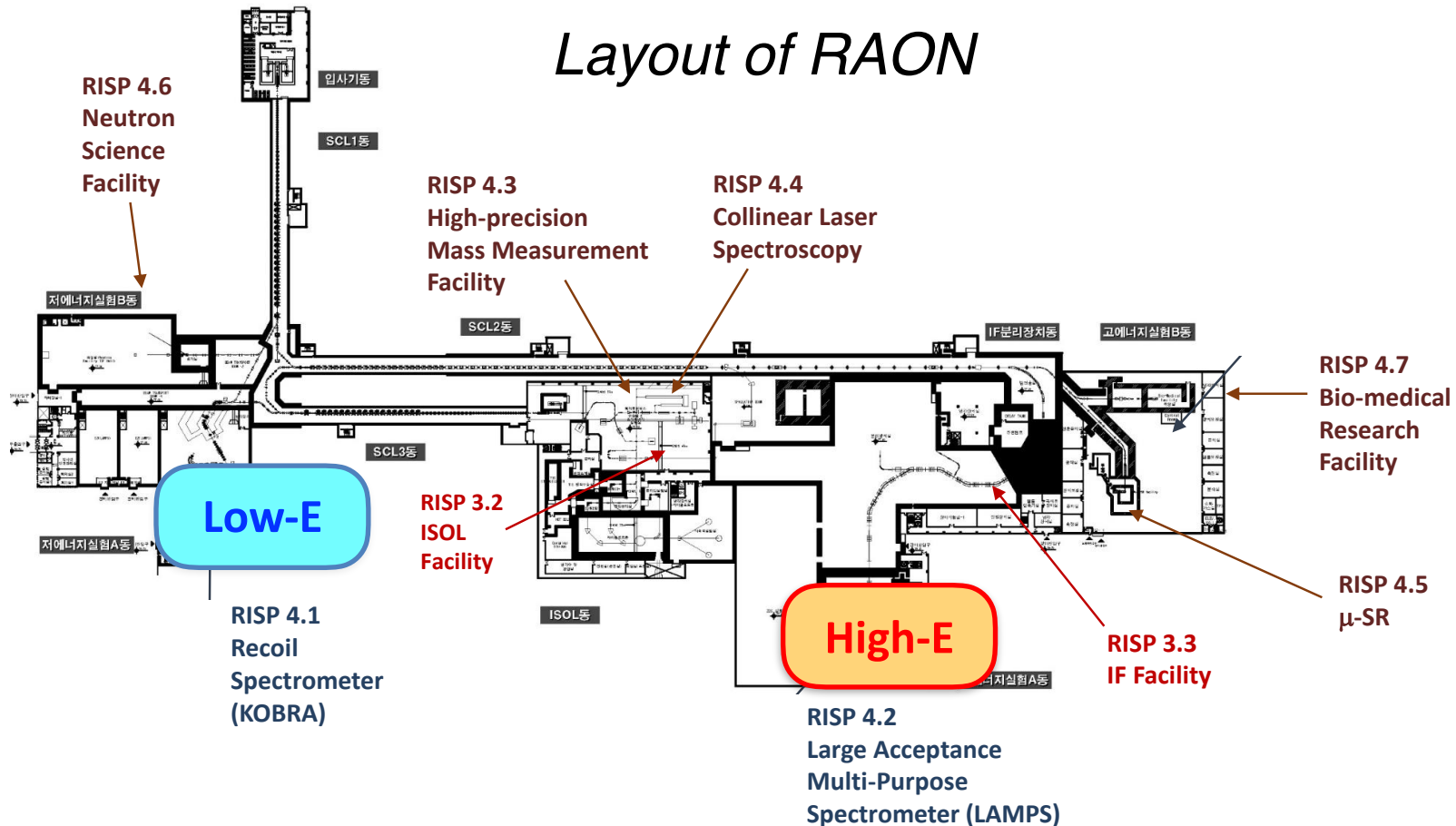


Large **A**cceptance **M**ulti-**P**urpose **S**pectrometer

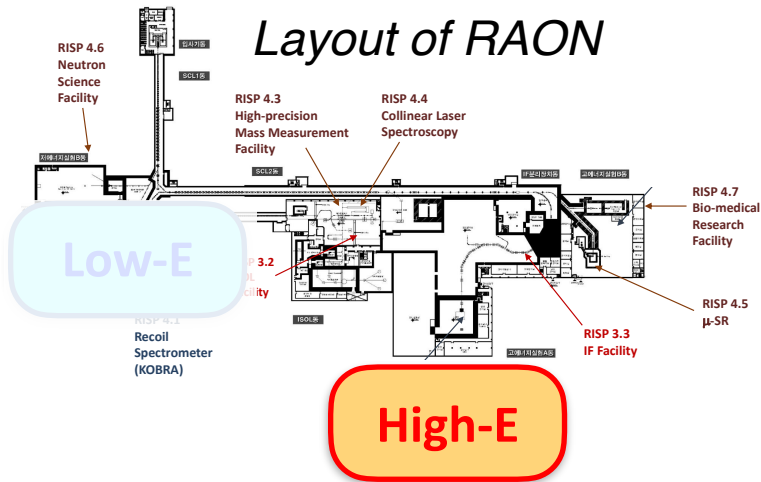
LAMPS experiments



LAMPS experiment was proposed to have two sectors:
low-energy and **high-energy**

Physics Motivation for High-Energy Experiment

Layout of RAON



High energy LAMPS

- Collision energy = O(100)MeV
- Primary goal is nuclear symmetry energy in Equation of State

EOS: $\frac{E}{A}(\rho, \delta) = \frac{E}{A}(\rho, 0) + S(\rho) \delta^2 + \dots$, where $\delta \equiv \frac{\rho_n - \rho_p}{\rho_n + \rho_p}$

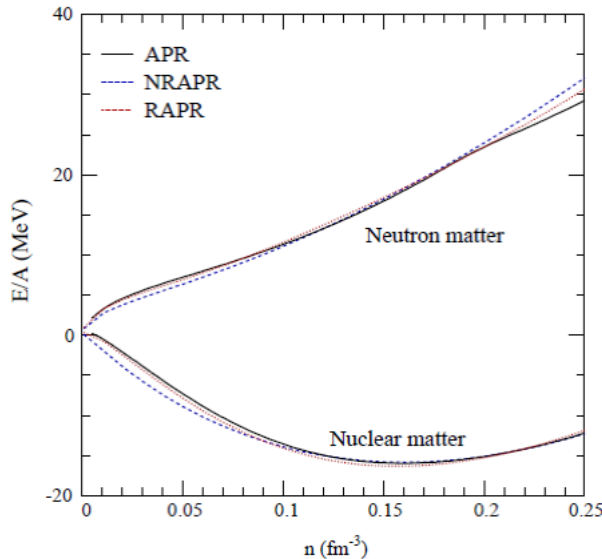
Symmetry energy

$$\left[S_v + \frac{L}{3} \left(\frac{\rho - \rho_0}{\rho_0} \right) + \frac{K_{sym}}{18} \left(\frac{\rho - \rho_0}{\rho_0} \right)^2 \right] + \dots$$

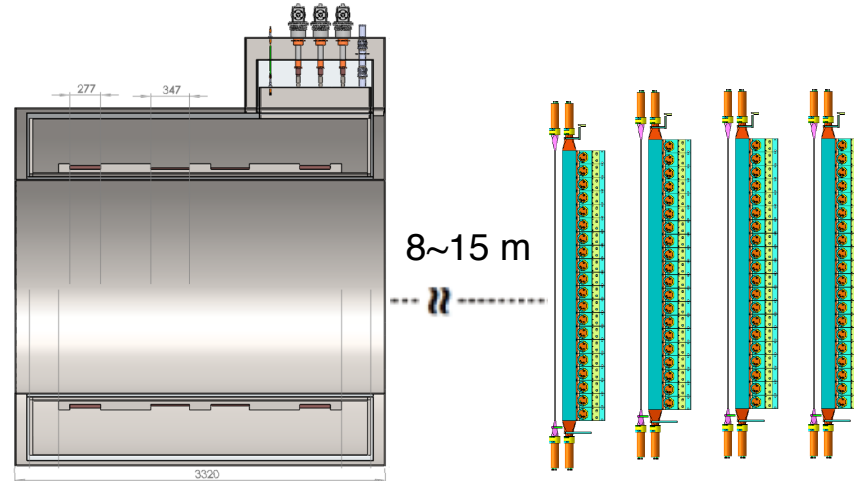
Potential observables

- Symmetry energy up to extremely neutron-rich matters
 - Nailing down model parameters
- Symmetry pressure and radii
 - Precision measurement of neutron skin
- Isospin mixing

Nice introduction by Dr. Tamii's talk (Tuesday)



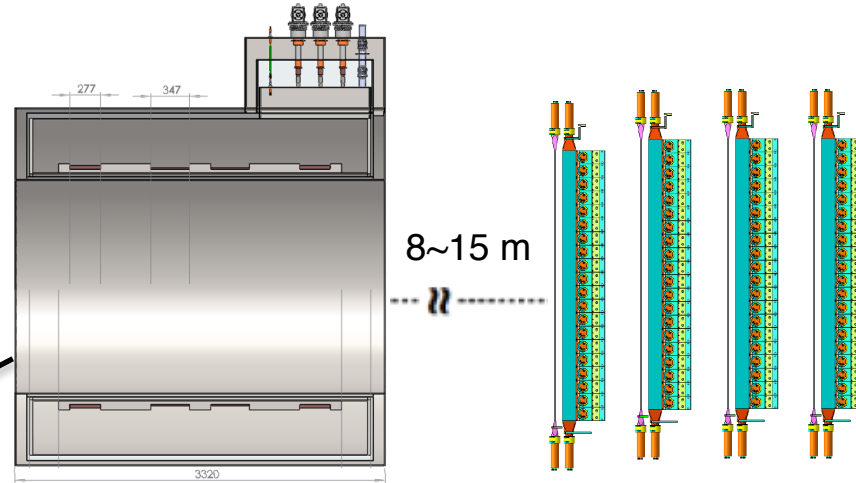
[Experimental Apparatus] High-Energy Experiment



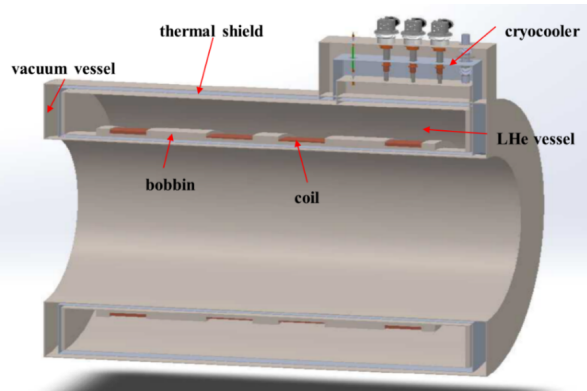
Requirement

Charged particles, neutrons in wide acceptance

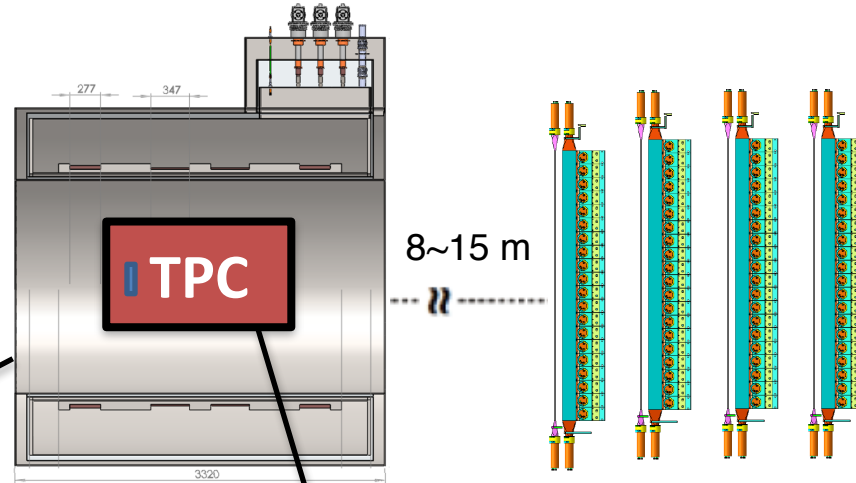
[Experimental Apparatus] TPC



Magnet design being finalized

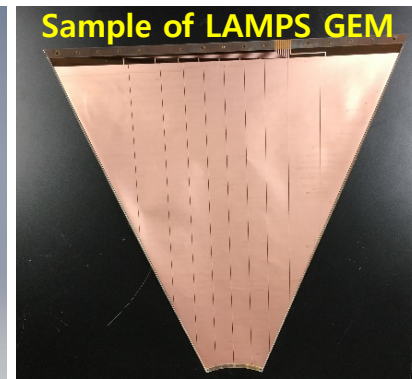
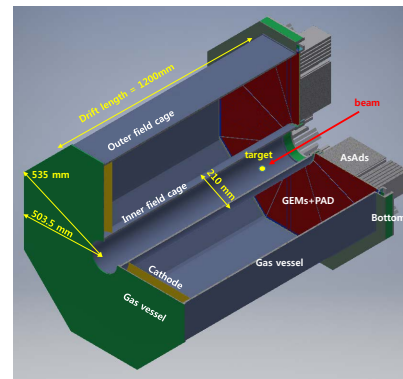
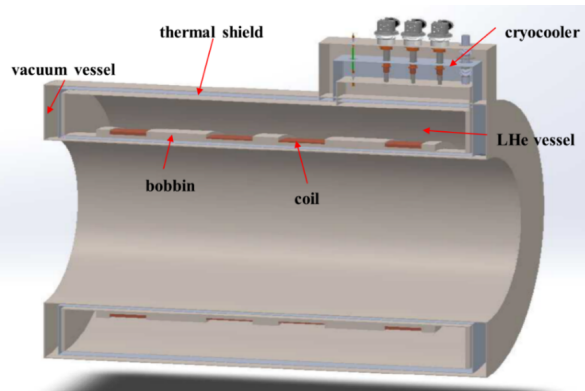


[Experimental Apparatus] TPC

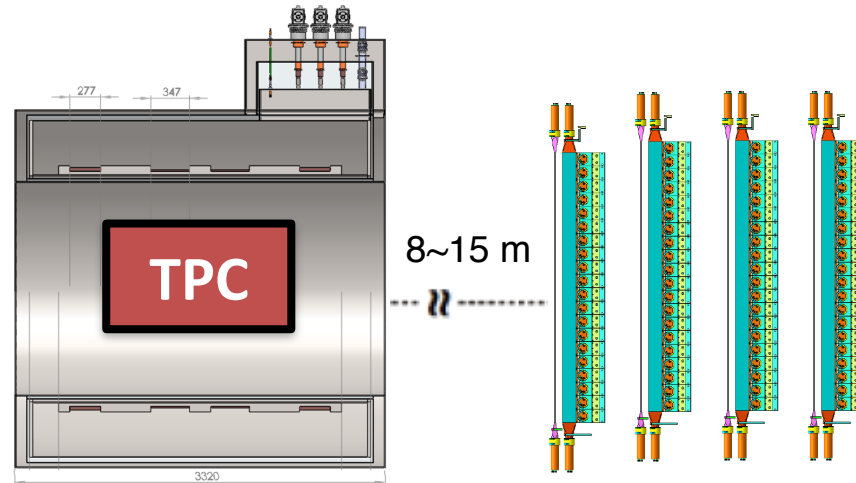


Magnet design being finalized

TPC under production



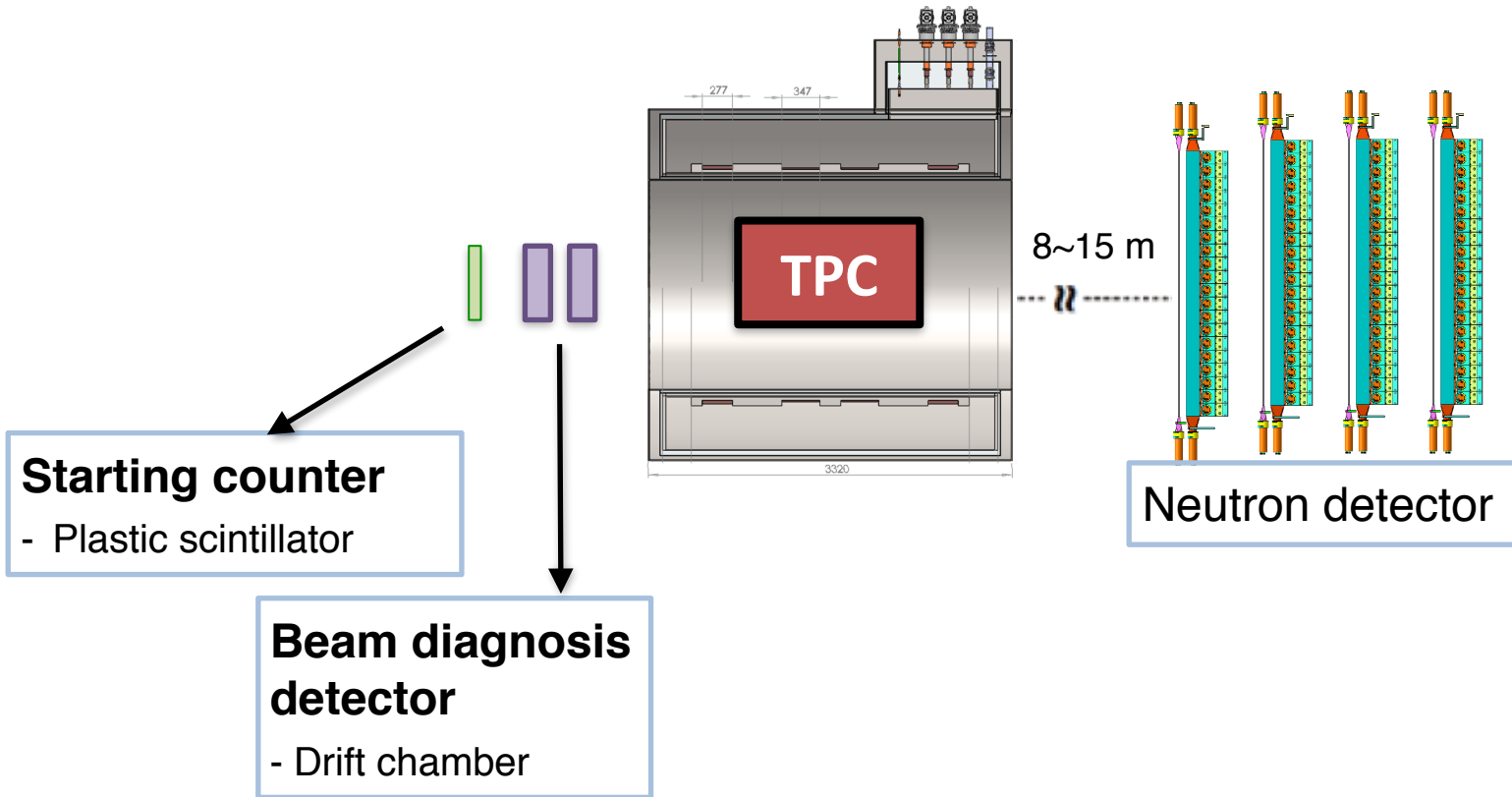
[Experimental Apparatus] Neutron detector array



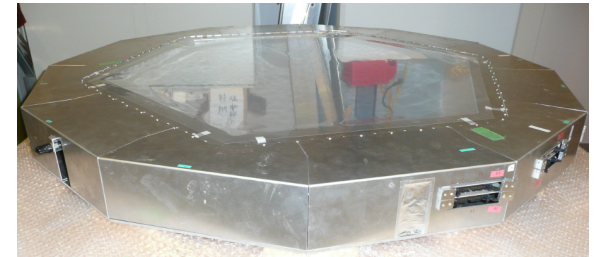
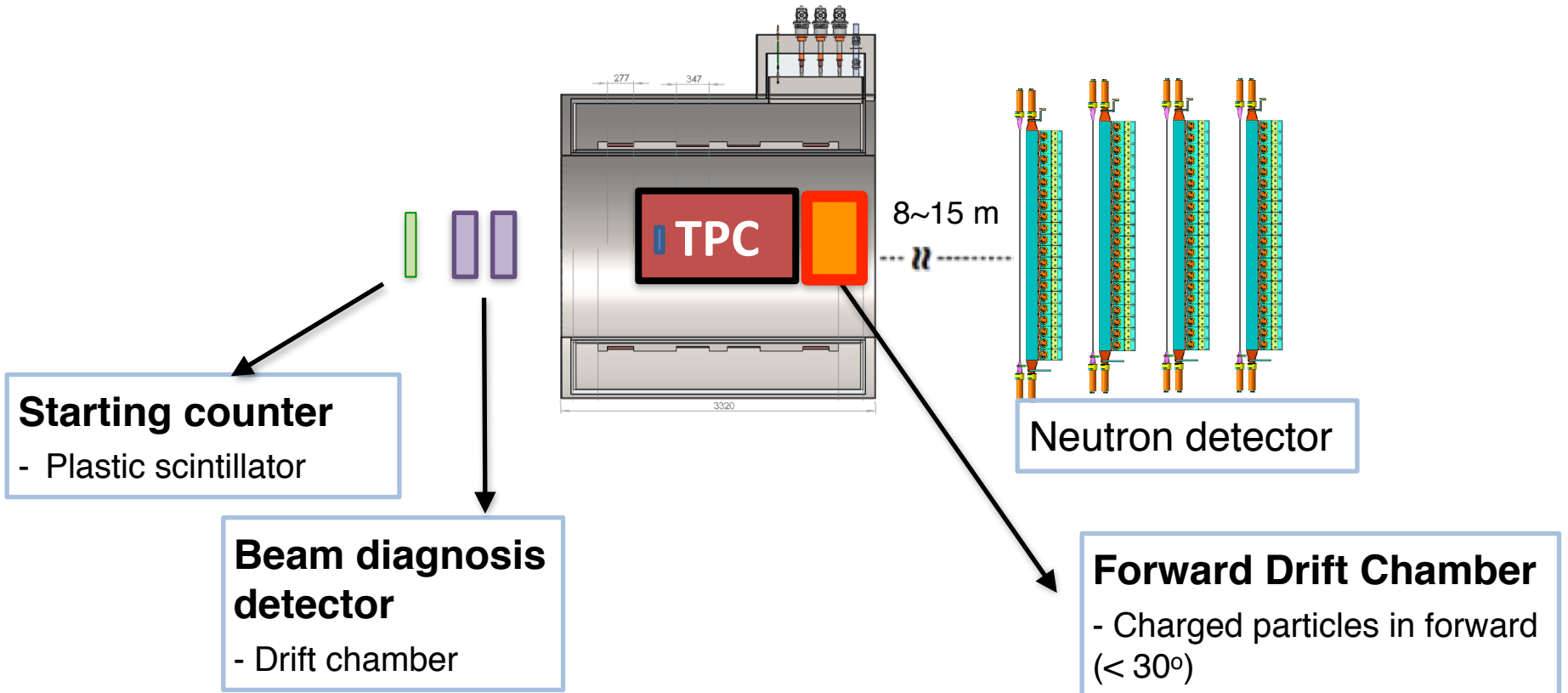
Neutron detector

- Manufacture completed
- To be tested

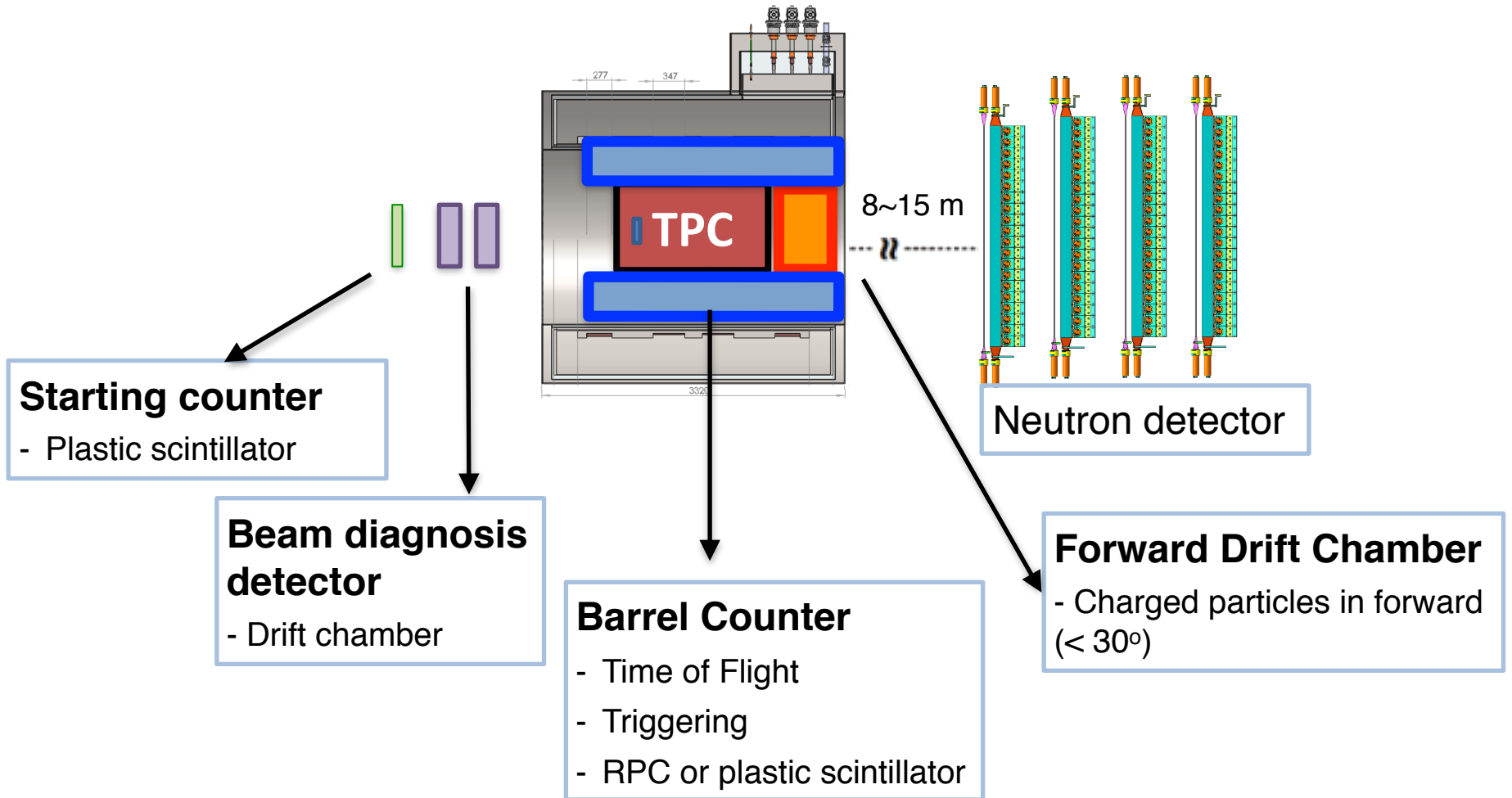
[Experimental Apparatus] More in R&D phase



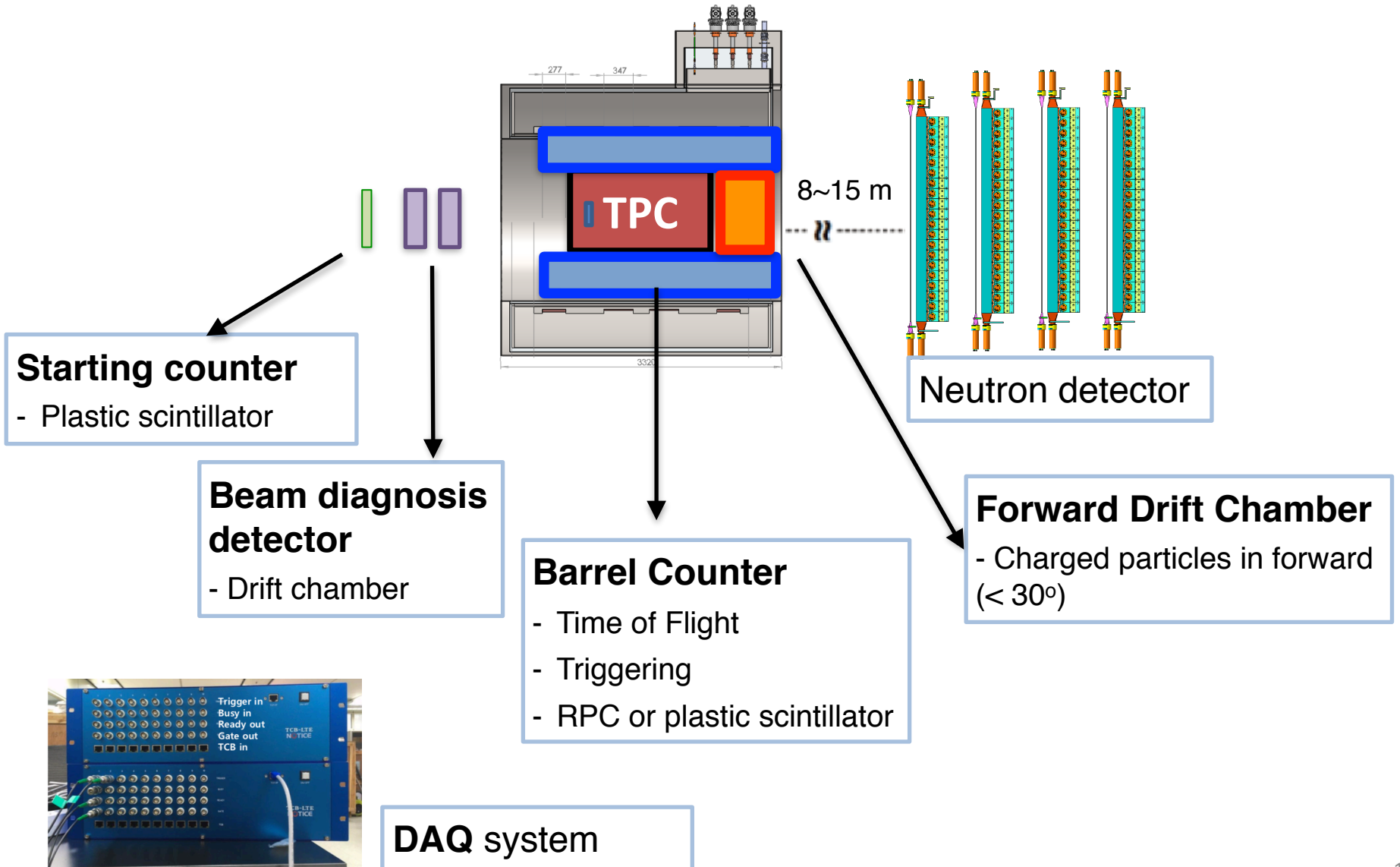
[Experimental Apparatus] More in R&D phase



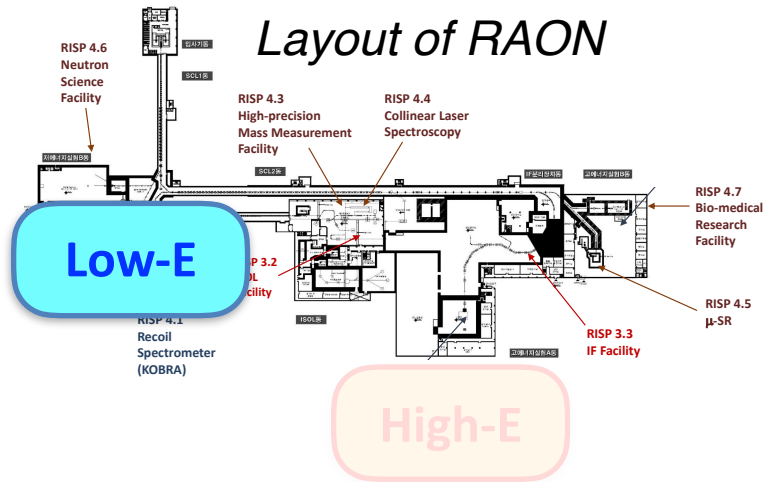
[Experimental Apparatus] More in R&D phase



[Experimental Apparatus] More in R&D phase



Physics Motivation of Low-Energy LAMPS

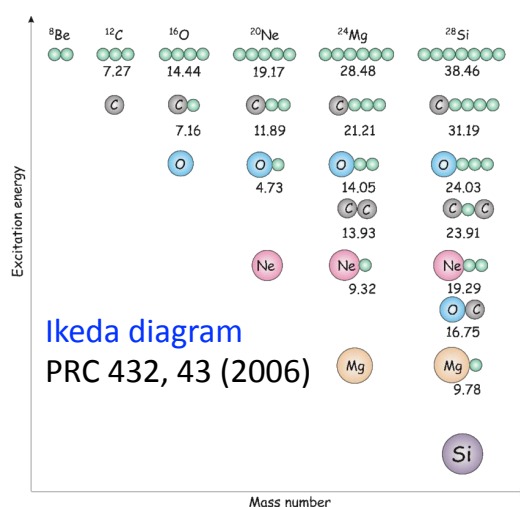
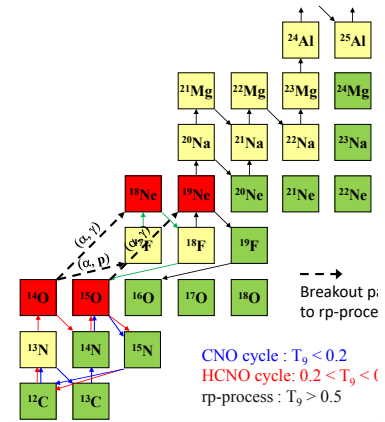


Low-energy LAMPS

- Collision energy = $O(10)$ MeV
- Primary goals are nuclear structure, Nuclear astrophysics
 - CNO, HCNO cycles rp-process
 - α -cluster states in nuclei
 - Dipole emission

Potential Day-1 analysis

- $X(\alpha, \gamma)Y$ scatterings
 - Angular correlation
 - Energy distribution
- Astro-physics processes



Ikeda diagram
PRC 432, 43 (2006)

Extrenal funds
from CENuM

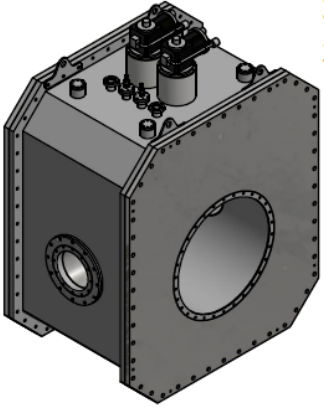


Center for
Extreme
Nuclear Matters

See Prof. Chae's talk

[Experimental Apparatus] AT-TPC

Low-Energy LAMPS: low energy tracking, PID and photon detection



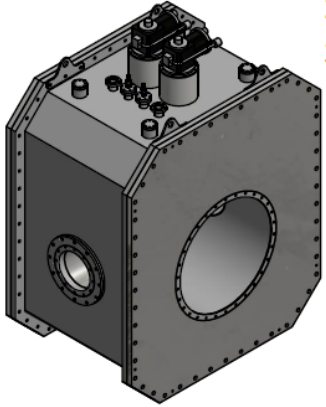
Superconducting magnet (2019)

- $B = 1.5 \text{ T}$, $d = 60\text{cm}$

Active-Target TPC (2020)

[Experimental Apparatus] LaBr_3

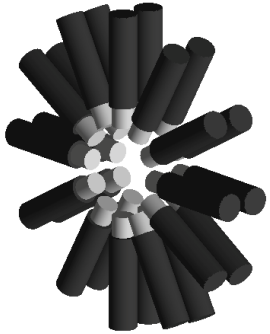
Low-Energy LAMPS: low energy tracking, PID and photon detection



Superconducting magnet (2019)

- $B = 1.5 \text{ T}$, $d = 60 \text{ cm}$

Active-Target TPC (2020)

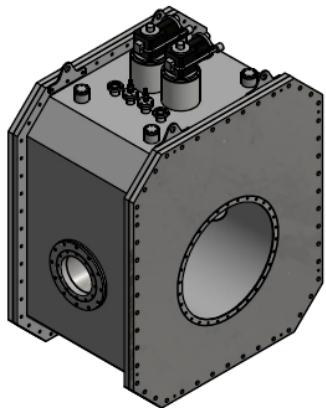


$\text{LaBr}_3(\text{Ce})$

- $R_t < 200 \text{ ps}$
- Decent energy resolution
- Total 24 modules with PMT

[Experimental Apparatus] Silicon-CsI

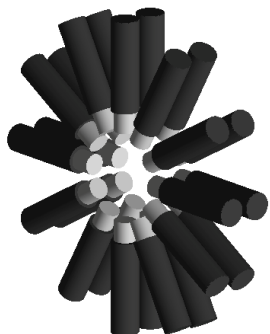
Low-Energy LAMPS: low energy tracking, PID and photon detection



Superconducting magnet (2019)

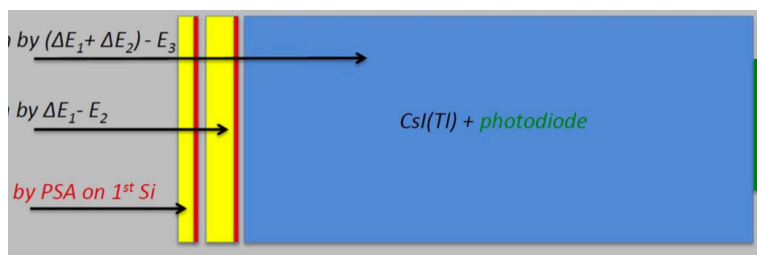
- $B = 1.5 \text{ T}$, $d = 60\text{cm}$

Active-Target TPC (2020)



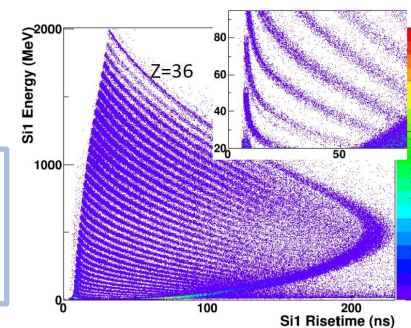
LaBr₃(Ce)

- $R_t < 200 \text{ ps}$
- Decent energy resolution
- Total 24 modules with PMT



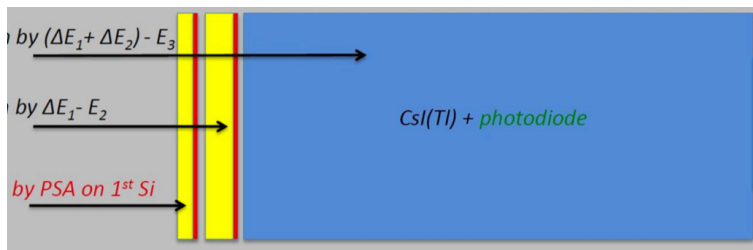
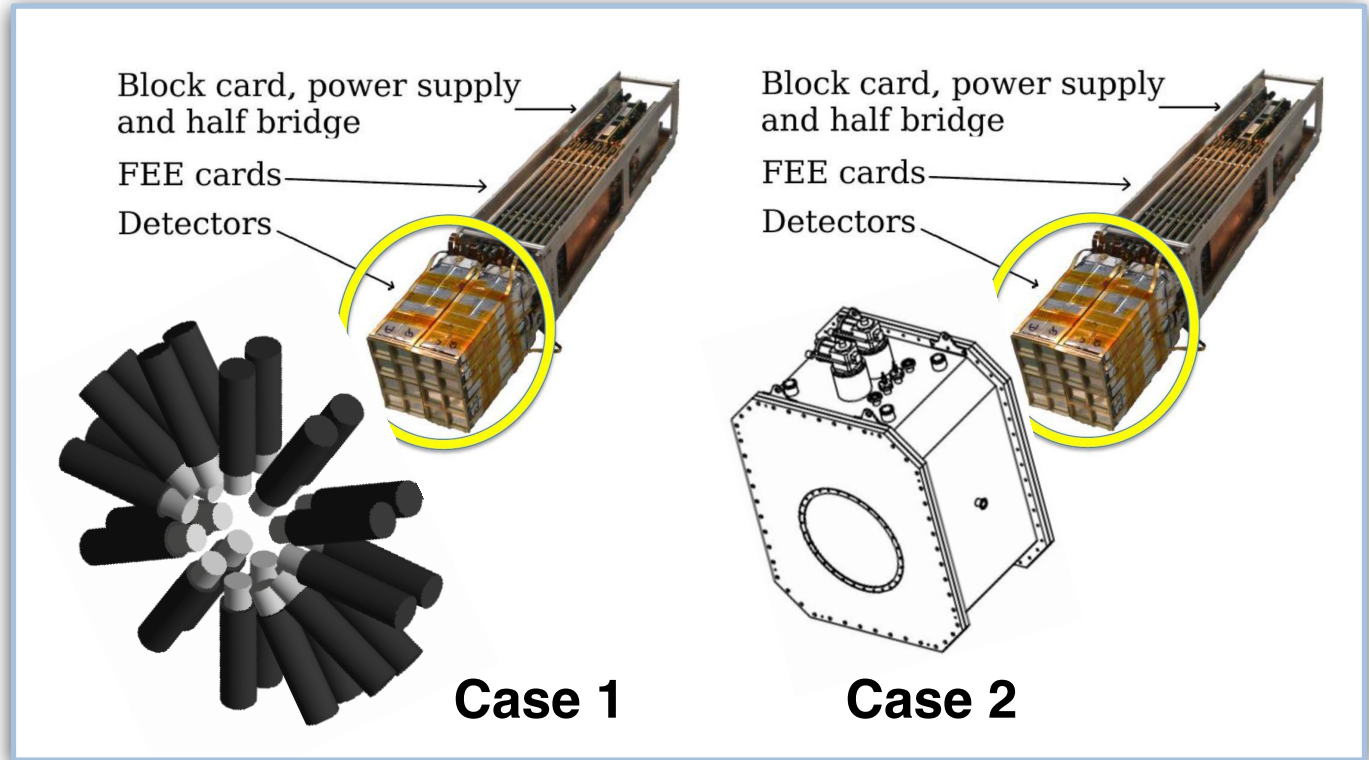
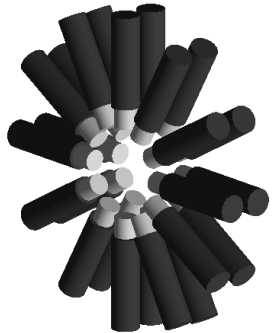
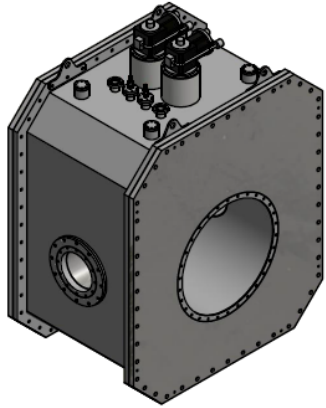
FAZIA type Si-CsI

- Excellent PID



[Experimental Apparatus] Possible configurations

Low-Energy LAMPS: low energy tracking, PID and photon detection



Group Members



Young Jin Kim
Hyo Sang Lee
Min Sang Ryu



Min Jung Kweon



Sanghoon Hwang



Dong Ho Moon
Hyunchul Kim



Jung Keun Ahn
Byungsik Hong
Jong-won Lee
Sung



Jong-Kwan Woo



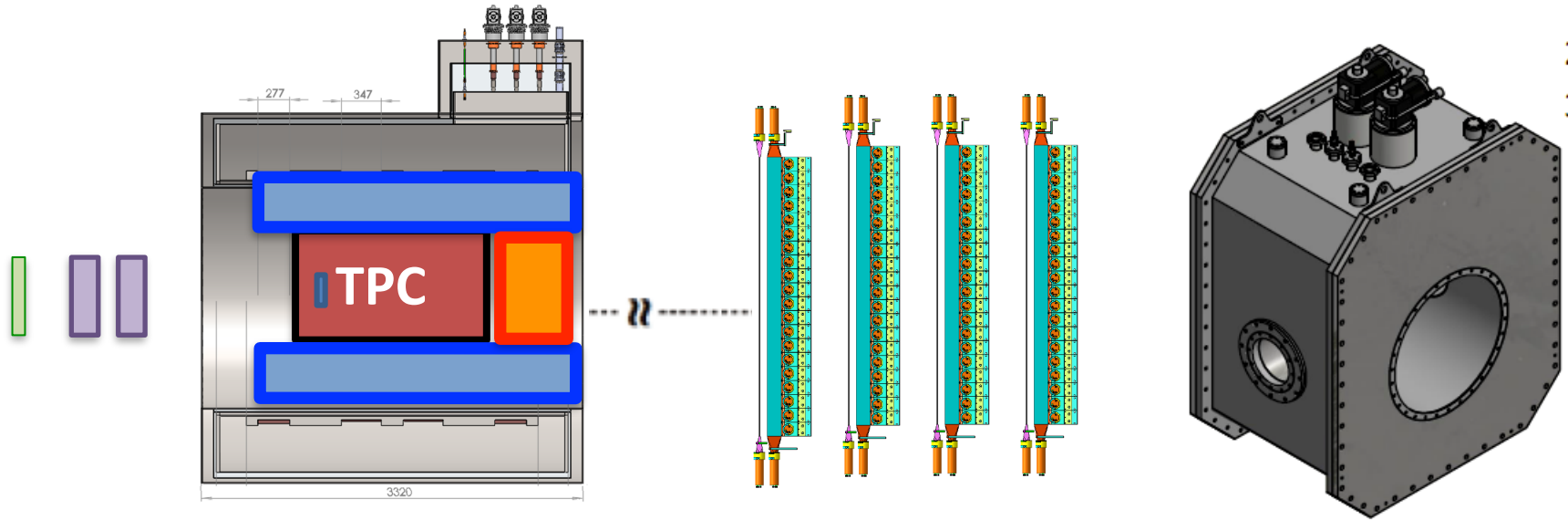
Eun-Joo Kim



Yongsun Kim

14 PhD's in 8 institutions, still growing.
Students are also working hard behind!

Summary



- LAMPS experiment aims to precisely measure nuclear symmetry energy and nuclear structure using low energy and high energy detection system
- Major components of detectors are built or under R&D aiming to be ready for the day-1 experiment
- We are on the track, so please stay tuned!