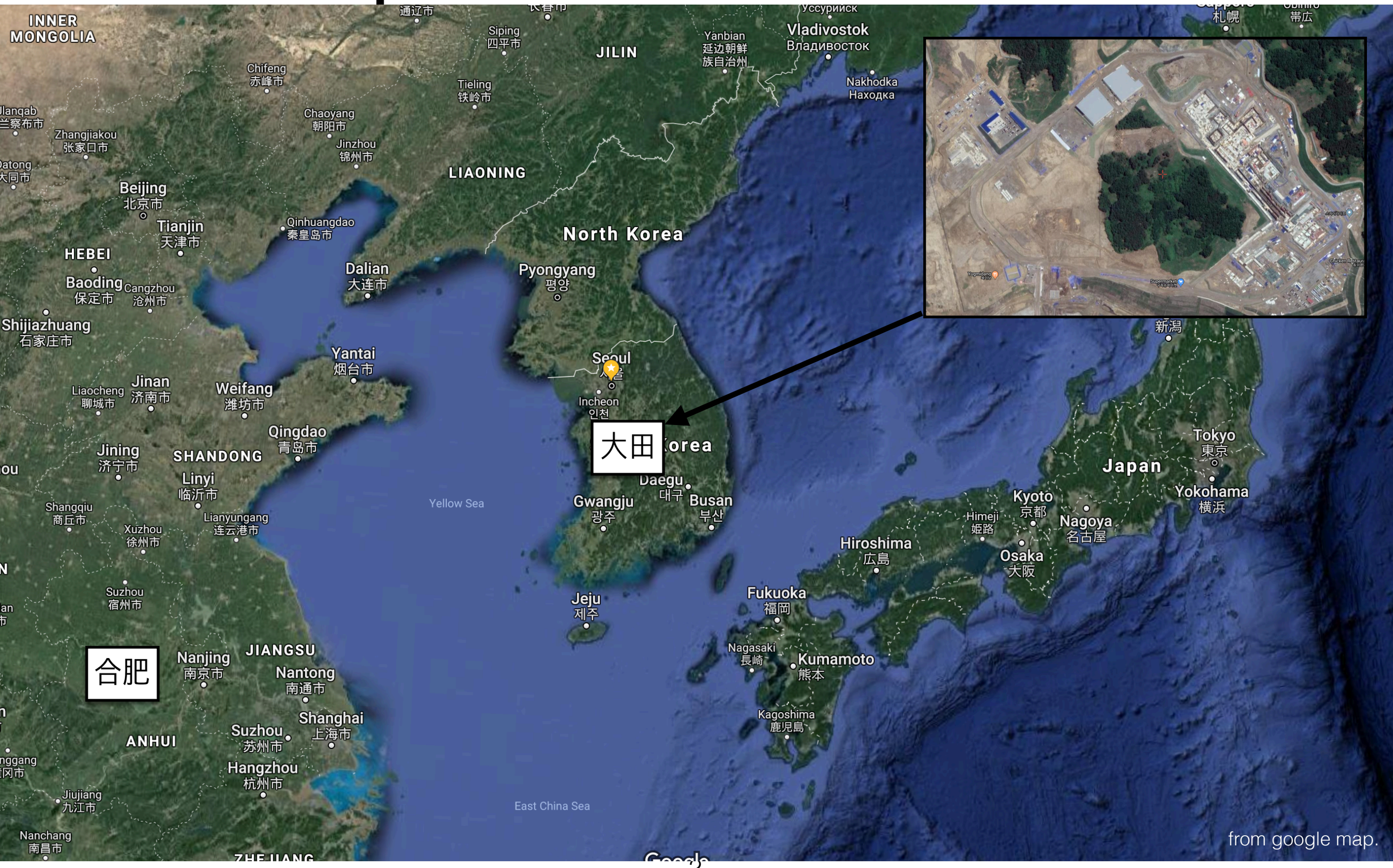
The 7th Asian Triangle Heavy-Ion Conference (ATHIC 2018)
November 3-6, 2018, University of Science and Technology of China, Hefei, AnHui, China

LAMPS at RAON

Lee Jong-won

Rare isotope Accelerator complex for ON-line experiment

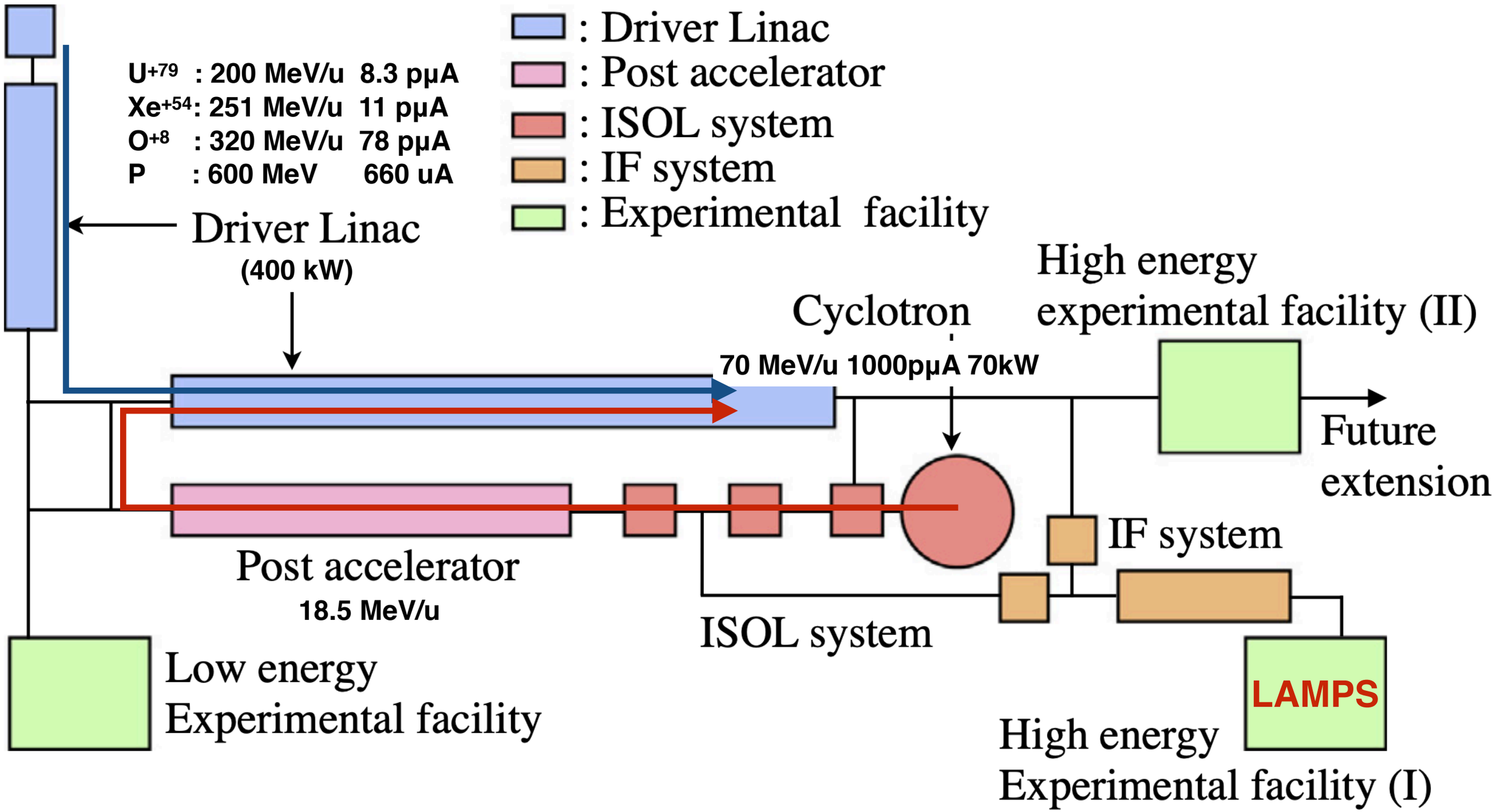
RAON



from google map.

Facility

-High intensity RI beams by ISOL & IF
  - ISOL : direst fission of ^{238}U by 70 MeV proton
  - IF : by 200 MeV/u, 8.3pμA ^{238}U
-High quality neutron-rich RI beams
-Exotic RI beams by ISOL + IF



Status of RAON

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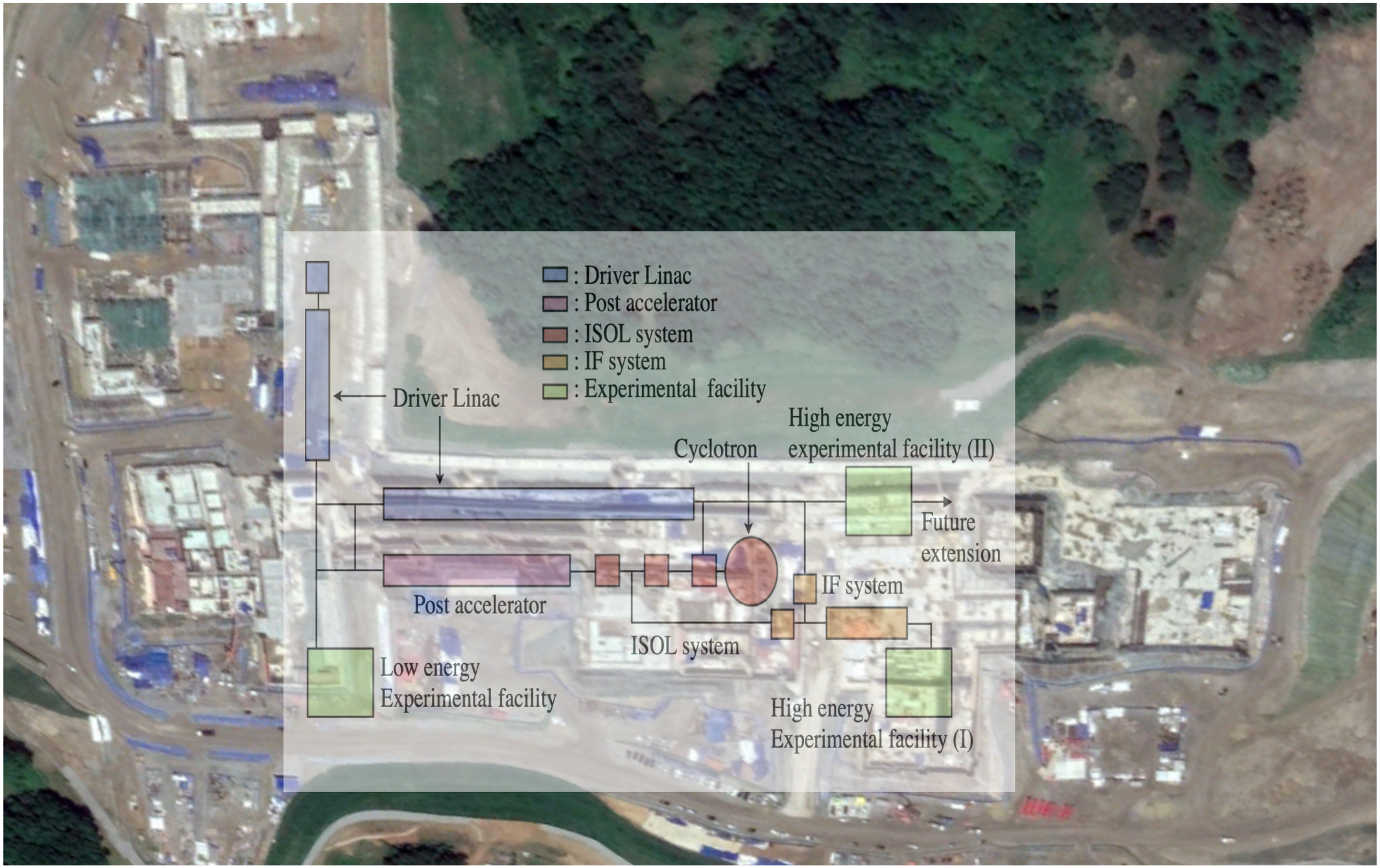


Status of RAON

Physics of LAMPS

Physics of LAMPS

-Nuclear symmetry energy at supra-saturation density via heavy-ion collision experiment

- Using rare isotope beam
- Various beam energy
- Various collision system

-Ratio of mirror nuclei & $\pi-/\pi+$

-Isospin diffusion parameter

-Collective flow

-Dipole emission

-Energy range

$18.5\ \mathrm{MeV/u} < E_{beam} < 250\ \mathrm{MeV/u}$

-Example of reactions

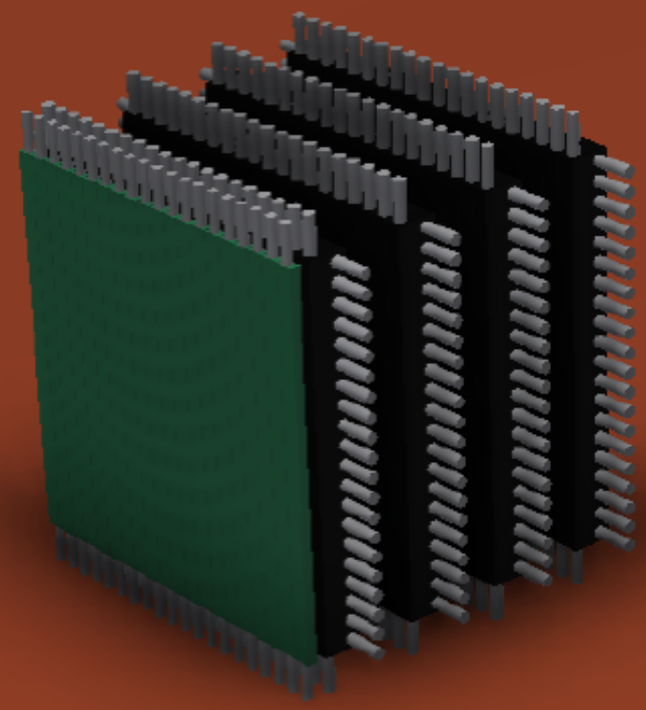
$^{50,54}Ca + {}^{40}Ca$, $^{68,70,72}Ni + {}^{58}Ni$, $^{106,112,124,130,132}Sn + {}^{112,118,124}Sn$ …

Measureable parameters

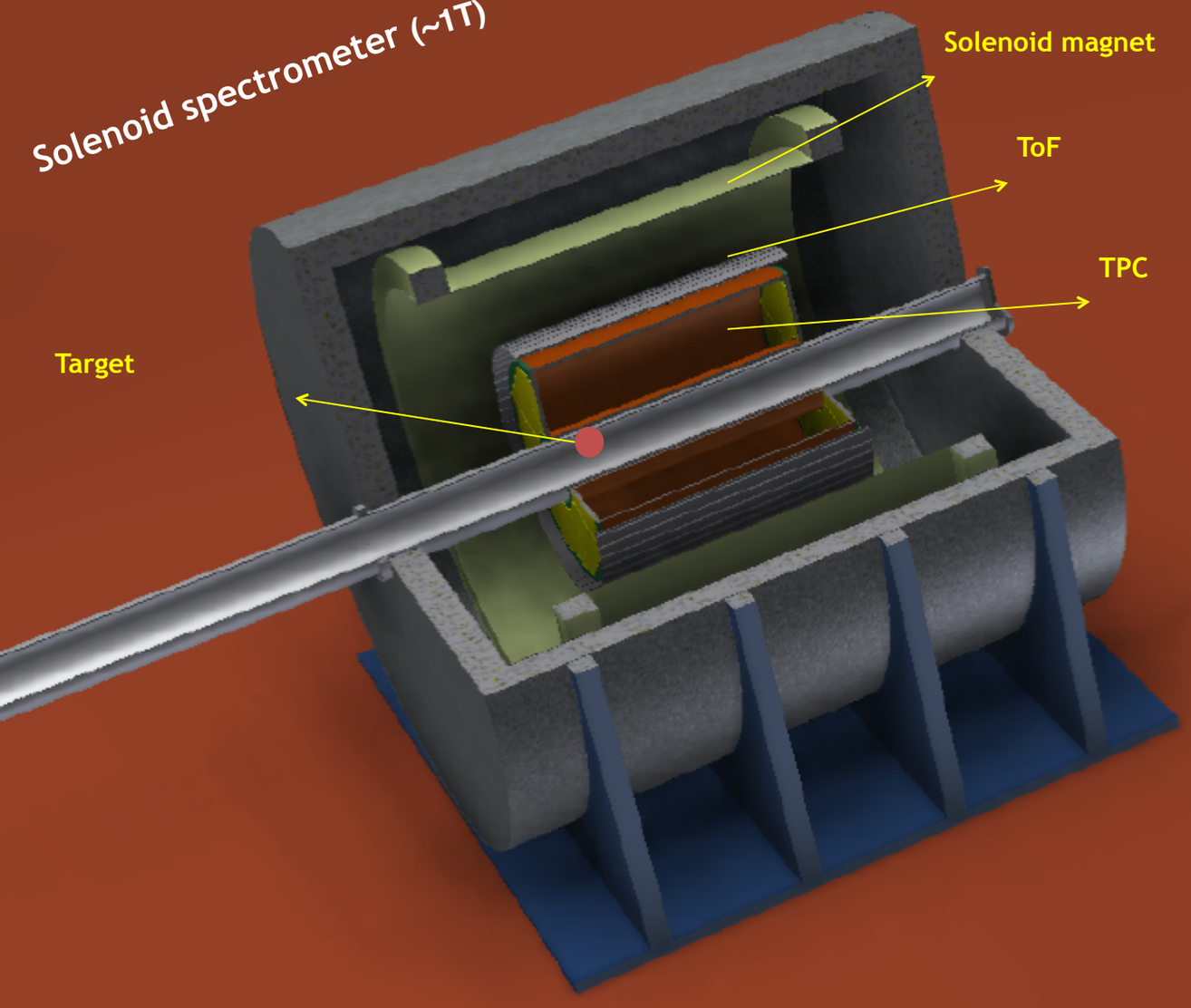
- Particle ratios: n/p, 3H/3He, etc.
- Pion ratio
- Collective flow
- Electric dipole emission

Detectors

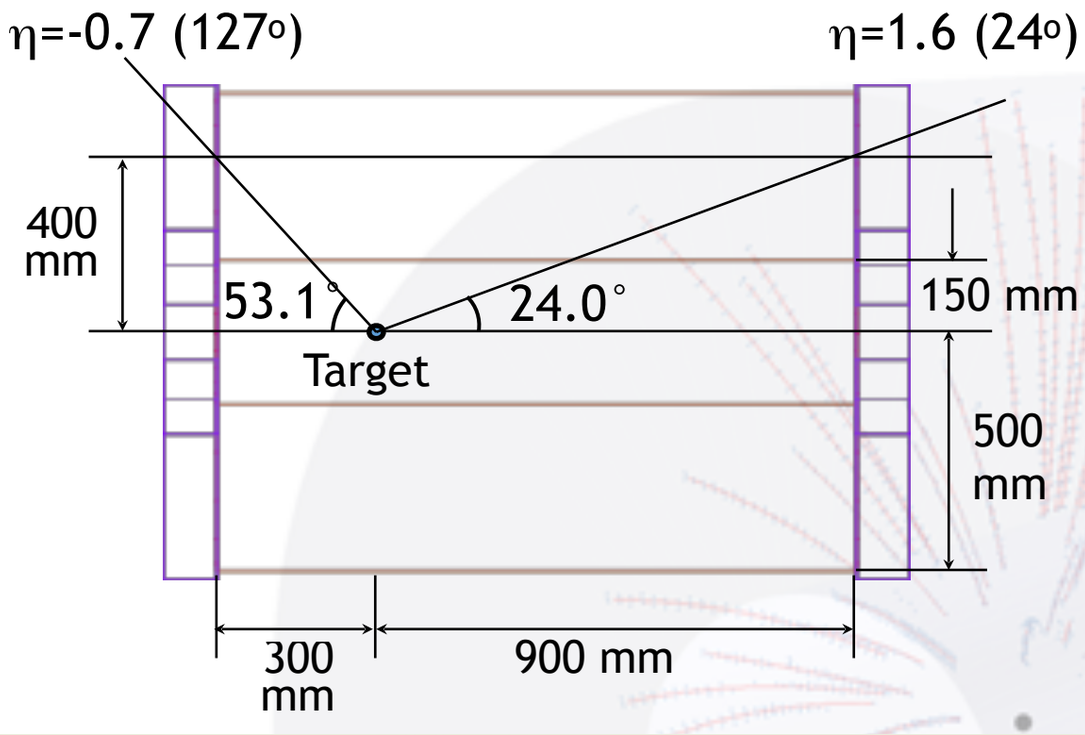
Neutron detector array



Solenoid spectrometer (~1T)



Time Projection Chamber (TPC)



Specipication

-Complete information of charged particles
- **momentum & PID of charged particles**

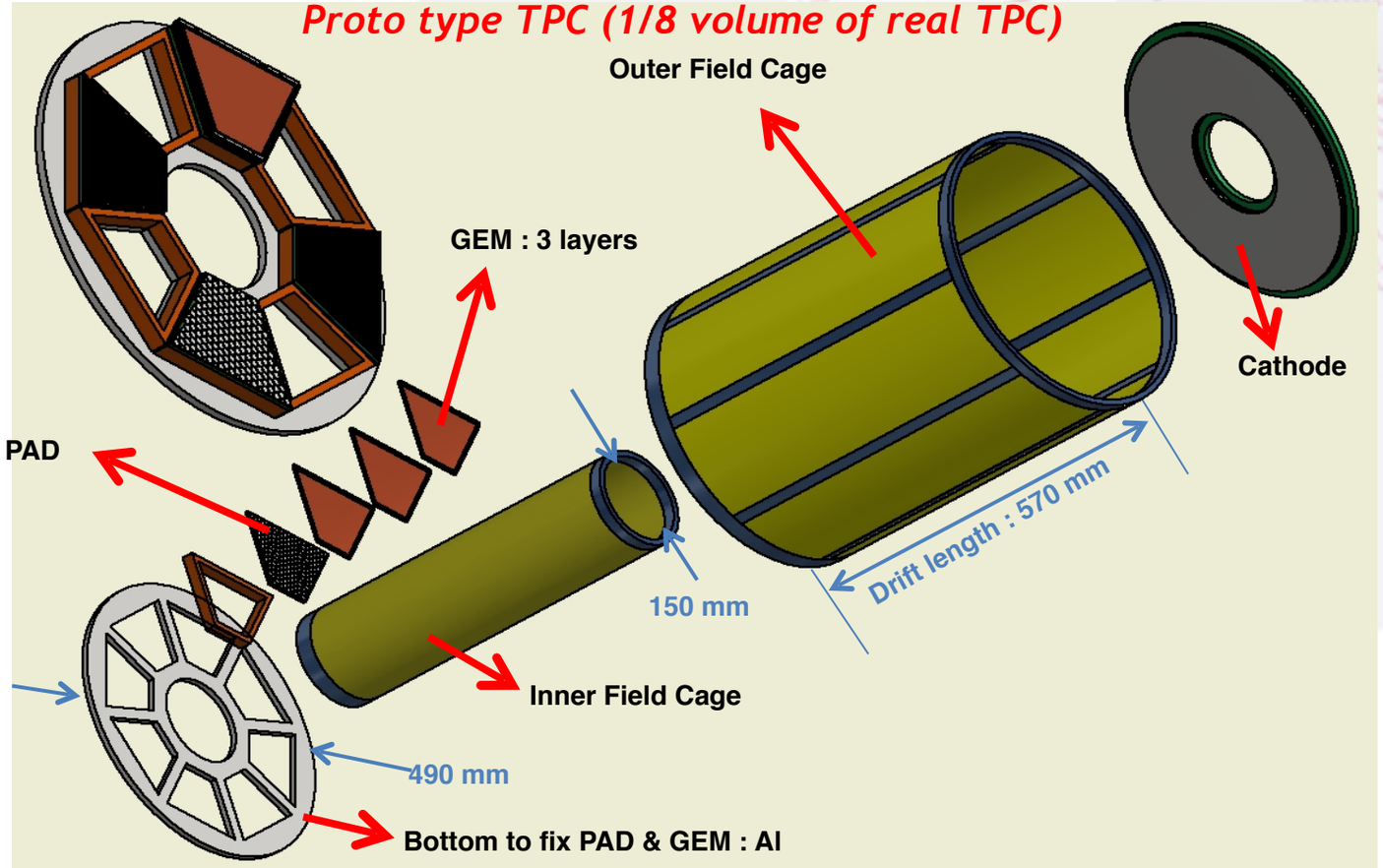
-DAQ
- **GET electronics**

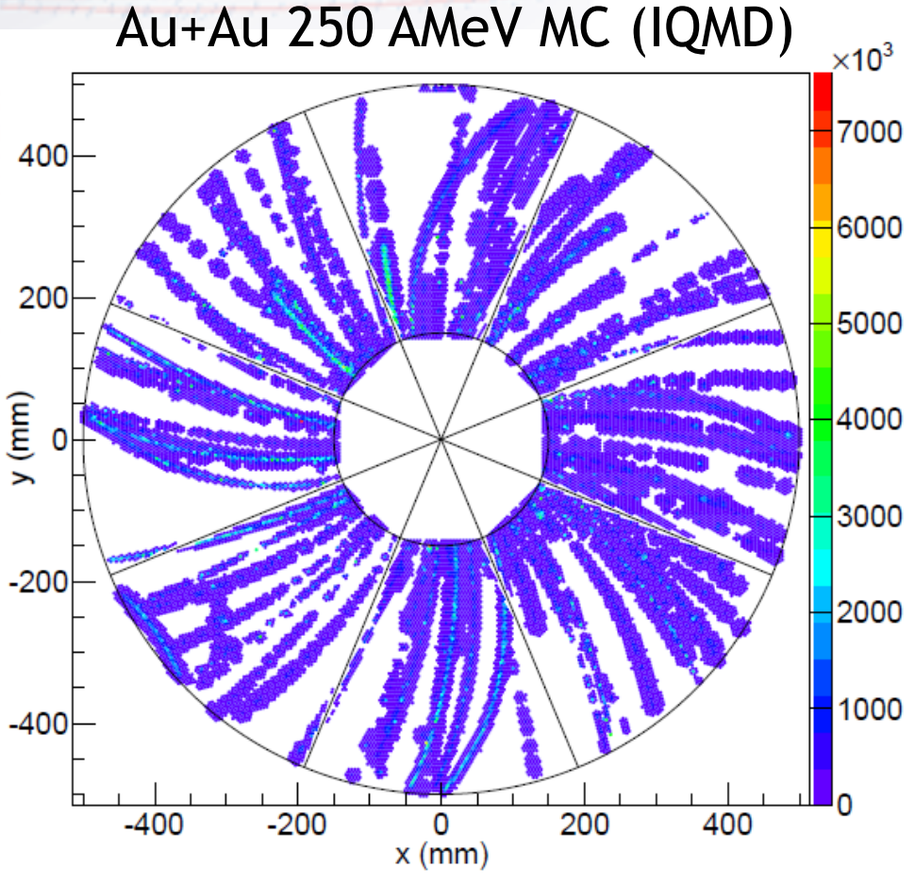
-Inside solenoide magnet
- **Magnetic field strength : upto 1 T**

-Dimension
- **Diameter : 1000 mm**
- **Length : 1200 mm**

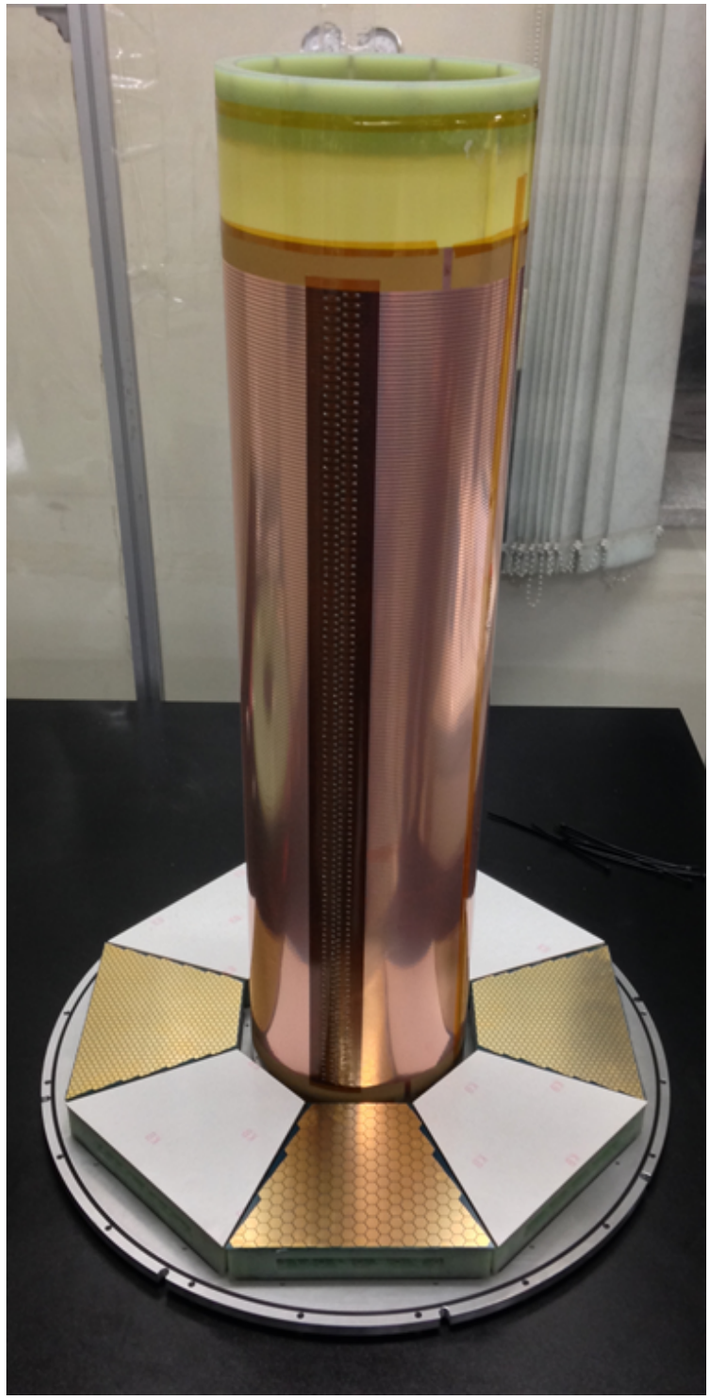
-Acceptance
- **3πsr**

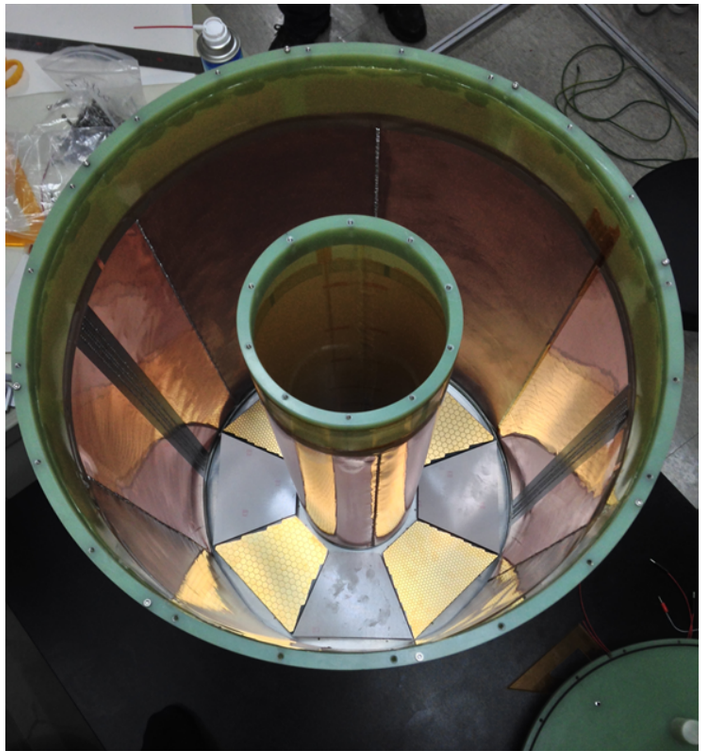
3π sr acceptance

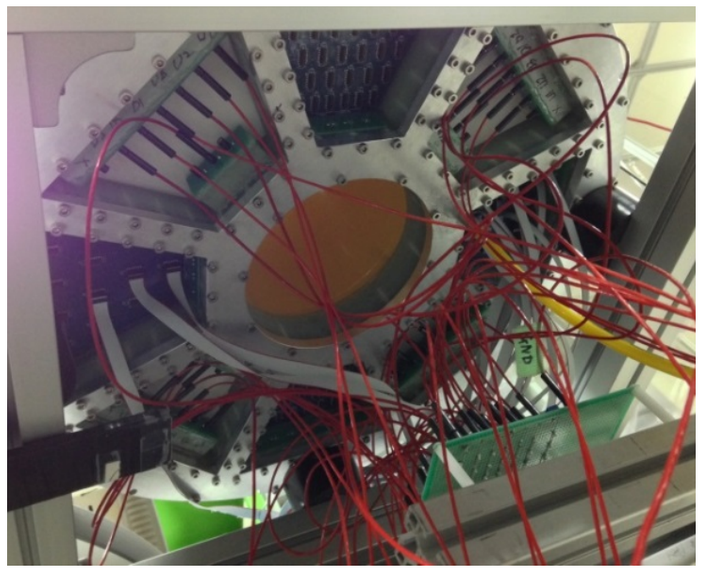


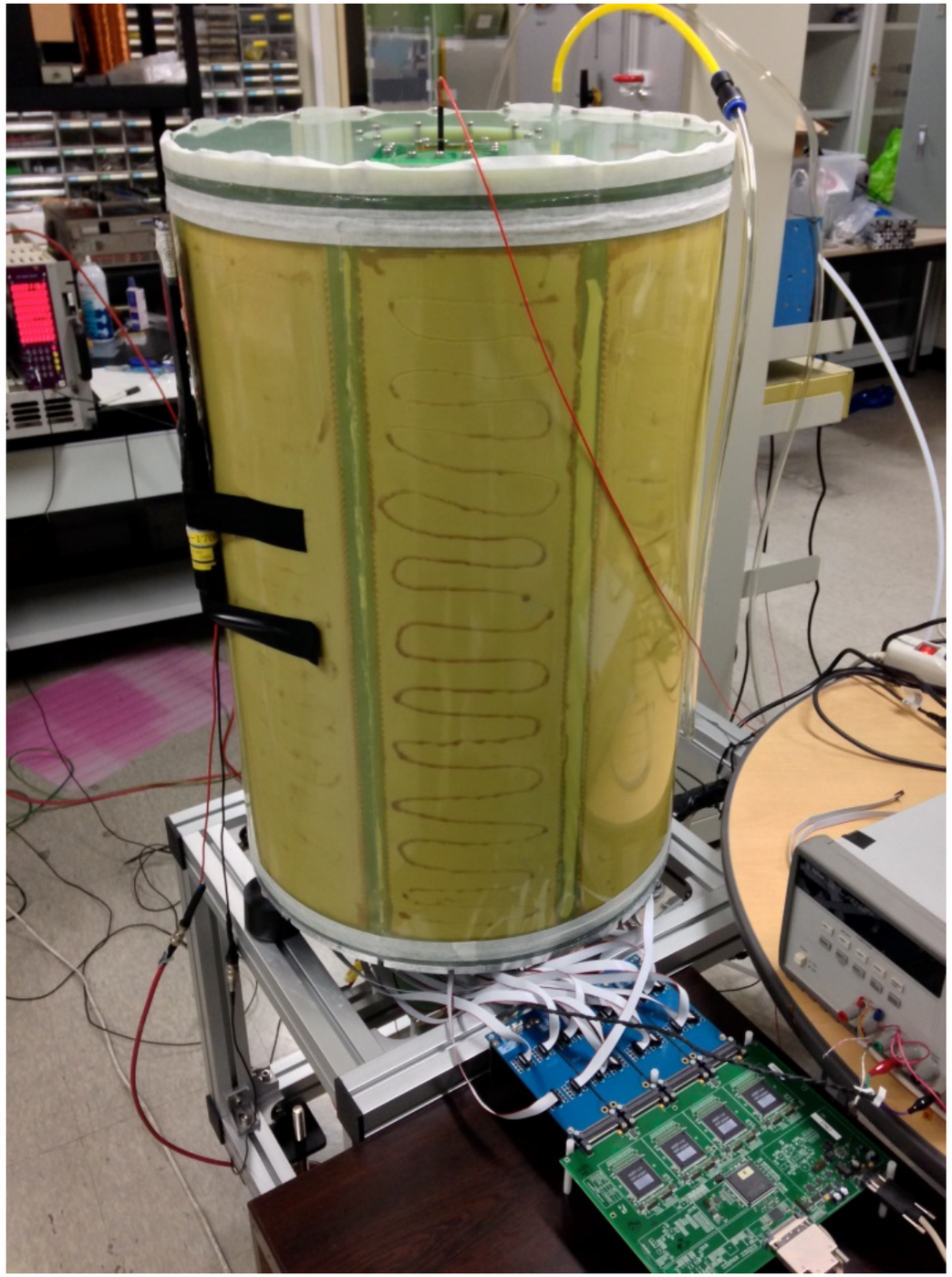


Prototype TPC









1/8 size in volume of real-size LAMPS TPC (2016)

GEM test for Real-size LAMPS TPC is underway

Superconducting Solenoid magnet

Requirements

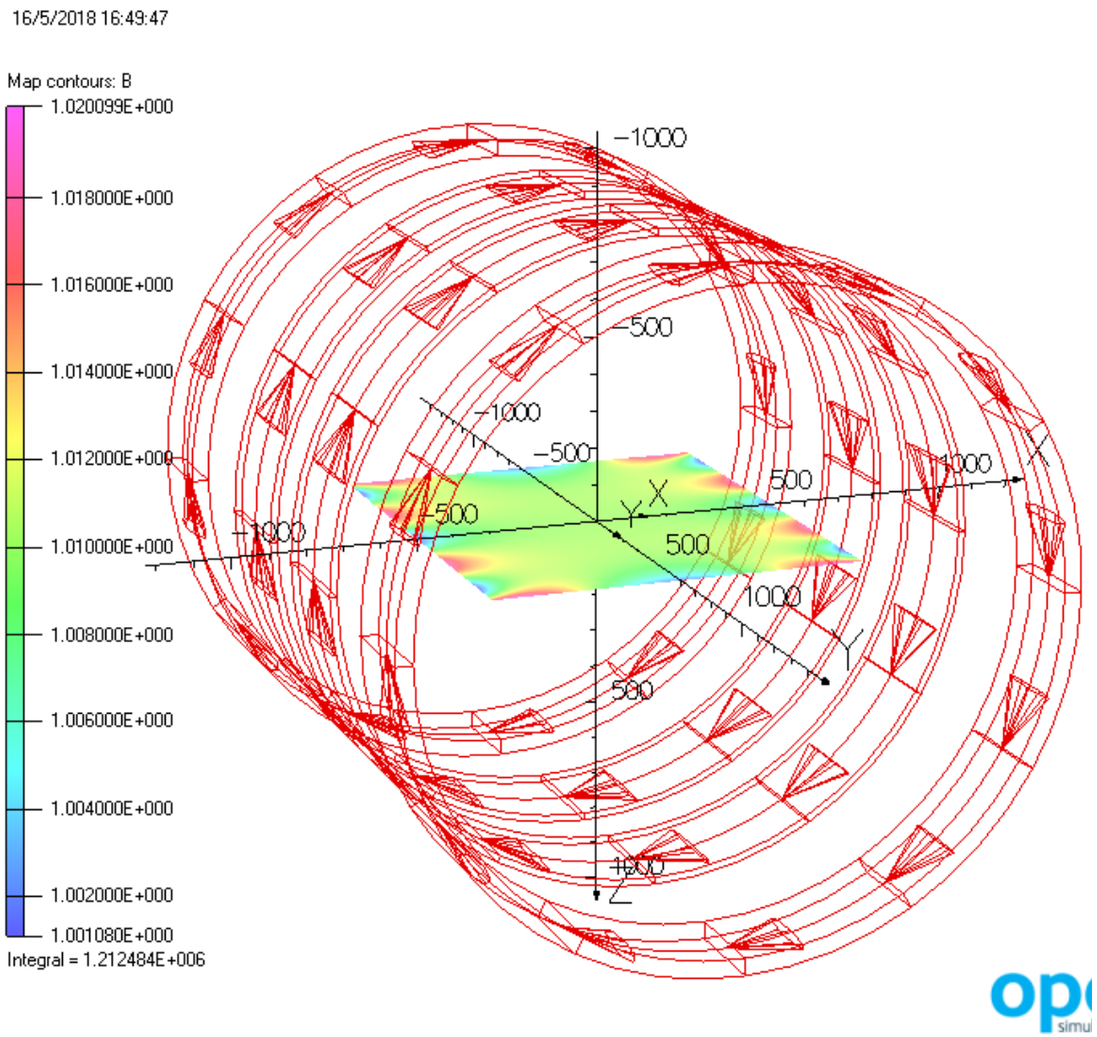
-Field uniformity : ΔB/B < ± 1%

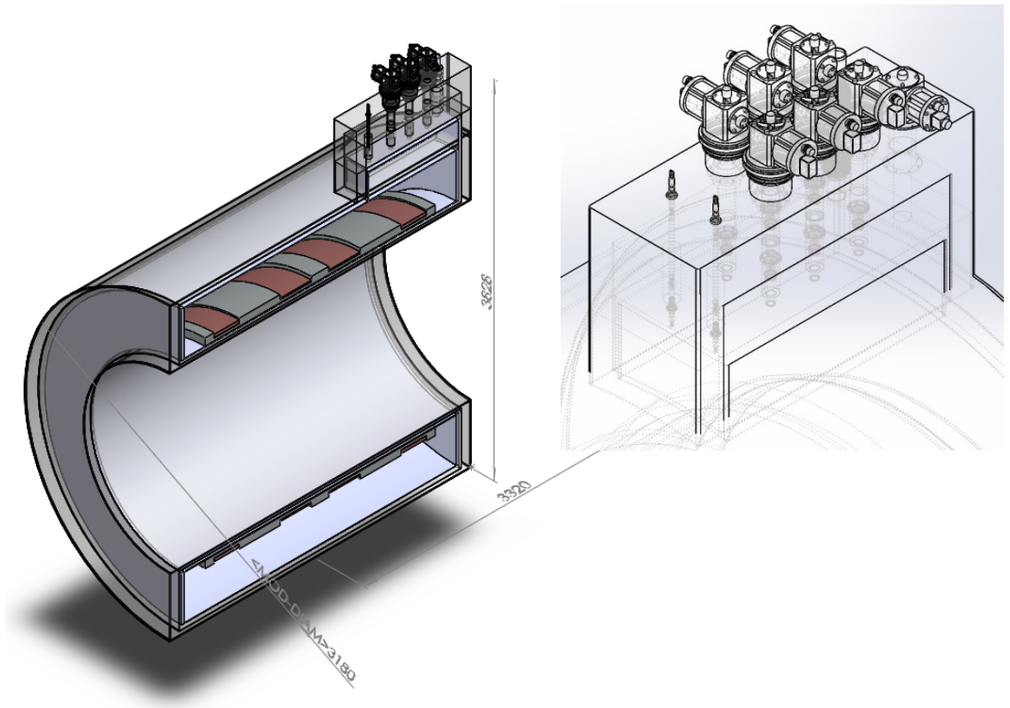
-Field Intensity : upto 1T

- Inner radious : 1600 mm

ΔB/B : 1.87 % (기준: < ± 1 %)

B_{min} : 1.005 T (기준: > 1.0 T)





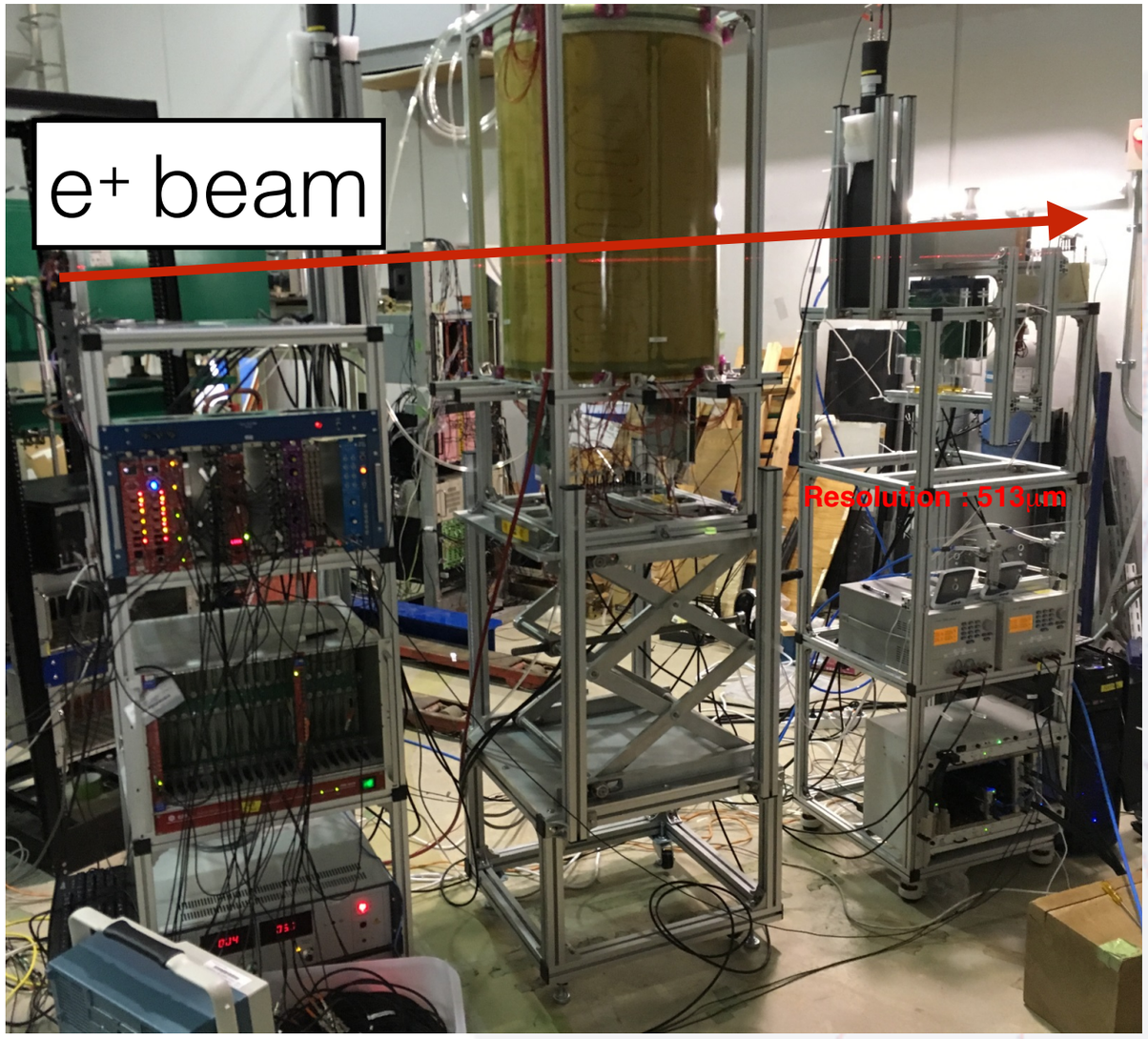
Progress & schedule

-Purchasing : 2018

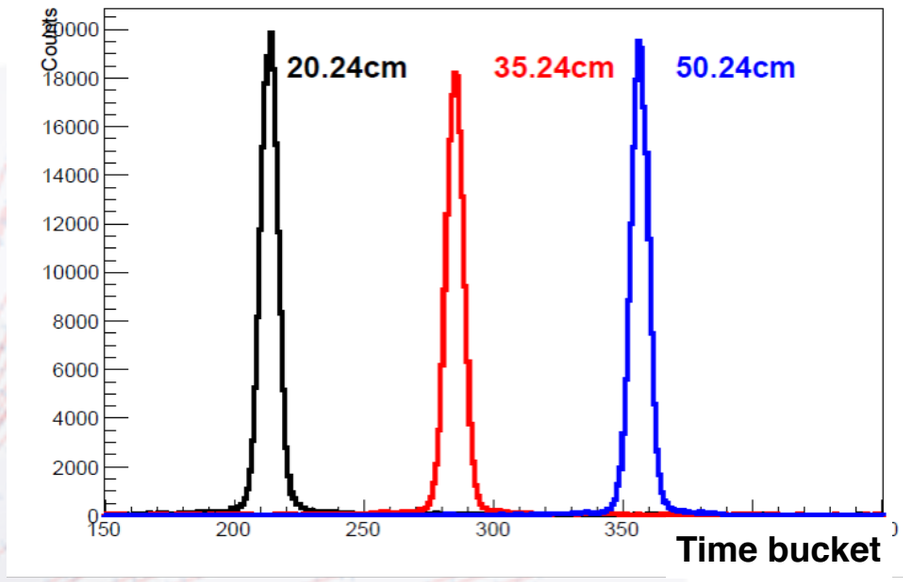
-Production : 2019~2020

-Commissioning : 2021

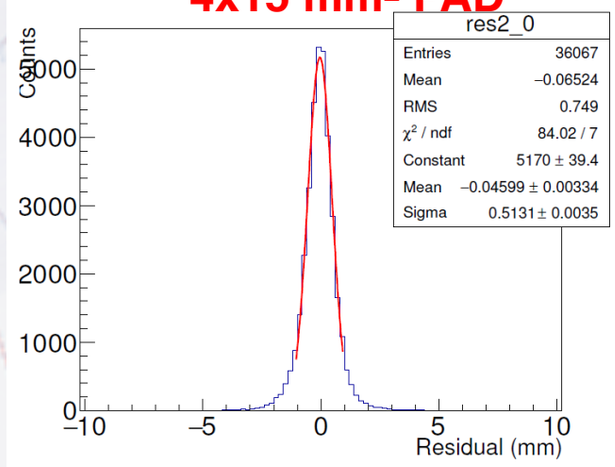
TPC ELPH beam test and result



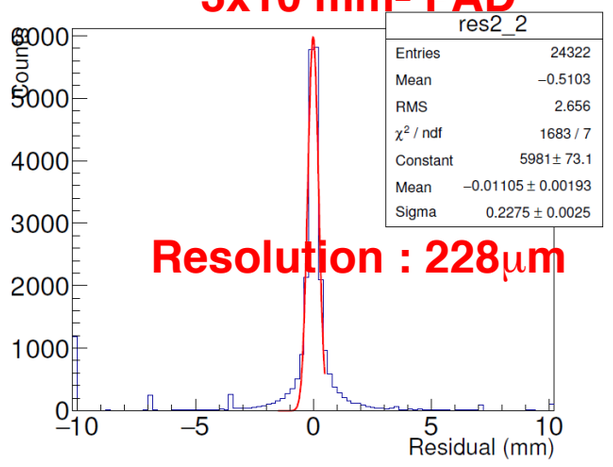
Drift Time distribution as beam height @ ELPH test



4x15 mm² PAD



3x10 mm² PAD



Run summary

- beam time : 2days (12h+12h)
- positron beam
- beam height @ TPC
  : 20.24cm, 35.24cm, 50.24cm
- test gas : Ar-CH4(90:10), Ar-CO2(90:10)
- Electric field of FieldCage
  : 115, 125, 135, 145, 155V/cm – P10
  170V/cm – ArCO2
- Operating HV @ GEM : 345V

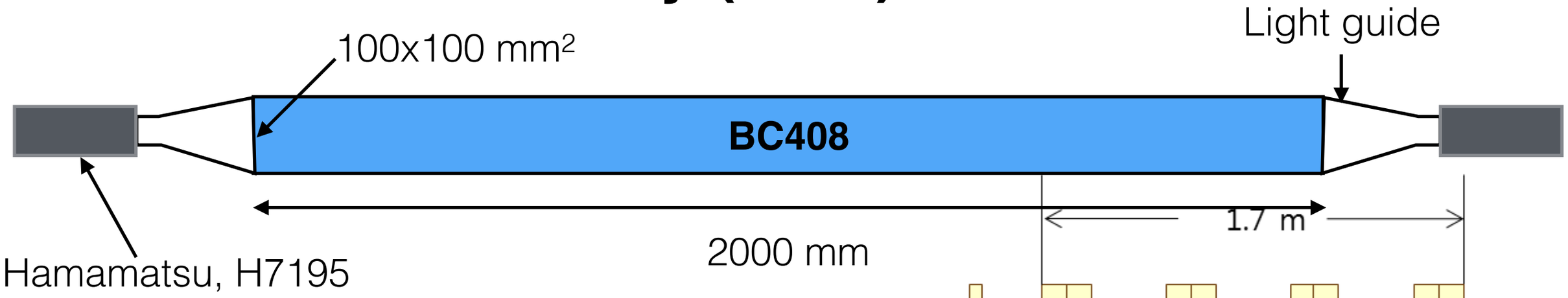
Result summary

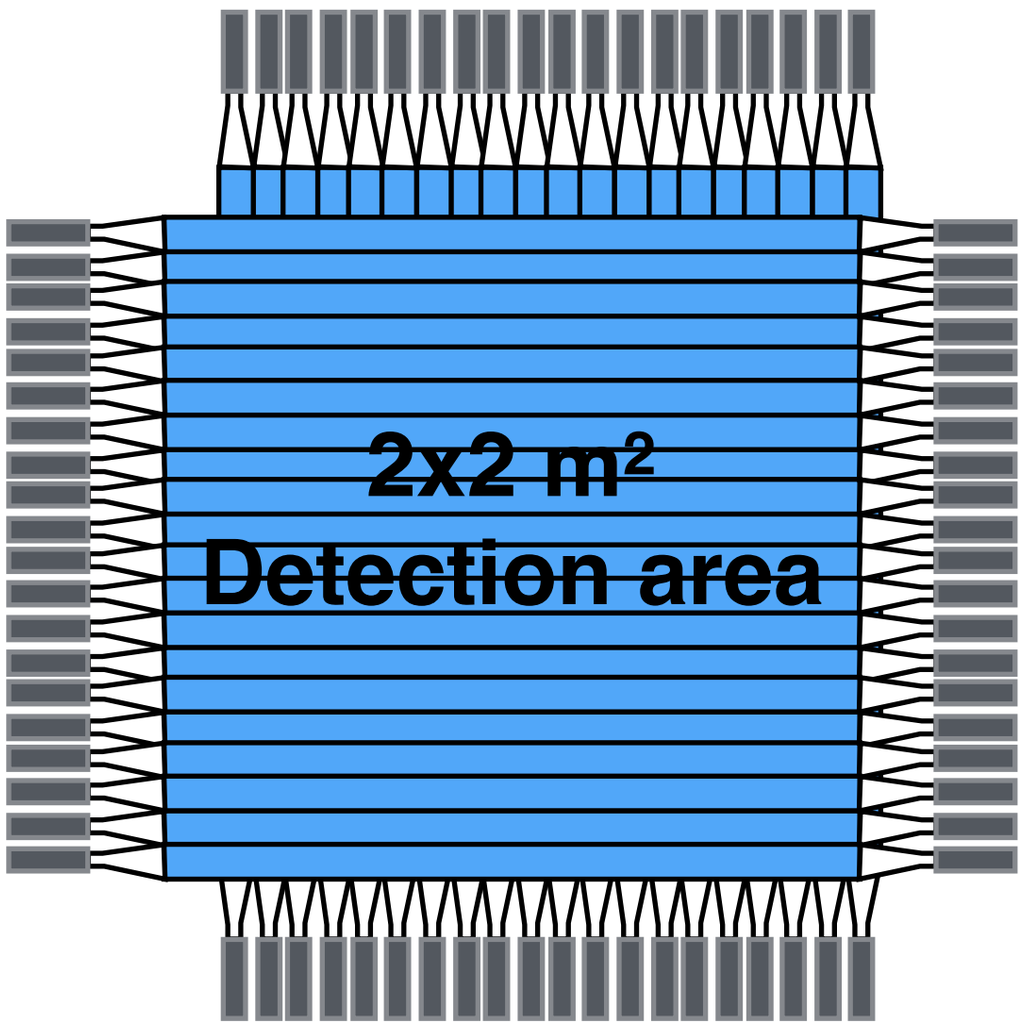
-Drift velocity
- P10: 5.25 cm/μs @ E=155 V/cm
- P20: 6.77 cm/μs @ E=205 V/cm
- $ArCO_2$: 1.06 cm/us @ E=170 V/cm

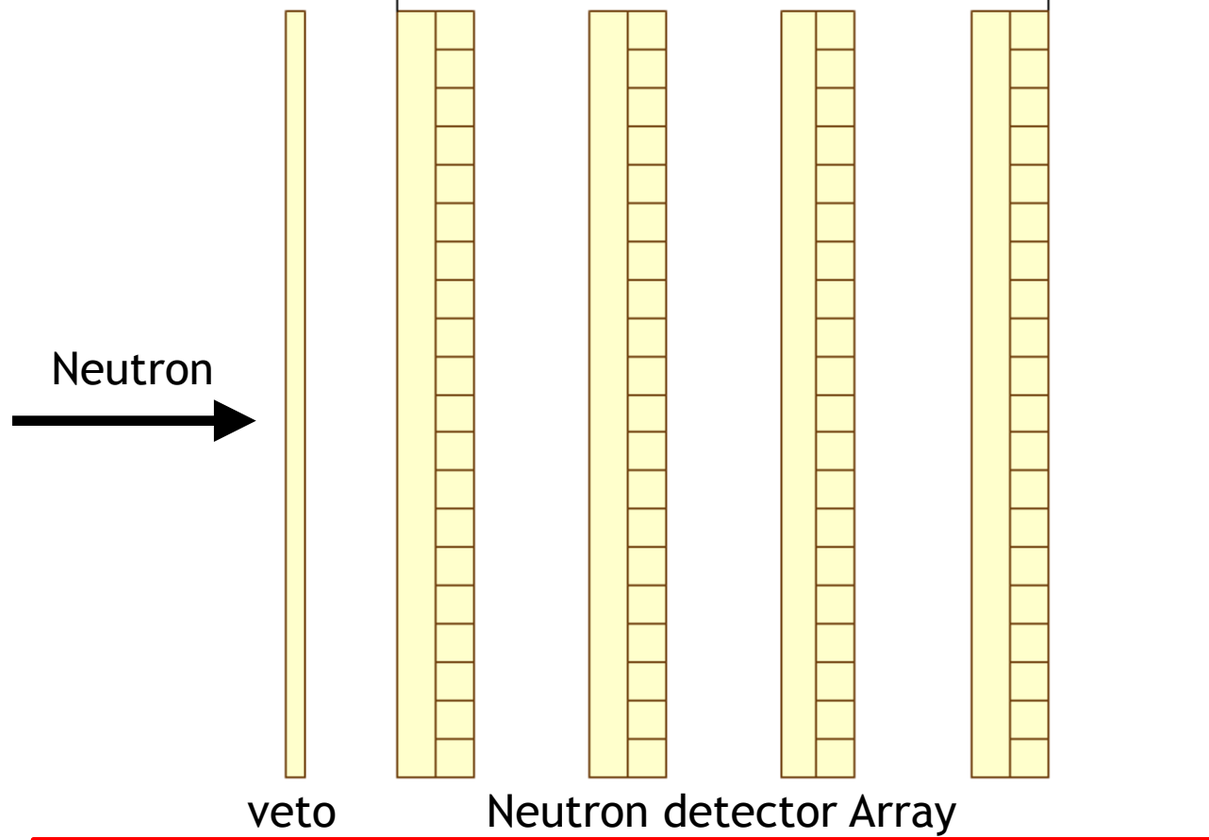
-Diffusion
- P10 : 414μm @ E-155 V/cm

-Position resolution
- 3x10 mm² Pad : 228μm
- 4x15 mm² Pad : 513μm

Neutron Detector Array (NDA)







Specipication

-Complete information of neutron

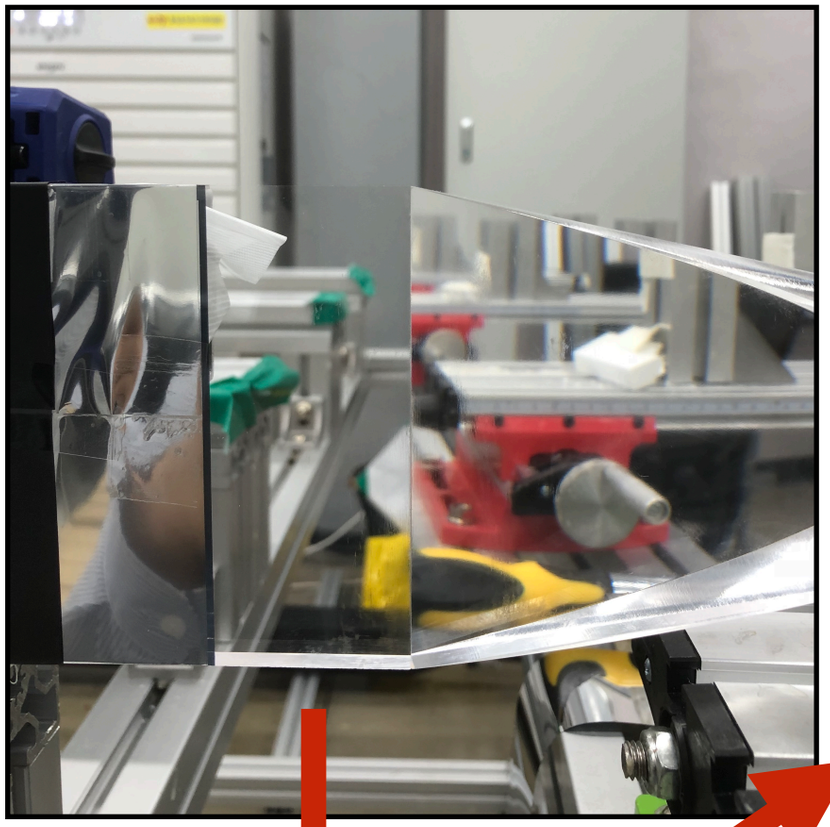
Energy & Momentum from TOF and hit position

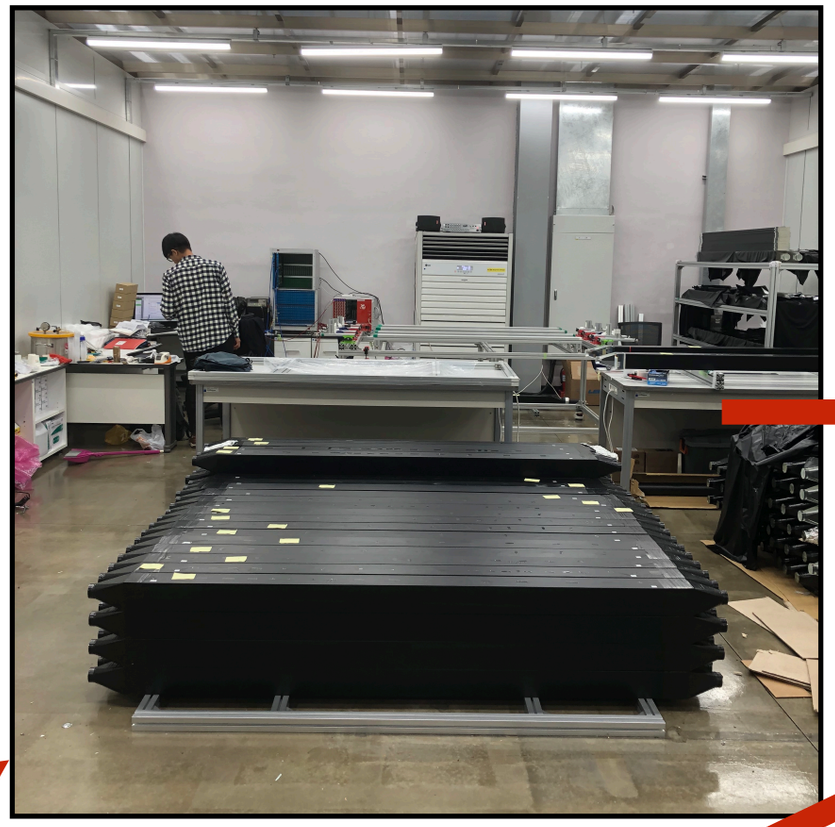
-DAQ

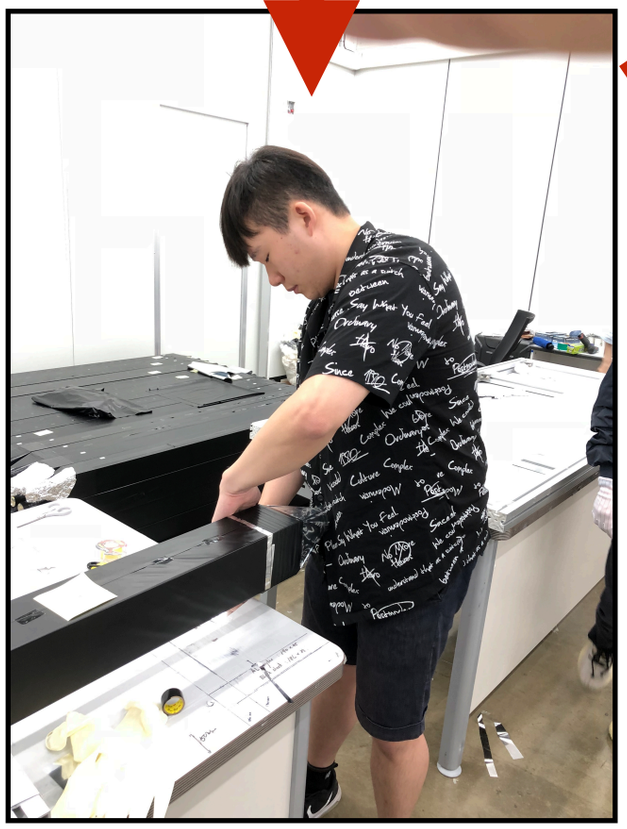
- **500 MHz FADC (Notice)**

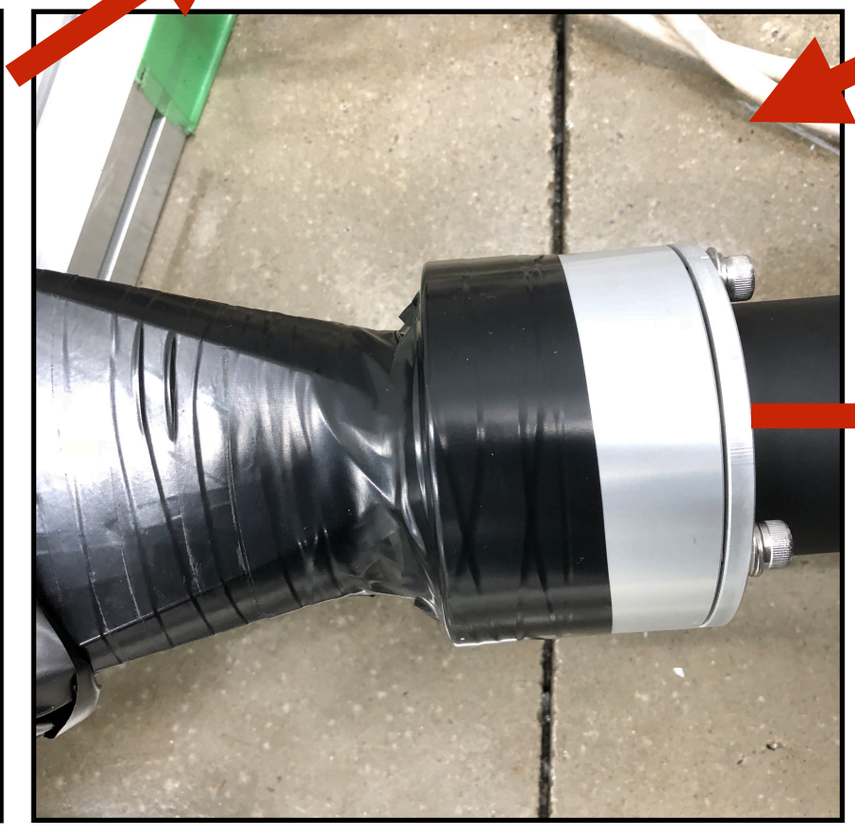
-Dimension

- **2 x 2 m² detection area (~0.0014 sr)**
- **Depth : 20 cm / stage, 4 stage in total**





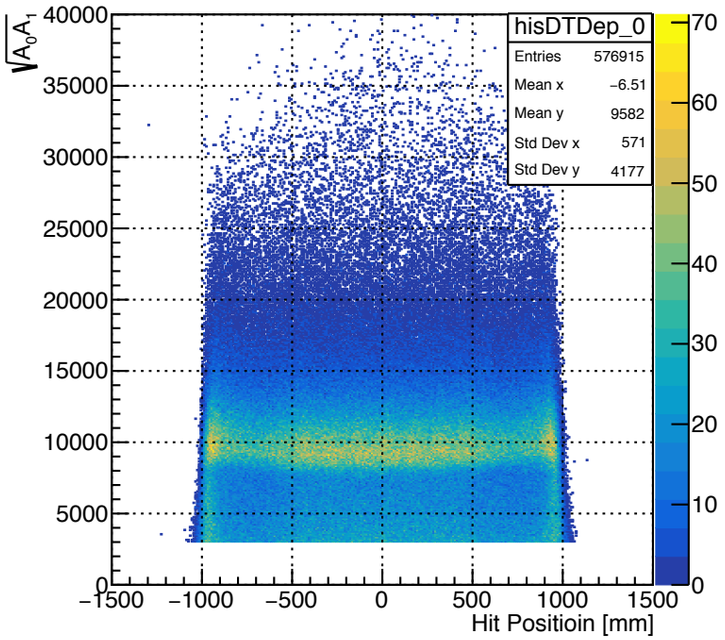




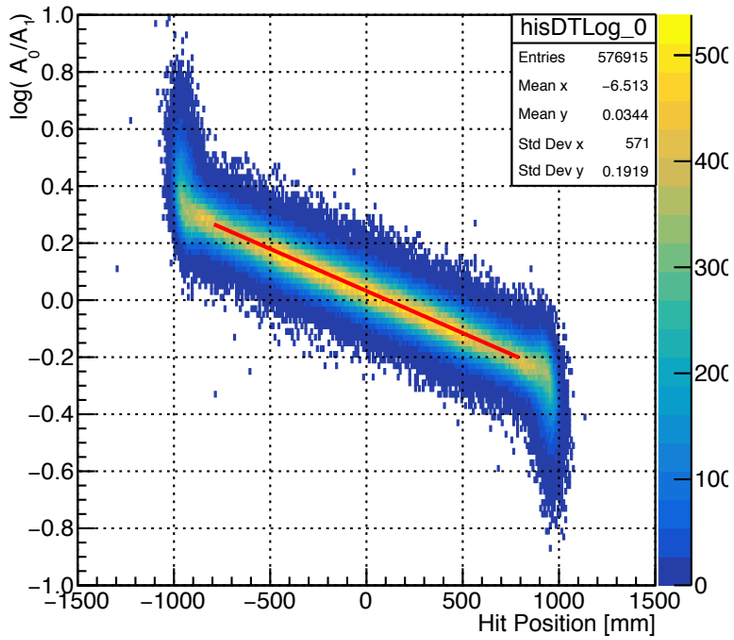
We will end production & construction in this month(2018/11).

Basic Performance of NDA

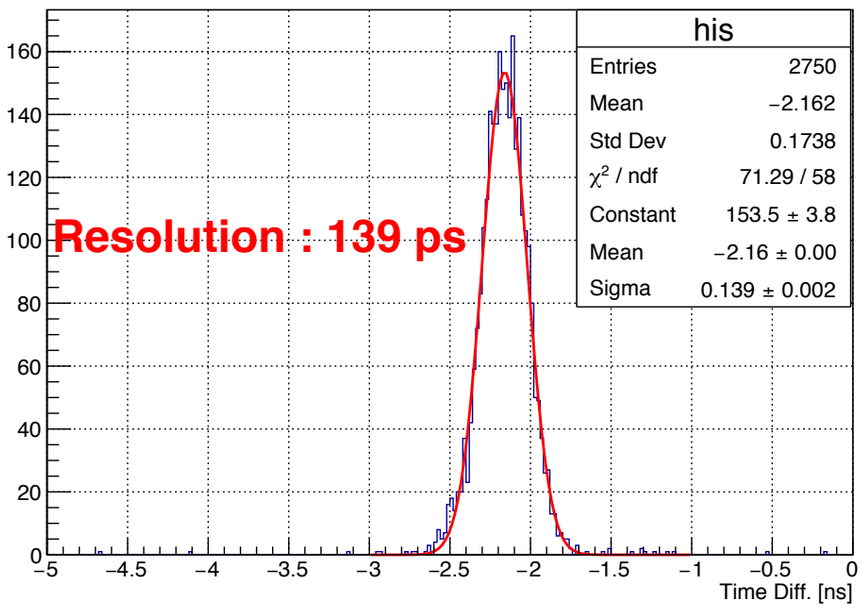
Cosmic ray hit dist.



Attenuation



Timing resolution



Result summary

-MIP peak

- **9k ~ 10 k count (Changes ~ 10% by position)**

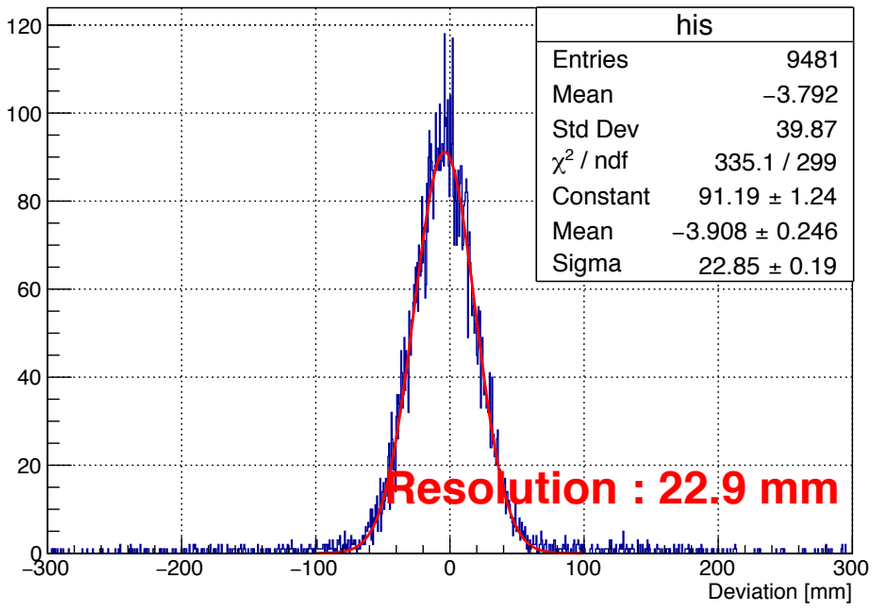
-Attenuation Length

- **3389±22 mm (50% for 2m)**

-Position resolution

- **154~158 mm / ns**

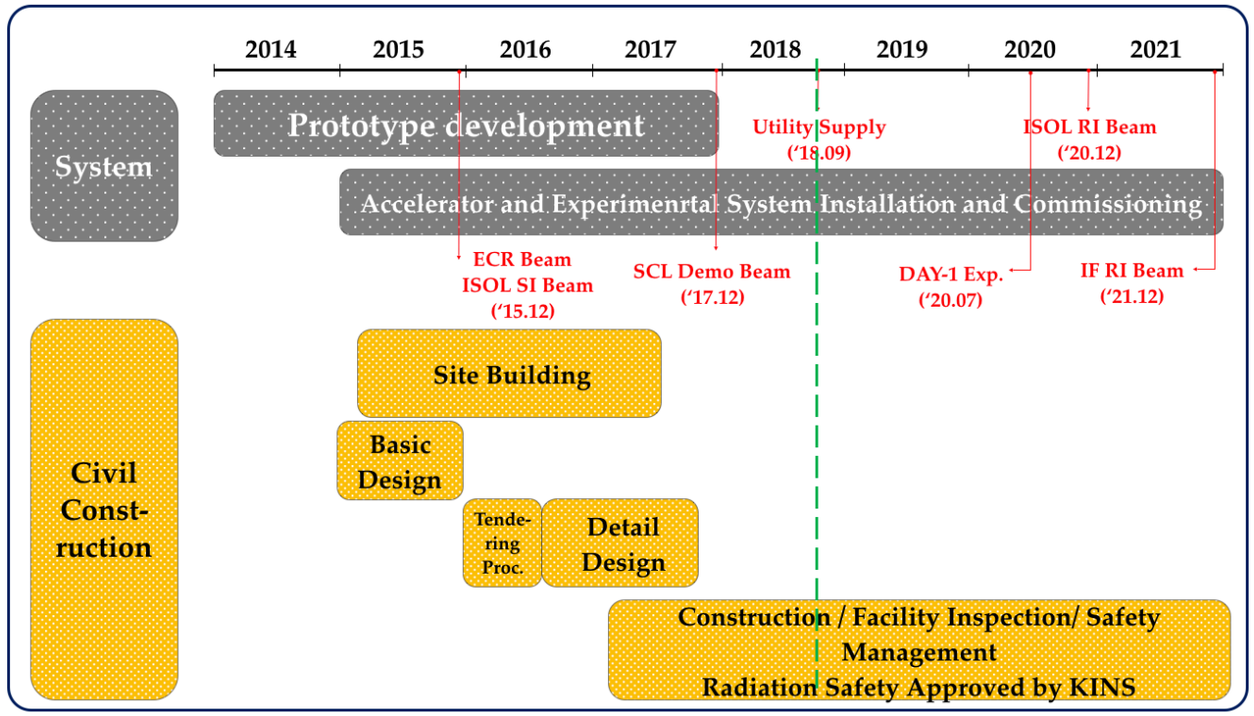
Position resolution



Status & Plan

Facilitiy

-ECR beam / ISOL SI Beam : ’15.12
-SCL Demo Beam : ’17.12
-Utility Supply : ’18.09
-DAY-1 Exp. : ’20.07
-ISOL RI Beam : ’20.12
-IF RI Beam : ’21.12



Detector preparation

-NDA
- Production & construction : Nov. 2018.
- Calibration & commissioning : ~2021

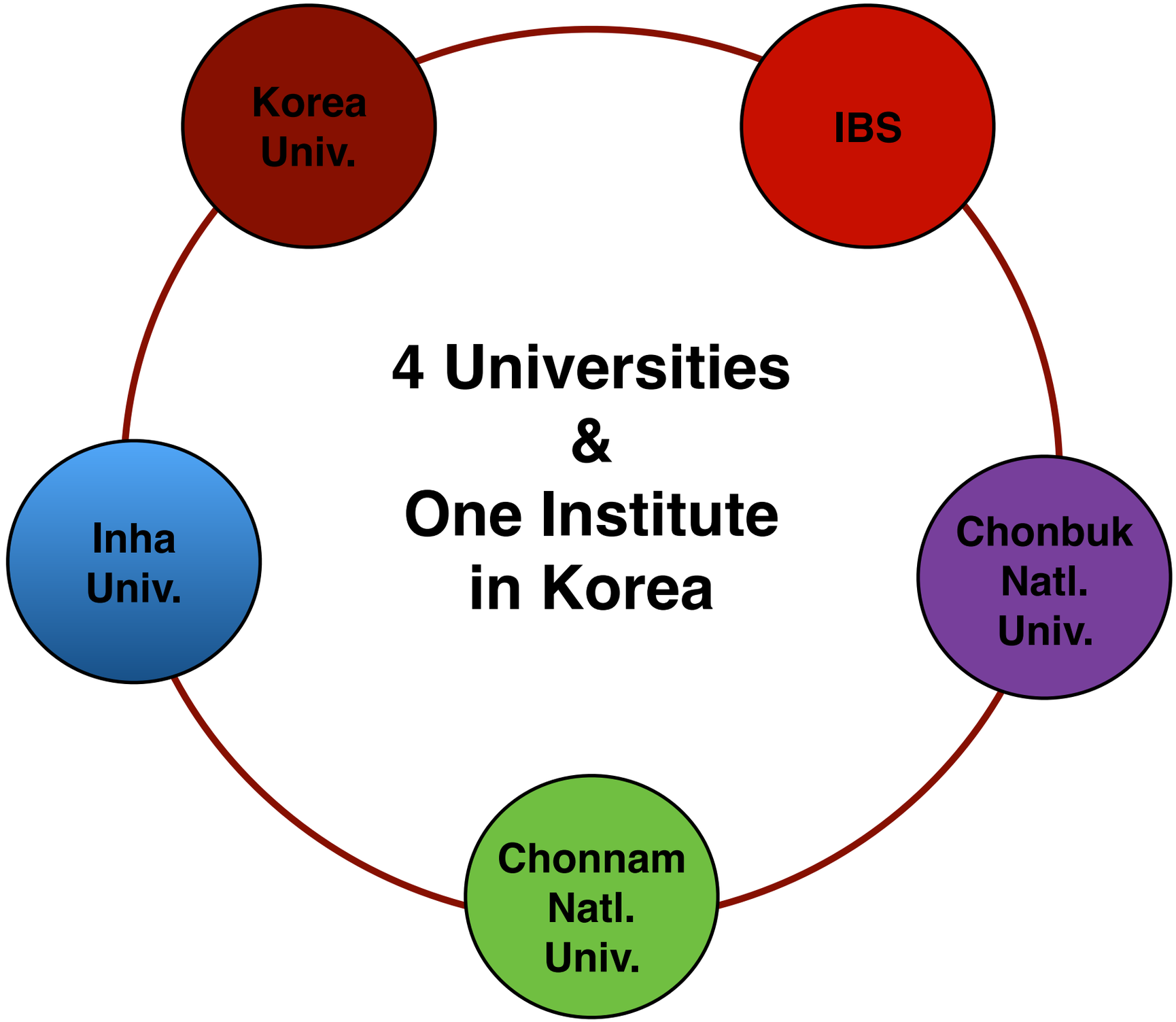
-TPC
- Basic characteristic & Model confirmation.
- Testing GEM for Real-size TPC.
- Real-size TPC will be produced in 2019.

-Target / T0 detectors & TOF detectors
- Detector studing / design : 2019
- Production and installation : 2020

-Solenoid magnet
- Basic design confirmation ended.
- Production : 2020
- Commissioning & operation : 2021~

- ***All of LAMPS system will be ready by 2020***
- ***Start installation & standalone commissioning during 2021***

LAMPS Collaboration



We want more Collaborators and Physics.

Summary

- We prepare the LAMPS experiment toward RAON's completion.
- The LAMPS experiment will search and explore new area of the nucliear interaction and gives us new information about nuclear matter.
- Assembly of neutron detector array modules will be ended in this year(2018).
- Assemblies and constructions of TPC and Magnet are in progressing, and will be ended till 2020.

I want to close my presentation with the famous phrase.

鞠躬盡瘁 死而後已*

I shall bend to the task until I am worn out, and not stop until I am dead.

*제갈량 출사표
*諸葛亮之 出師表
*Zhuge Liang’s “Later Chu Shi Biao”

鞠躬盡瘁 死而後已*

This word is too heavy…

鞠躬盡瘁 成而後已.

Thanks
謝謝
감사합니다.
ありがとうございます。