A suggestion for a forward detector in the LAMPS

Beomkyu Kim, Chong Kim, and Sanghoon Lim
PNU

Why a forward detector at LAMPS?

- **Nuclear symmetry energy** is the most important observable in the **LAMPS**
- **The collective flow coefficient** by observing charged particles **for a large pseudorapidity range** is one of the important factors for **measuring the nuclear symmetry energy**

$$\frac{E}{A} = E(\rho, \delta = 0) + E_{sym}(\rho)\delta^2 + \ \ldots$$

$$E_{sym}(\rho) = E_{sym}(\rho_0) + \frac{L}{3}\left(\frac{\rho - \rho_0}{\rho_0}\right) + \frac{K_{sym}}{18}\left(\frac{\rho - \rho_0}{\rho_0}\right)^2$$

1, 2, 3

where L and K_{sym} are the slope and curvature of the energy, respectively.

1) B. Hong, J.K. Ahn, Y. Go et al., Eur. Phys. J. A 50, 49 (2014).
2) C.F. von Weizs¨acker, Z. Physik 96, 431 (1935).
3) B.-A. Li, L.-W. Chen, C.M. Ko, Phys. Rep. 464, 113 (2008).

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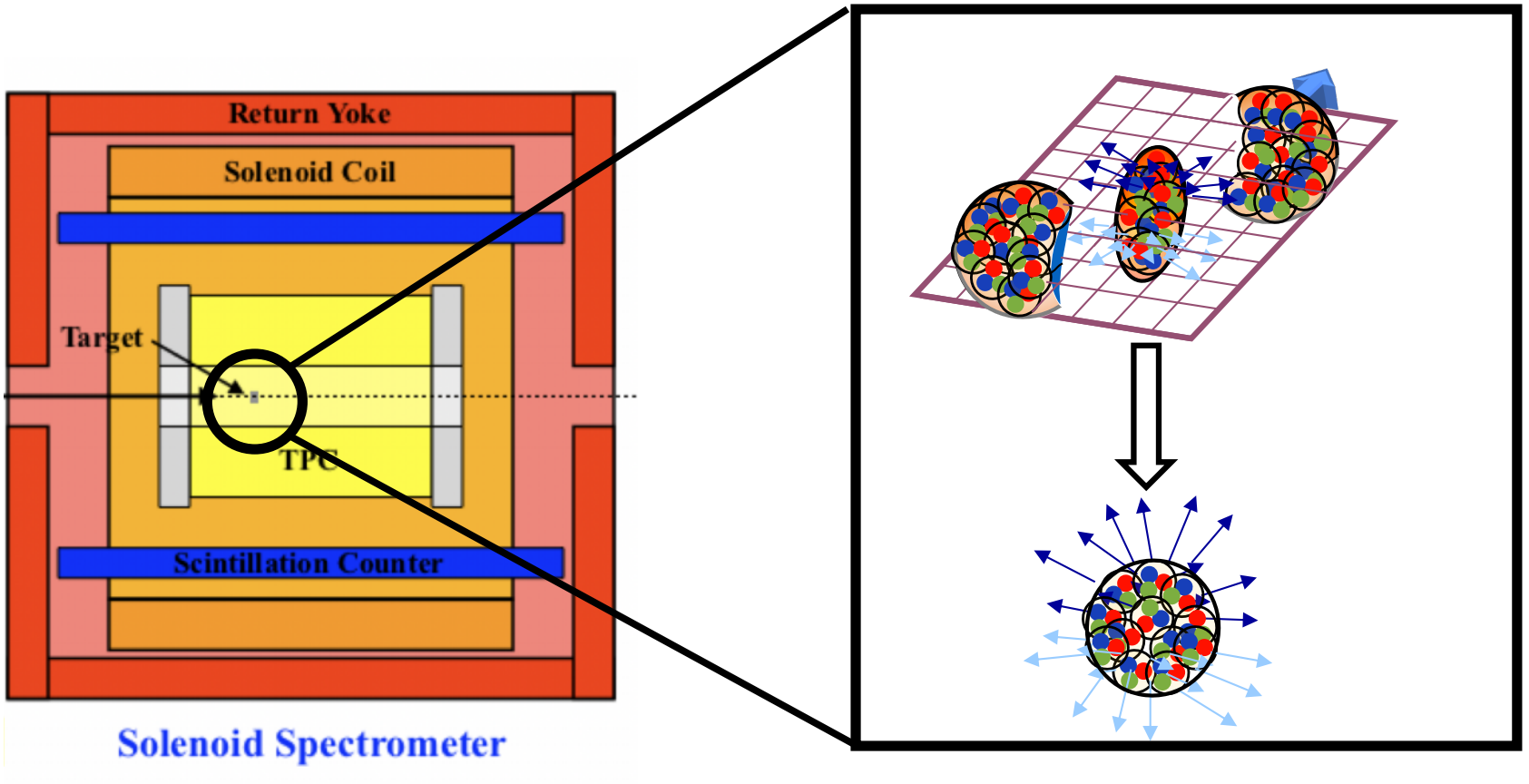

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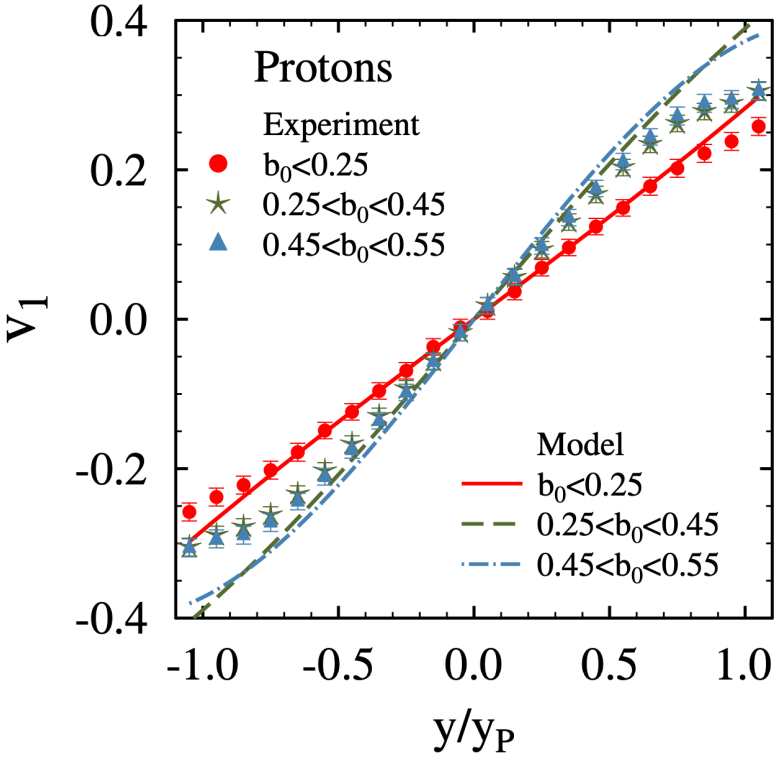
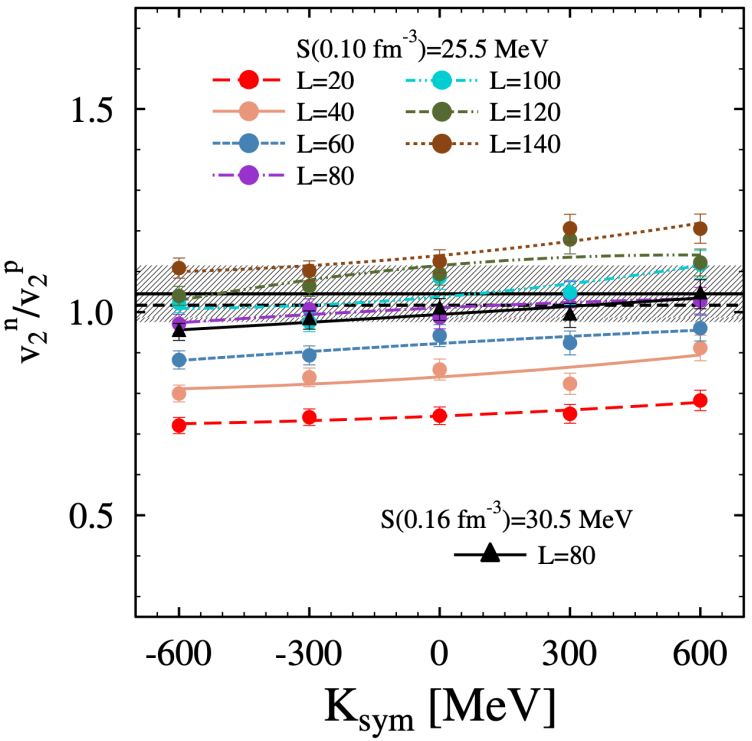
M.D. Cozma, Eur. Phys. J. A 54, 40 (2018).





Why a forward detector at LAMPS?

- **The current LAMPS experiment** cannot observe **about 40% of charged particles** escaping through **the forward region**!

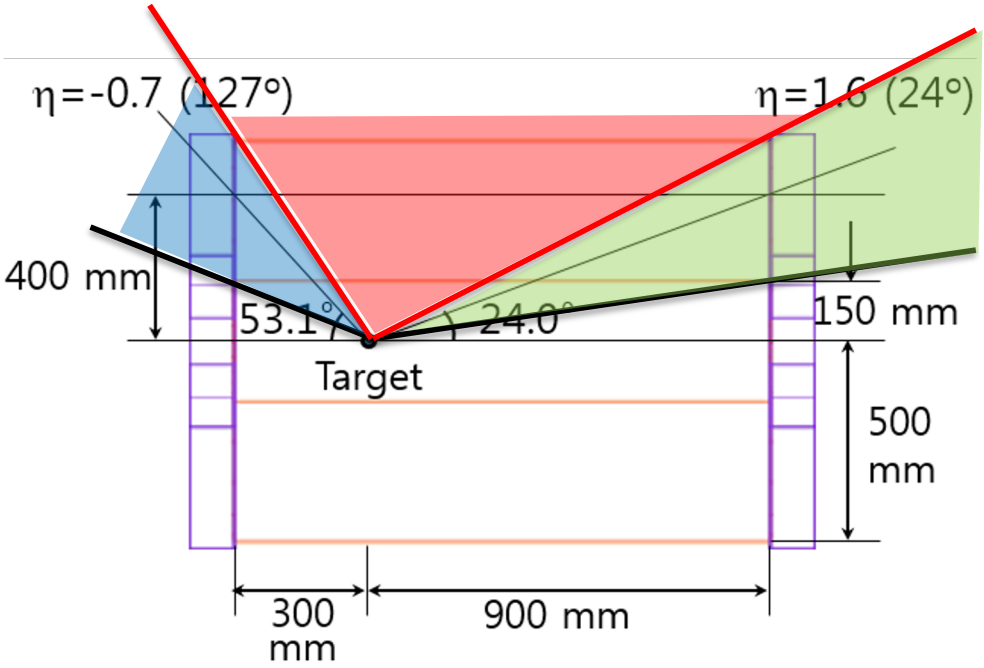


Fig. 1: A schematic diagram of the TPC of LAMPS. The TPC cannot observe charged particls In the green area.

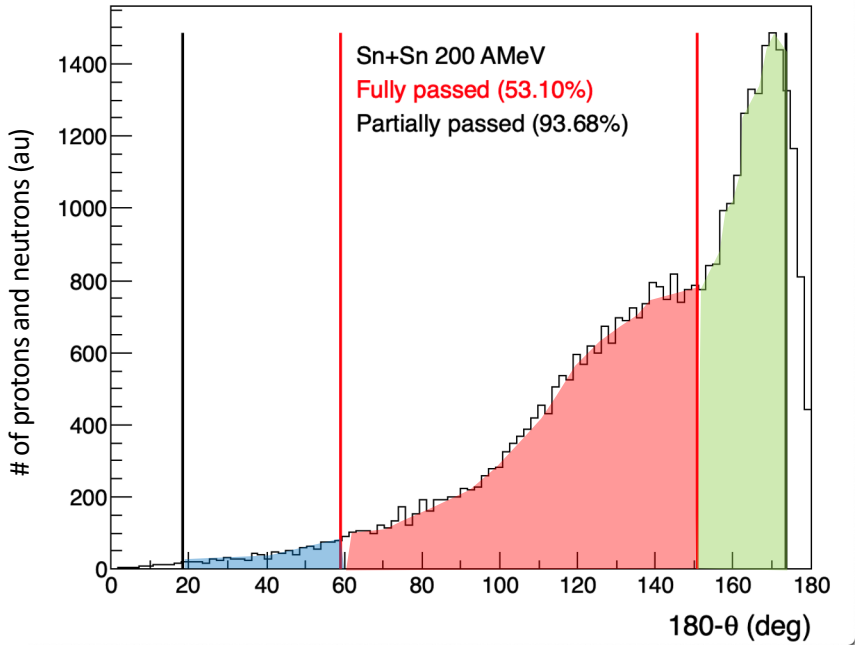
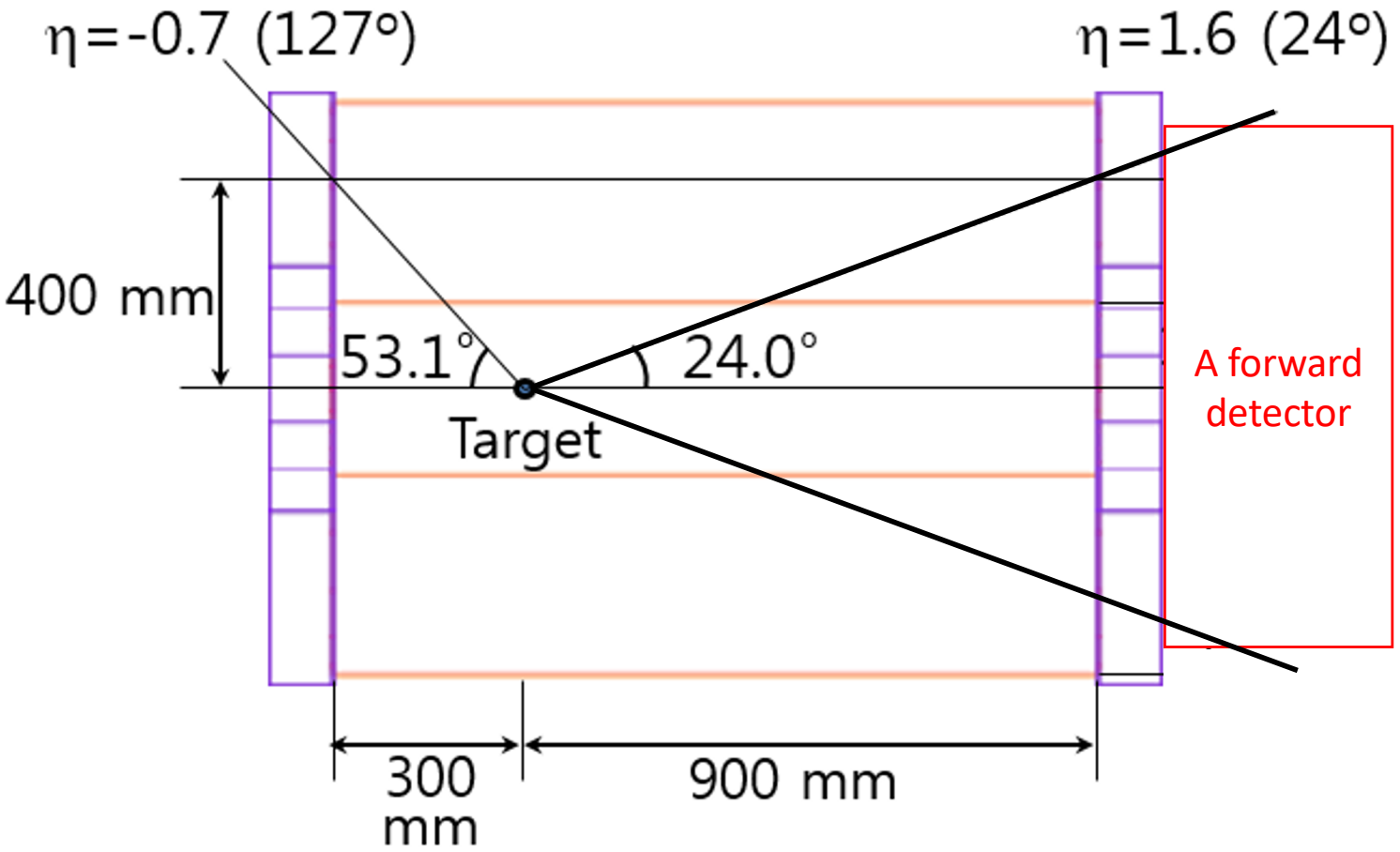


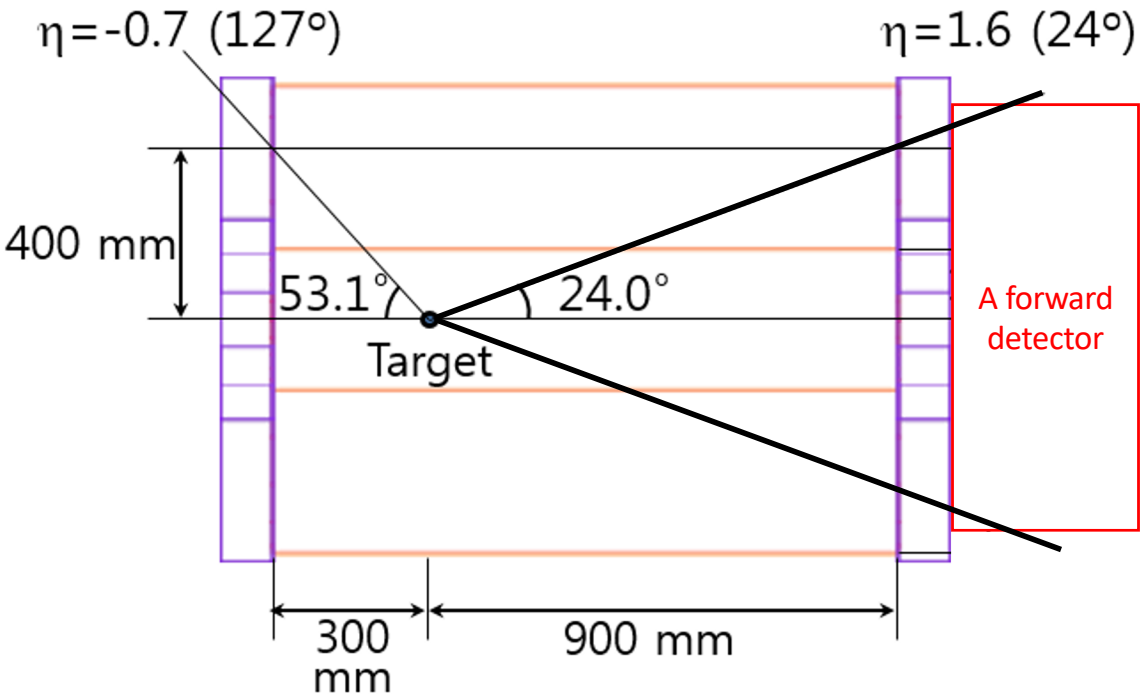
Fig. 2: # of generated particles as a function of θ with GEANT 4 simulation in Sn–Sn collisions at a beam energy 200 AMeV . The number of particles flying through the green area in Fig. 1 accounts for about 40% of the total # of particles.

The goal of the proposal

- **Study promising candidates** for the forward detector
- **Fabricate and install the front detector** for the determined type
- Contributing to **the study of the nuclear symmetry energy** with the full acceptance information of charged particles **using the forward detector**



Requirement of the forward detector



- Located **inside the solenoid and its B-field**
- The most important functionality: **tracking and PID**
- Allowed **maximum physical volume**: **1,050 mm (ϕ) × 650 mm (L)**
- As close as possible to the **TPC endcap**
  - Larger effective pseudorapidity acceptance
  - More **homogeneous B-field**

Candidates of the forward detector

- The Drift Chamber (DC)

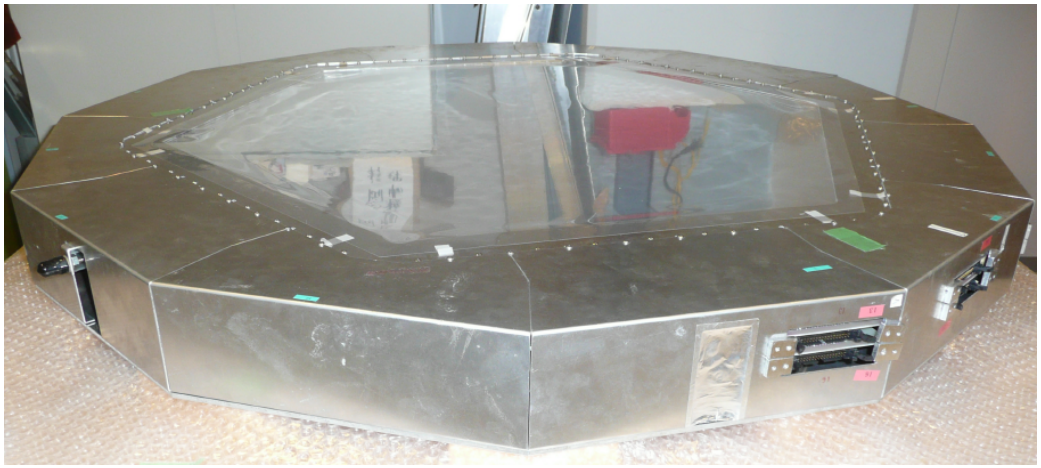


Fig. 3: DC0 from Spring-8 (figure from the slides by Prof. Ahn)

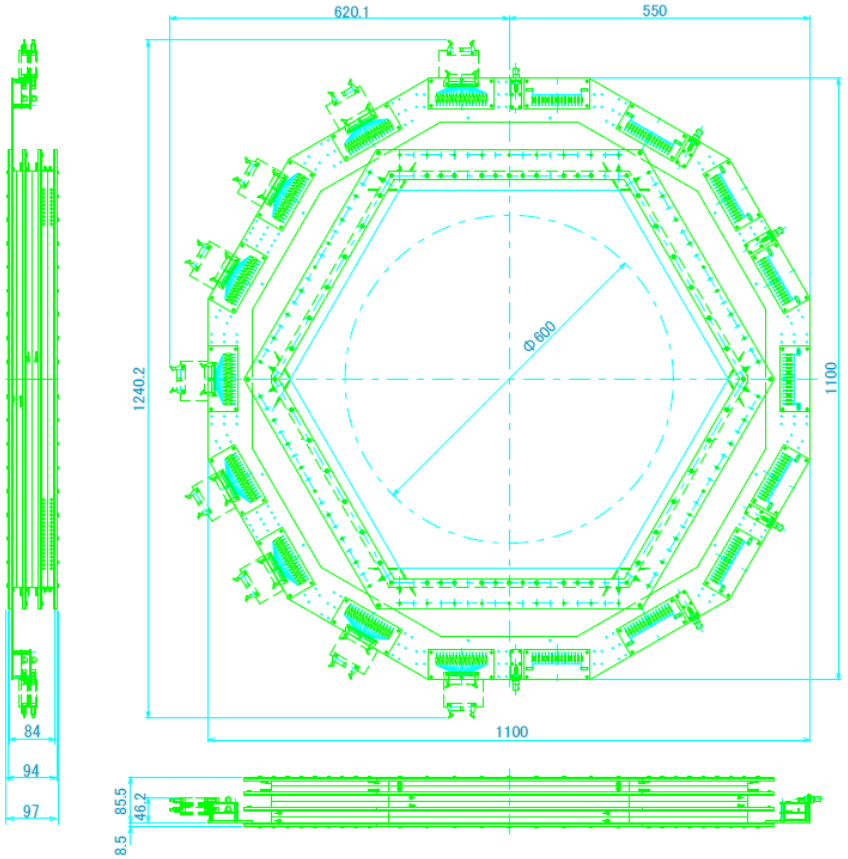
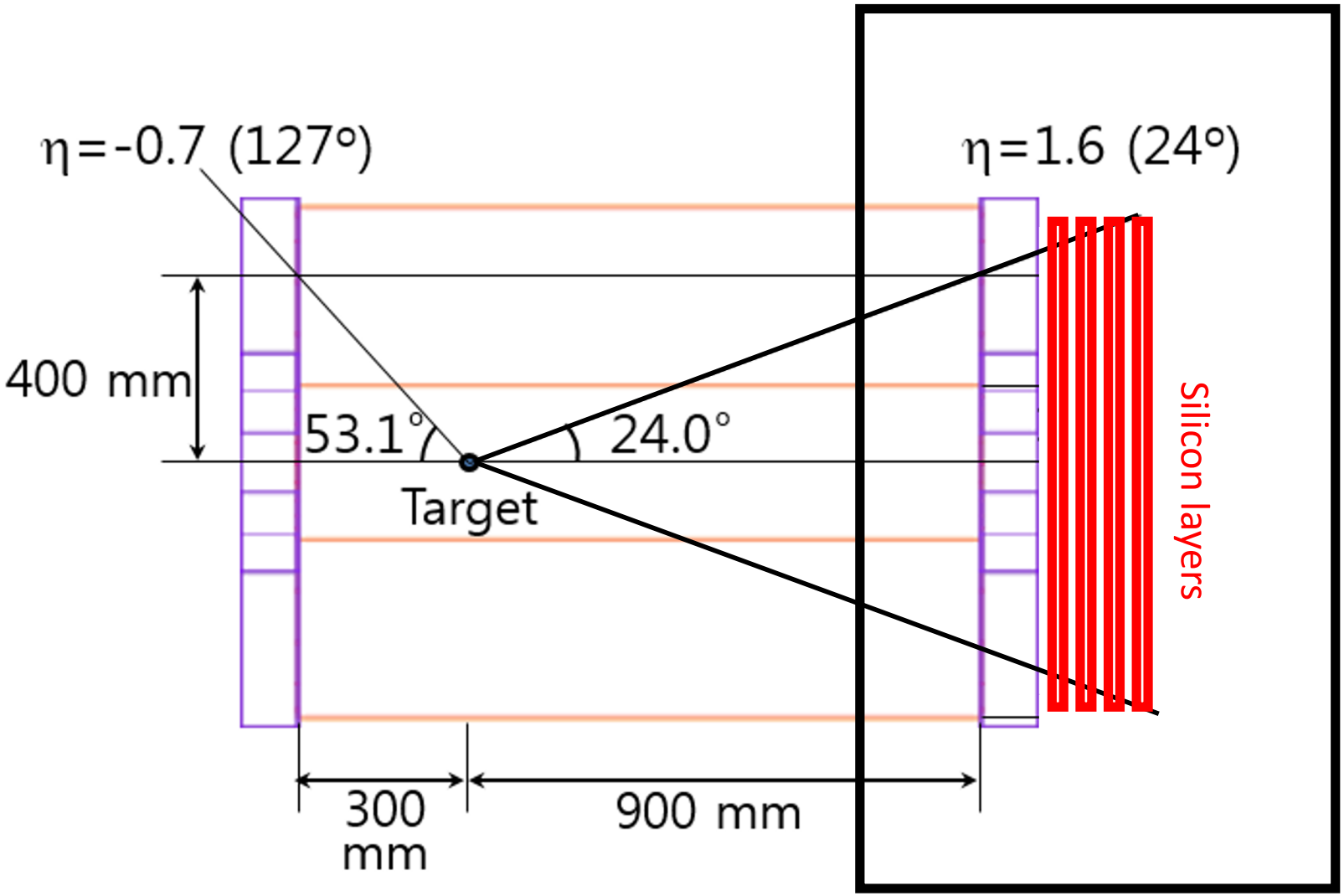


Fig. 4: Geometrical structure of the DC0 in Fig. 3 (figure from the slides by Prof. Ahn)

Candidates of the forward detector

- A silicon detector



Candidates of the forward detector

- The scintillation fiber

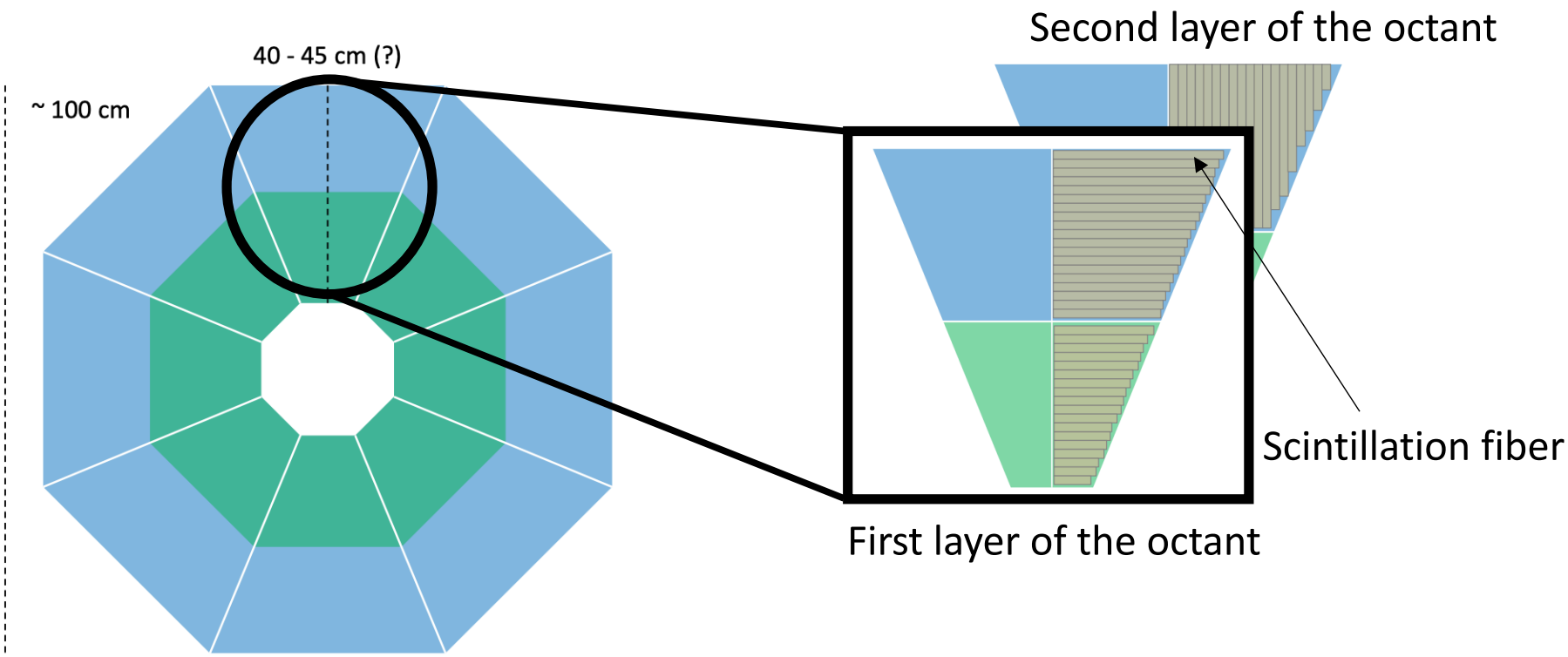


Fig. 6: One layer of the scintialltion fiber detector. Overall dimension can be smaller as it gets closer to the TPC. The size of 100 cm is the maximum value when it is assumed to be at the edge of the solenoid

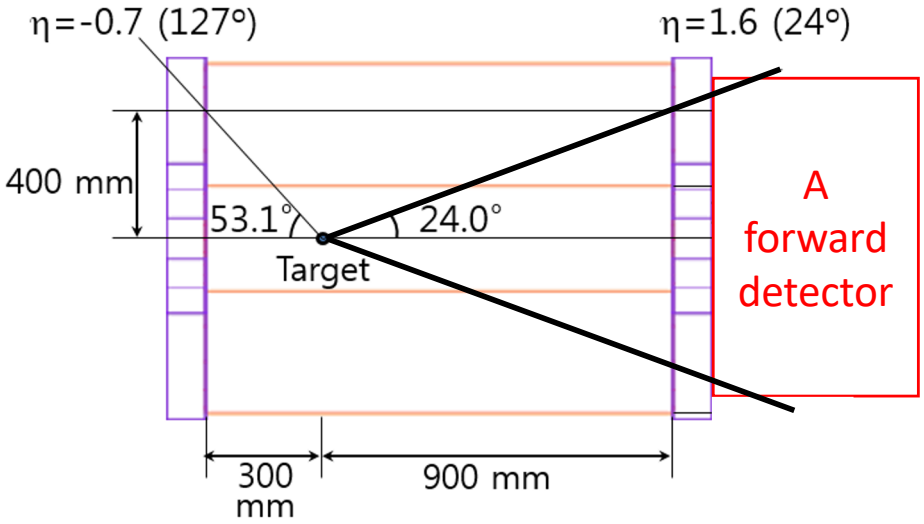
Planning

- Tentative schedule

	2021				2022				2023				2024				2025			
Performance study for the detector	■	■																		
Implementaion of GEANT 4 simulation for the detector	■	■	■																	
Design for the detector structure			■	■	■	■														
Research on the electronic board			■	■	■	■														
Build a detector test system					■	■	■	■												
Prototype production of the detector					■	■	■	■												
Tests on the prototype detector for the charactristics							■	■	■	■										
Beam test of the detector									■	■	■	■								
Event builder programing for the detector					■	■	■	■	■	■	■	■								
Installation and stabilization of the detector											■	■	■	■	■	■				
Synchronization with other LAMPS detectors											■	■	■	■	■	■				

Summary

- **Why the forward detector?**
  - **The current LAMPS experiment** cannot observe **about 40% of charged particle** escaping through **the forward region**!
  - Observing charged particles **for a large pseudorapidity range** is one of the important factors for **measuring the nuclear symmetry energy**



- **Requirement of the detector**
  - Located **inside the solenoid and its B-field**
  - The most important functionality: **tracking and PID**
  - Allowed **maximum physical volume**: **1,050 mm (ϕ) × 650 mm (L)**
  - As close as possible to the **TPC endcap**
- **Candidates: DC, Silicon, scintillation fiber, and so on!**