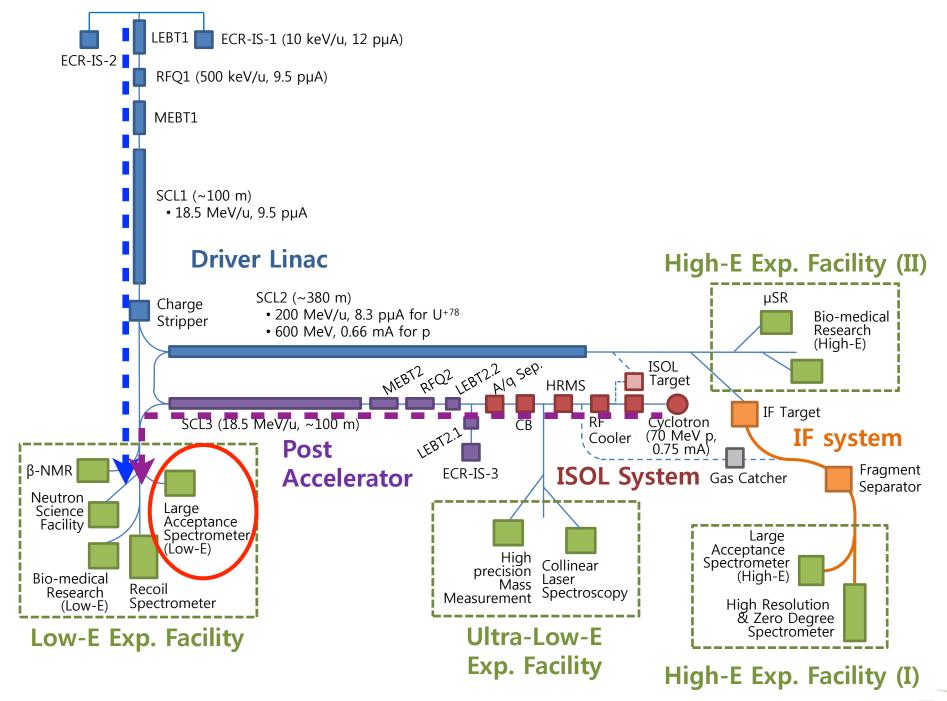
Rare Isotop



LAMPS Experimental Facilities



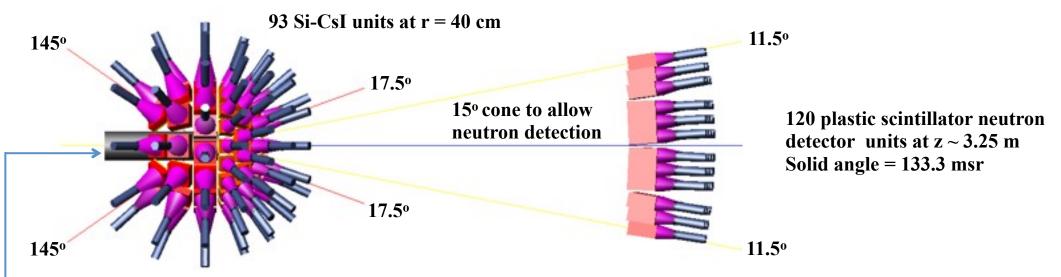
Rare Isotope



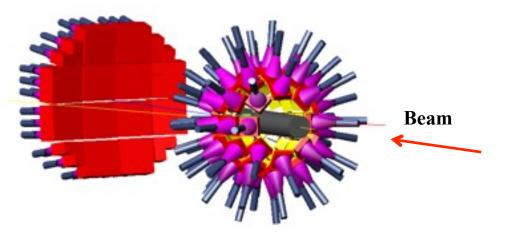


Low Energy LAMPS Experimental Setup

E_{beam} < 18.5*A* **MeV** For GDR Experiments (to test PDR measurements as well)



25° cone to allow target installation

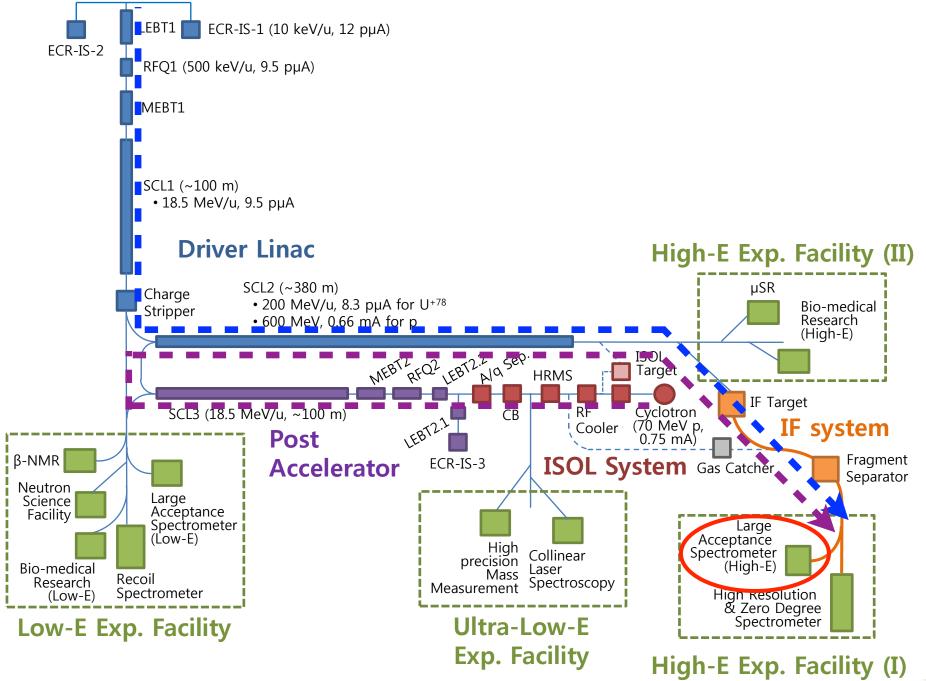


^{50,54}Ca, ^{68,70,72}Ni, ^{106,112,124,130,132}Sn RI beam + ¹⁹⁷Au/²⁰⁸Pb (stable target) + ¹²C/no target (background control) *could be possible from ISOL



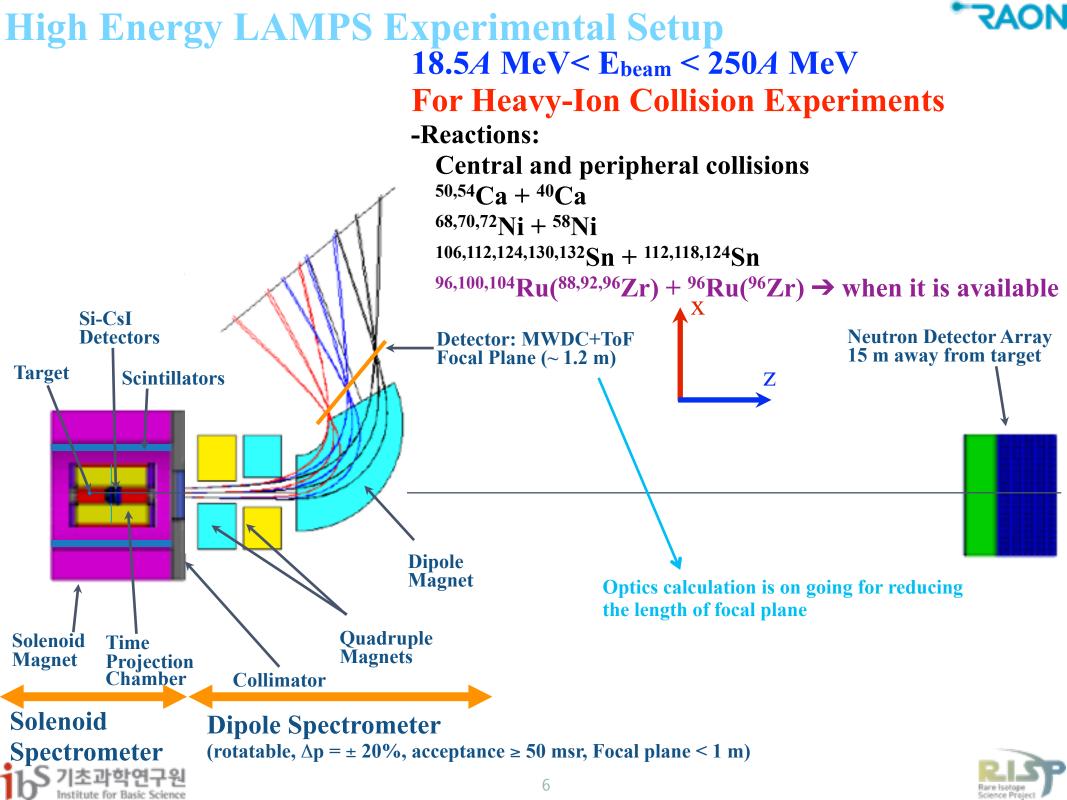
LAMPS Experimental Facilities











RAON Schedule

| * RAON |
|--------|
|--------|

| | | 10 1 | 20 2 Q 4 | 12 3Q 7 | 4Q 10 | 1Q 13 | 20 2Q 16 | 013 3Q 19 | 4Q 22 | 1Q 25 | 20 2Q 28 | 14 3Q 31 | 4Q 34 | 1Q 37 | 20 2Q 40 | 015 3Q 43 | 4Q 46 | 1Q 49 | 20 2 2 C | 016 Q 30 2 55 | 2 40 5 5 | Q 10 B 61 | 2 2 20 1 64 | 017 2 30 4 6 | Q 40 7 7 | Q 10 | Q 2 3 7 | 201 Q 3 '6 7 | 8 Q4 79 | IQ 3 | LQ 84 | 201 2Q 87 | .9 3Q 90 | 4Q 93 | 1Q 96 | 20 2Q 99 | 20 1C ## | 2 20 # # | 2 1 # # | Q 2 | 202 2Q ## | :1 3Q / | 4Q ## | 1Q ## | 20 2Q ## |)22 31 # | |
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| | | Technical/Engineering Design | | | | | | | ľ | | | | | | | | | | 10 k | w 1 | Targ | Ť | | Ť | T | Τ | Ť | Τ | Τ | Τ | | Ĭ | | | | | | | Γ | Т | Τ | Τ | ٦ | ٦ | | | Г |
| | | Fabrication/Installation | - | | | | | | | | off | line | ine | | | | | | | | -line | | t | t | | | | | + | | 1 | | | | | | | h | nigh | -po | we | er ta | arge | et | | _ | t |
| | Target/Ion Source Station | Hardware/Stable Beam Comm. | - | | | | | | | | | | | | | | | | | | | | | | | | | | ╈ | + | + | | | | | _ | | | T | ł | | | - | | | | t |
| | | RI Beam Comm. | - | | | | _ | | | | | | | | | | | | | | + | | | ╞ | | | | | | | ╡ | | | | | _ | | | | + | | | - | - | | _ | t |
| _ | | Technical/Engineering Design | | | | | | | | | | | | | | | | Е | CR | -СВ | R Sta | I ID atio | | RF | -coo | oler, | 1 | A. epai | 'q rato | | + | | | to | sci | .3 | | | | - | | | - | - | | | ł |
| ISOL | RI Beam | Fabrication/Installation | - | \square | | | | | | | | | | | | | | | 1 | t | | Ť | t | ľ | Ť | | | | | - | + | ┥ | - | - | | | | | | | + | + | + | + | - | _ | ł |
| | Separation System | Hardware/Stable Beam Comm. | - | | | | _ | | | | | | | | | | | | | | | | | ╞ | | | + | | | 1 | st B | 11 | am | fro | n 15) | OL. | | | | + | + | | + | - | - | | |
| | System | RI Beam Comm. | + | | | | | | | | | | | | | | | | | | | | | | | | N | nes | | | | 1 | + | + | | | | | | + | + | | + | - | - | | ł |
| | | Fabrication | | | | | | | | | | | | | | | | | | | | | ł | ╞ | 70 | Me | | | on | | | | | - | | | | | | | - | | _ | + | _ | | |
| | Proton Driver | | - | \vdash | | | | | | | | | | | | | | | | | | | | \vdash | | ме | WP. | rot | on | + | + | - | - | + | - | _ | | | | + | + | - | + | - | - | | + |
| | | Installation/Commissioning | | \square | | | | | | | | | | | | | | | _ | - | + | | | | | | | + | + | + | | | | + | | | | | | + | - | + | _ | _ | _ | | + |
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| Low-energy Nuclear Science | Detection System | Fabrication | - | H | \square | | | _ | | | pp - | Ср | not. | | | | - | | | | F | | - | | ſ | Day- | -1 e> | ct a | IT K | JBF | ιA | - | + | + | + | | | | + | + | + | + | + | + | _ | | + |
| | | Installation/Commissioning | | \mathbb{H} | | | | | | | rrA | ic p | oto | сурс | | | | AQ i de | systect | æm tørs | - | _ | + | | | | | | | + | - | | | - | | | | | | | + | | + | + | | | |
| | | Experiment | | \square | | | | | | | | | | | | | L | - | | $\left \right $ | | | - | + | + | + | + | - | + | - | 1 | - | - | 1 | - | | | | | - | - | - | 4 | 4 | | | 1 |
| | | Technical/Engineering Design | | \square | | | | | | | | | | | | | | | | | s | pec | trom | eter | | + | + | + | + | + | + | - | + | \downarrow | - | | | | + | + | + | + | + | \downarrow | | | |
| | Recoil Spectrometer | Fabrication | | | | | | | | | | _ | | _ | | | | | | | | | | | | | | | | + | - | | | 4 | | _ | | | - | + | + | | + | \downarrow | | | - |
| | speed sincler | Installation/Commissioning | | \square | | | | | | | | | | | | | | Ľ | n-fl | ight | t sep | ara | tor | | | | | | | + | | | | 4 | | | | | | | | | \downarrow | \downarrow | | | |
| ner | | Experiment | | \square | | | | | | | | | | | | | L | | | | | | | 1 | _ | | | | + | 1 | | | 1 | 1 | - | | | | | - | 1 | | 4 | 4 | _ | | 1 |
| Low-e | | Technical/Engineering Design | | | | | | | | | | | | | | | | | | | | 1 | R pı | rødu | ictio | nta | rget | | + | _ | - | | | \downarrow | | | | | | + | + | | 4 | \downarrow | | | |
| | Target System | Fabrication | | \square | | | | | - | | | _ | | | | - | | | | | I | | | | | | | | | + | - | | - | \downarrow | + | | | | | + | + | | \downarrow | \downarrow | | | |
| | | Installation/Commissioning | | | | | | | | | | | | | | | | | | | | _ | + | | | l | | 1 | | | | | | | | | | | | | | | \downarrow | \downarrow | | | |
| | | Experiment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 4 | 4 | | | 1 |
| | | Technical/Engineering Design | | Н | | | | | | | | | | | | | | | | | | | | | | | | | | | S. | olen Aag | net | \downarrow | | | | | - | | | | | | | | |
| ē. | Large Acceptance Spectrometer | Fabrication | | \square | | | | | | | | | | | | | | | | | I | | | | | | | | | | | | | | | | | | | | | | Dipole | e Spei | | mete | Ì |
| re-energy Science | opectionieter | Installation/Commissioning | | | | | | | | | | | | | | | | | | | | D | AQ : | syst | em D | Ne | utro tors | n (1/2 | 9 | TPC | : | | 1 | | | | | | I | | 1 | | 4 | 4 | | | + |
| | | Experiment | | | | | | | | | | | | | | | | | | | | | | | | | | | | Gan | ıma | An | av | | _ | | | | | F | ł | + | - | - | | | ļ |
| Intermedia Nuclear | | Technical/Engineering Design | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | - | | | | | | | | | | _ | | | | |
| NL NL | Zero-Degree Spectrometer | Fabrication | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | sτq | & Dij | pole : | Spec | trom | 1 |
| - | spectrometer | Installation/Commissioning | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | _ | _ | | | |
| | | Experiment | | Ц | | | | | | | | | | | | | | | | | | | | 1 | | | | | | _ | | | | 4 | | | | | | | | | 4 | 4 | | | 1 |
| | Collinear Laser | Technical/Engineering Design | | | | | | | | | | | | | | | | | | | | | | | | | | | 5 | | 4 | | _ | \downarrow | | | | | | + | | | \downarrow | \downarrow | | | |
| | Spectroscopy | Fabrication/Installation | | \square | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | \downarrow | \downarrow | | | + |
| | | Test/Comm. | | | | | | | | | | | | | L | L | L | | | | | | | L | | | | | | | | - | | | | | | | | | | | \downarrow | 4 | | | |
| | | Technical/Engineering Design | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | \downarrow | | | | | | | | | | | | | |
| | Neutron | Fabrication/Installation | | Ц | | | | | | | | | | | | | | | | | | | | | | | | | | | F | 'ast | neut | ron | | | | | | | | | Ģ | TP | 20 | | And in the second secon |
| g | | Test/Comm. | | | | | | | | | | | | | L | L | L | | | | | | | | | | | | | | | | | | | | | | | | | | ╡ | | | | |
| cier | | Technical/Engineering Design | | \square | | | | | | | | | | | | | | | | | | | | | | | | | М | RJ | ΥOF | | | | P | eni | ing | tra | p | | | | | | | | |
| sp | High Precision Mass Measurement | Fabrication/Installation | | \square | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Pe | | ng tra | | ith hi | ighly | í |
| Applied Science | | Test/Comm. | | | | | | | | | | | | | L | L | | | | | | | | | | | | | | | | | | | | | | | + | ╞ | | | ╡ | | | | |
| Ap | | Technical/Engineering Design | | | | | | | | | | | | | | | | | | | | | | | | | | | | | þ | nifo | rm t | ea | n irr | adi | atio | n sy | yste | m | | | | | | | |
| | Bio-medical | Fabrication/Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Ra | ster : | scanr | ning | syste | - |
| | | Test/Comm. | | | | | | | | | | | | | | | | | | | | Р | т | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Technical/Engineering Design | | | | | | | | | | | | | | | | | | | | | | | | | 1 | Mu | on t | arge | t | | | | | | | | | | -10 | w er | nergy | у µ-h | eam | line | |
| | | | | 1 | | | | | | | | 1 | | | | 1 | [| | 1 | | | 1 | | | | | | T | | | | | | | | | | | | | Ĩ | Ĩ | Ĩ | í | | | Ĩ |
| | μ-SR | Fabrication/Installation | | | | | | | | | | | | | | | | | | _ | _ | _ | | | _ | | | | | | | | | | | | _ | | - | | | | | | | | |
| | µ-SR | Fabrication/Installation Test/Comm. | | | | | | | | | | | | | | | | | | | SI | pect | rom | eer | | | | | | | | | | | | | | | | | | | | | | | I |







LAMPS Schedule

| | 2012 | | | | 20 | 13 | | 2014 | | | | | 20 | 15 | | 2016 | | | | | 20 | 17 | | 2018 | | | | | 20 | 2020 | | | |
|----|----------------------|-----------------------------|----|----|-----|---------|-------|-------|----|--|-------|-----|--|----|----|------|-------|--------|----|----|----------------|----|-------------|--------------|--------------|----|----|-------|------|------|----|----|----|
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 |
| BI | DS | | | TI | DR | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | Opt | tics ca | lcula | ition | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Magnet R&D Magnet productio | | | | | | | | | ction | | | | | | | | | | | | | | | | | | | | | | |
| | Detector R&D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Electronics, DAQ R&D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | Low | Low energy detector, electronics, DAQ production | | | | | | | | AMPS tallat | | Con sior | nmis ling | | | F | Exper | imen | t | | | |
| | | | | | | | | | | High energy detector, electronics, DAQ produ | | | | | | | orodu | iction | l | | LAM nstal | | | | nmis ning | | | | | | | | |





Budget



| Item | Budget (M USD) |
|------------------------------------|-----------------------|
| Low Energy Detector & Electronics | 3.3 |
| High Energy Detector & Electronics | 26.7 |
| Start Counter & Solid Target | 0.6 |
| DAQ & DAQ Electronics | 2.2 |
| Total | 32.8 (-11.2) |
| Currently available budget | 23.4 (21.6) |
| Item | Budget (M USD) |
| Dipole Spectrometer | 8.9 |
| Si-CsI | 2.3 |
| Total | 11.2 |

In order to fit to currently available budget, dipole spectrometer and Si-CsI detecter at high energy experimental setup will be for the upgrade

- •Forward fragmentation measurement
- •PDR/GDR resonance measurement
- •Nuclear structure study (e.g. Coulomb breakup)



Collaboration

RAON

Domestic

•Korea University -Neutron detector R&D -TPC R&D -GEANT-4 simulation

•Chonbuk National University -Low energy physics -GEANT-4 simulation

•Kyungpook National University -Si detector R&D

•Inha University -TPC tracking algorithm

International

•GSI -Triggerless DAQ -Diamond detector

•GANIL, Saclay, RIKEN, J-PARC -TPC electronics

23 people from 5 institutes
Looking for more collaborators from
both domestic and international
➢ To form international collaboration





R&D Plan, Production Plan



•Solenoid magnet design is completed

-Need to figure out production feasibility

-Communicate with domestic and foreign magnet companies

•Si-CsI detector & neutron detector are commonly used at both experimental setups

-Electronics also can be common

•TPC detector and electronics are quite complicated

-Need longer R&D time than other detectors

R&D and production of most of detectors will be done with domestic people
Adapt advanced electronics & DAQ system from foreign research institute and modify

•For future upgrade

➡Longer optics calculation for better dipole spectrometer performance -After optics calculation completed, magnet design will be started & focal plane detector design will be fixed

→Build Si-CsI detector at high energy experimental setup







Thank for your attention!



