Study items

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IPNS/KEK

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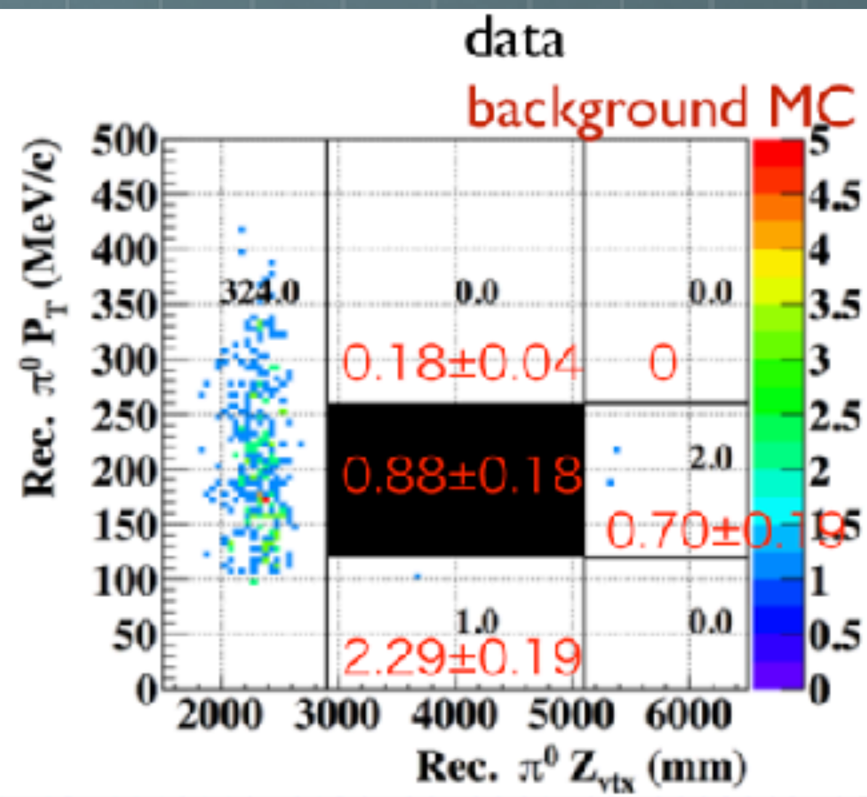
Working List

- Main Barrel performance check
- Charged Kpi3 decay
- Air Run
  - Systematic study on neutron interaction
- Origin of the accidental hits
  - Counting rate seems to be explained by the Kaon decays
  - Large different on vetoing (“OR”)
- How to produce huge amount of M.C.
  - K3pi0 distribution (how accurately reproduce the data?)
  - mass (calibration), beam profile (halo kaon)

$K_L \rightarrow \pi^+\pi^-\pi^0$

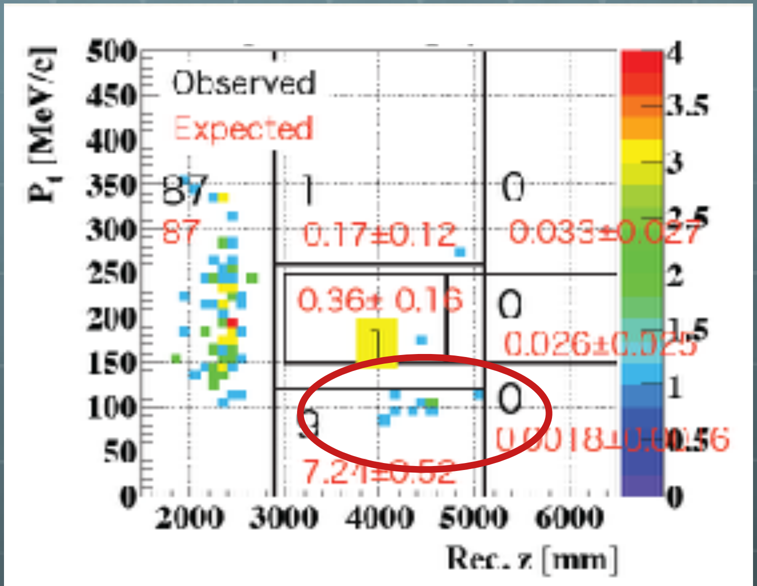
	New
KL->2pi0	0.07±0.07 ●
KL->pi+pi-pi0	0.18±0.05 ●
NCC	0.13±0.07 ●
Hadron cluster	0.26±0.08 ●
CV-pi0	<0.14
CV-eta	0.05 ●
KL->2gamma	0.02±0.02 ●
KL->3pi0 fast	<0.01 ●
Masking Ke3	<0.094 ●
Masking K3pi0	0.17±0.12 ●
Sum	0.88±0.18

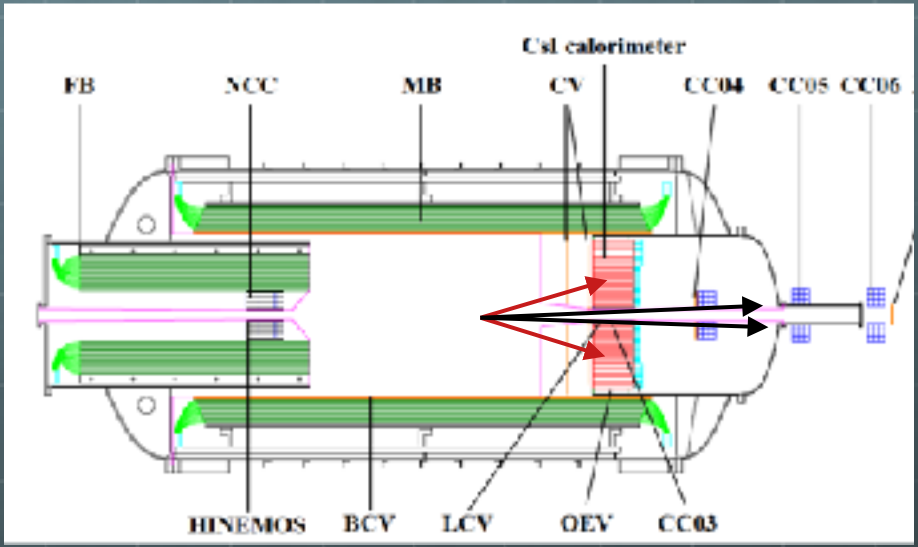


● Based on data (special run data or physics data with a special cut set)

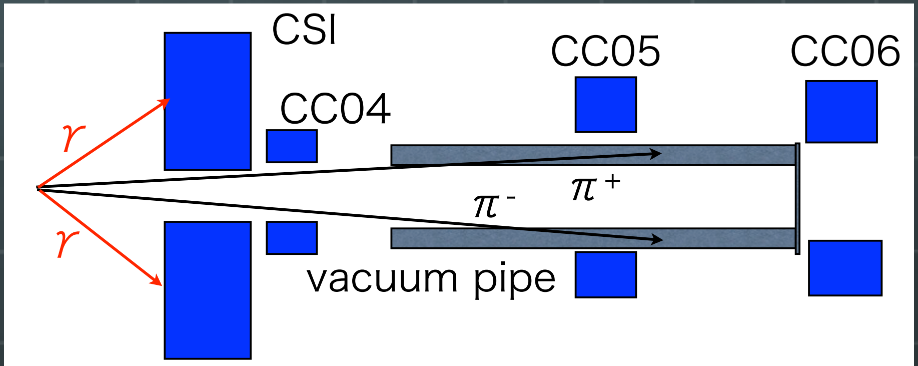
● Based on simulation ● Distribution from simulation, normalized by data

$K_L \rightarrow \pi^+\pi^-\pi^0$

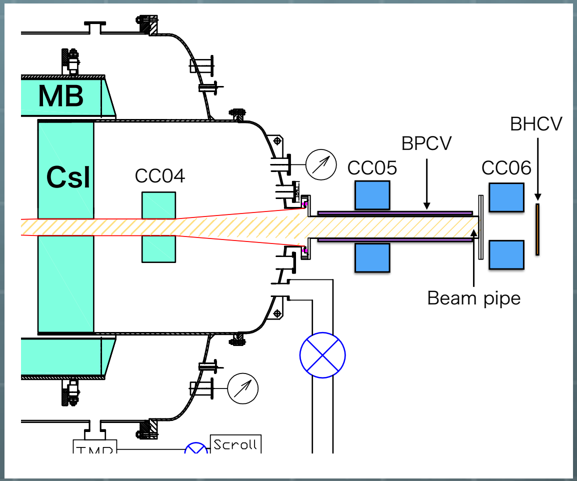


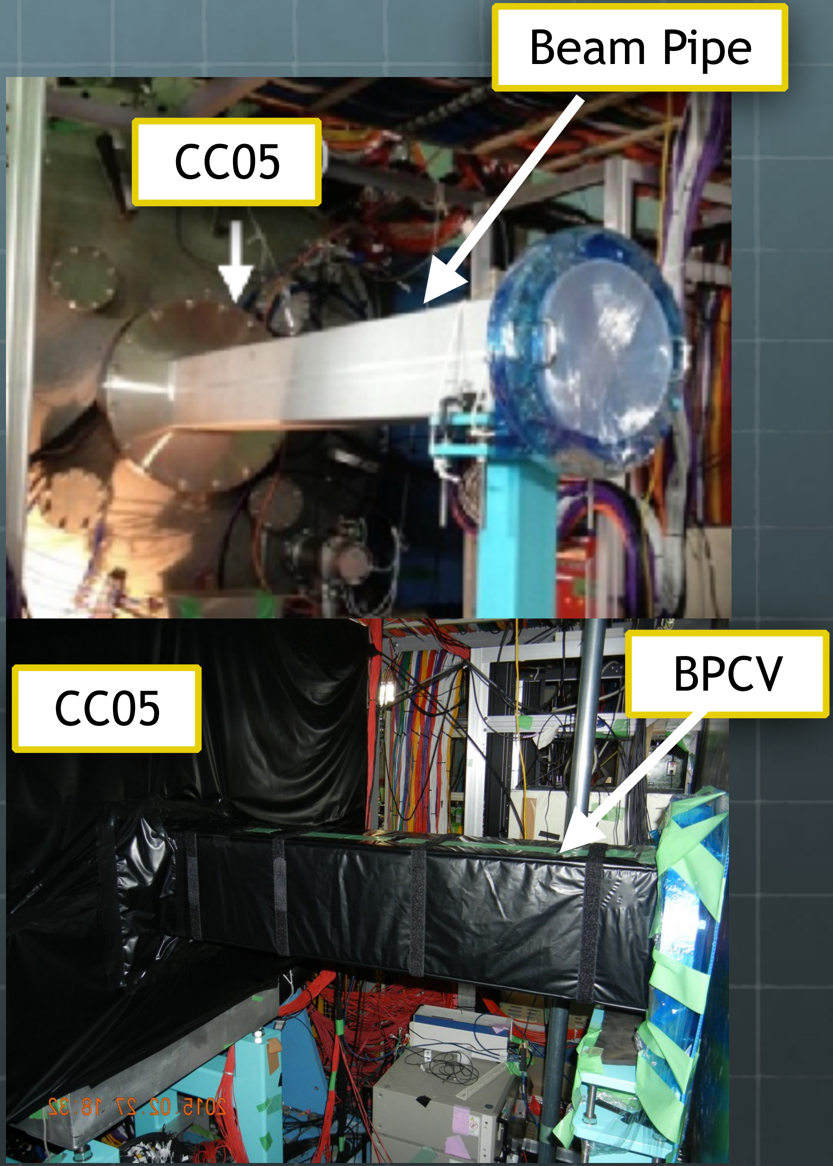


π^+ and/or π^- were not detected due to interaction inside vacuum pipe



$K_L \to \pi^+\pi^-\pi^0$

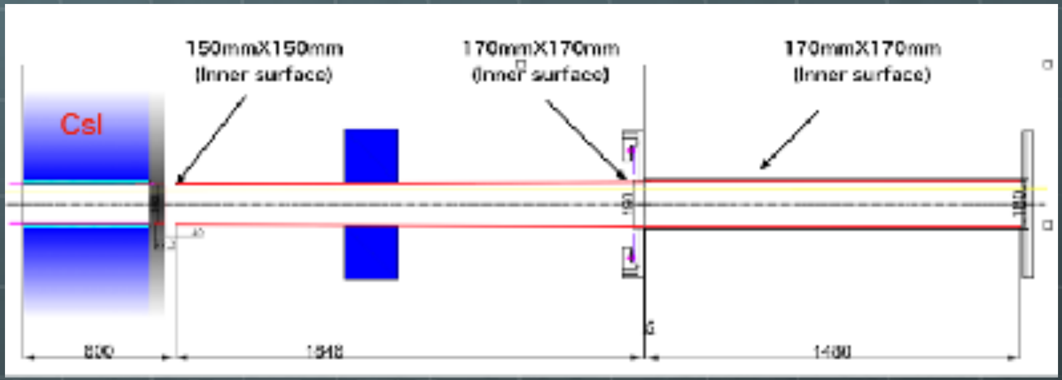




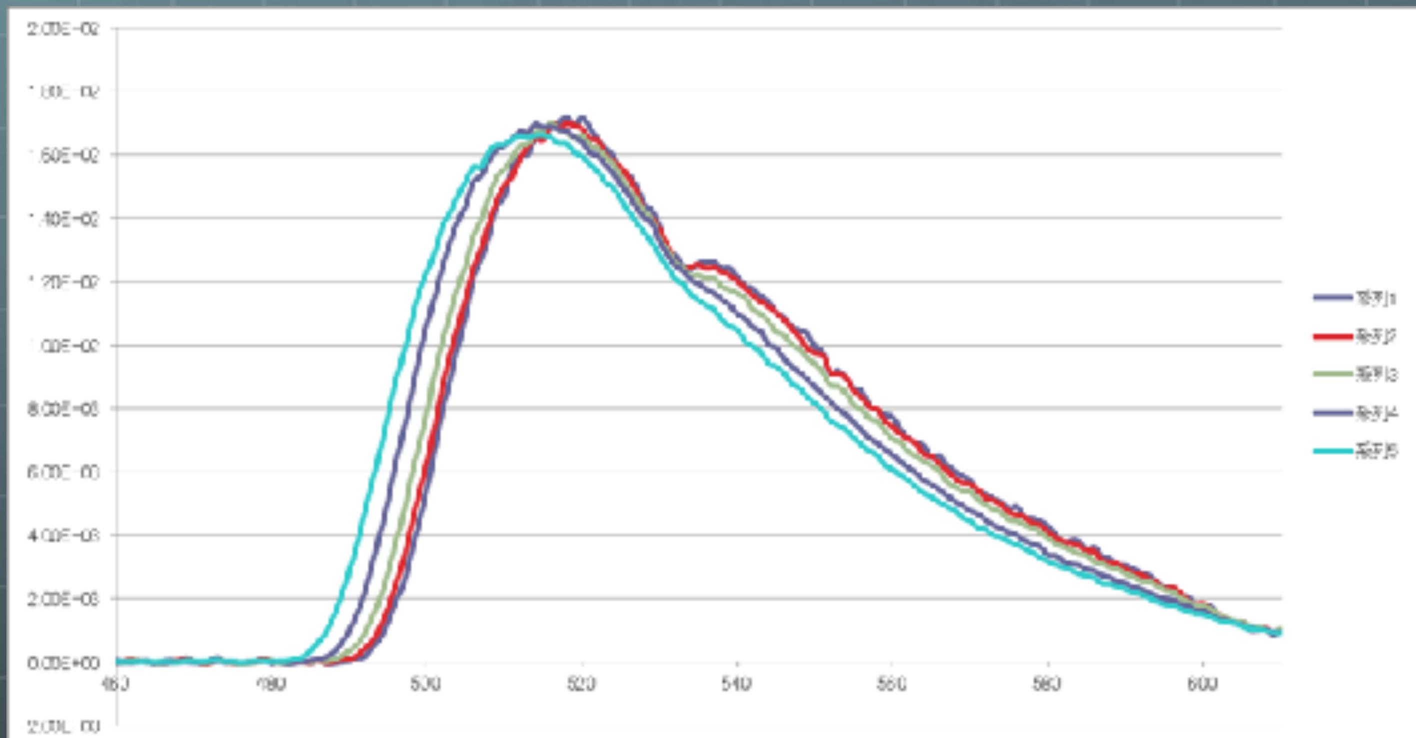
- Beam pipe with lighter material
  - Stainless Steel -> Aluminum
- Beam Pipe Charged Veto
  - 5mm-thick Plastic Scintillator
  - Wavelength shifting fiber readout

Road Map

- Confirmation of previous results
  - Follow-up the process to estimate B.G. level
  - Weak points of detector setup
- Detector design
  - Removing G-10 pipe
  - Install needed scintillators
- Detector R&D
  - Very limited space
  - The most inner place : close to the beam
  - A long and thin counter : Light yield
    - Scintillator, Wavelength Shifting fiber, reflector, MPPC V.S. PMT
  - Timing resolution

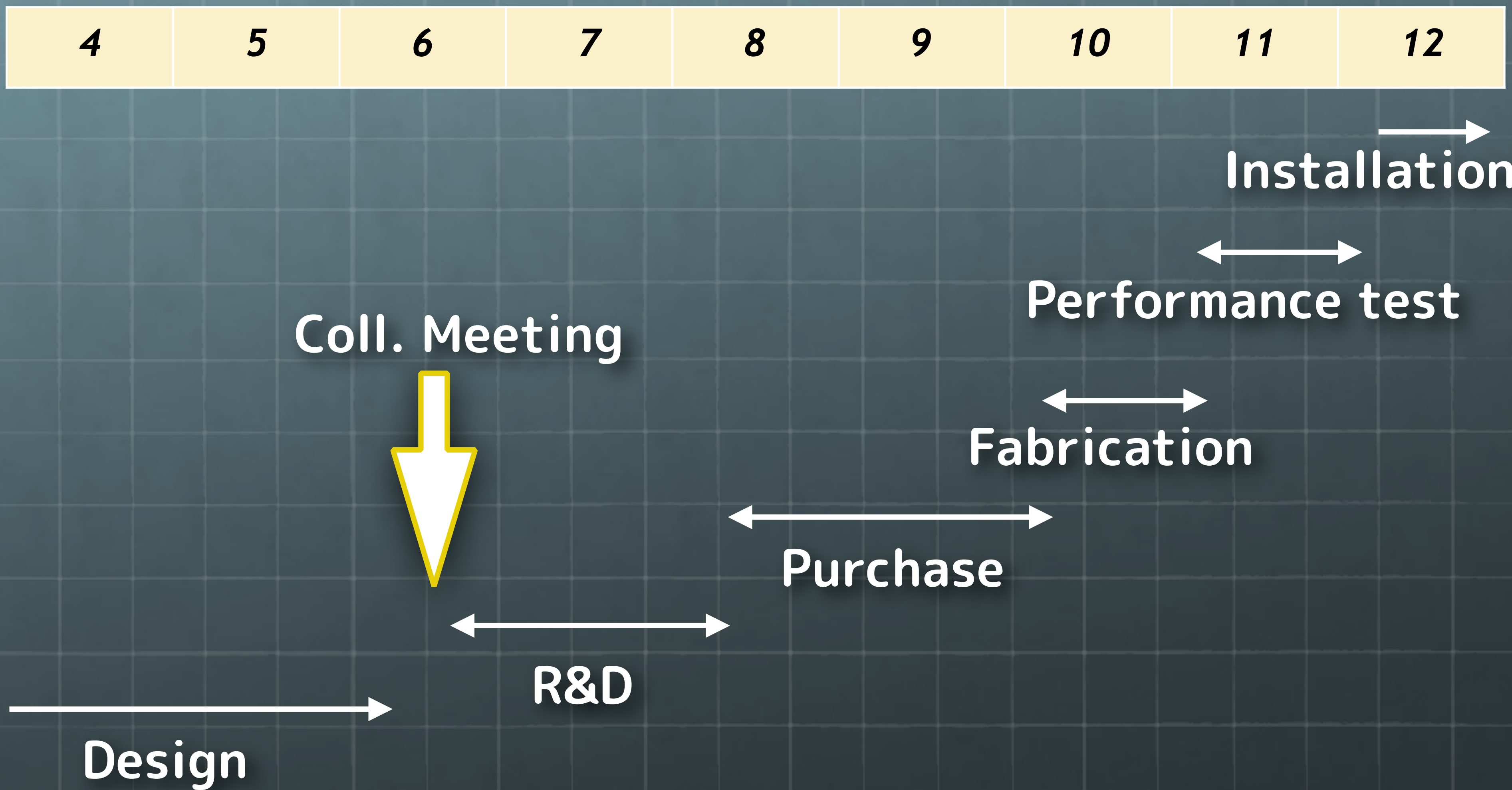


Position dependency



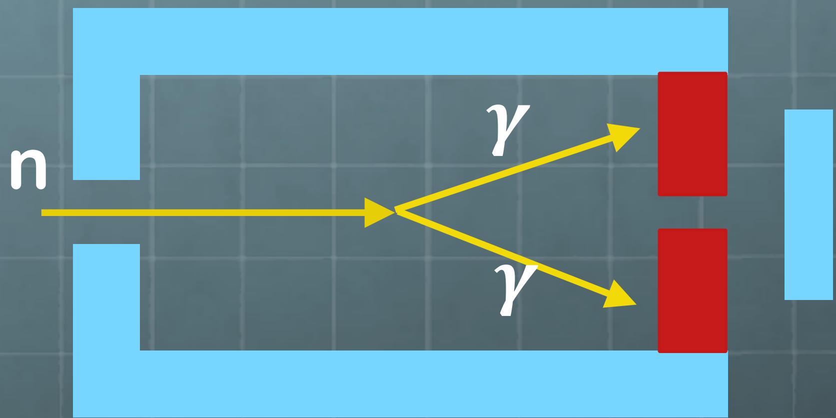
Wavelength (nm)

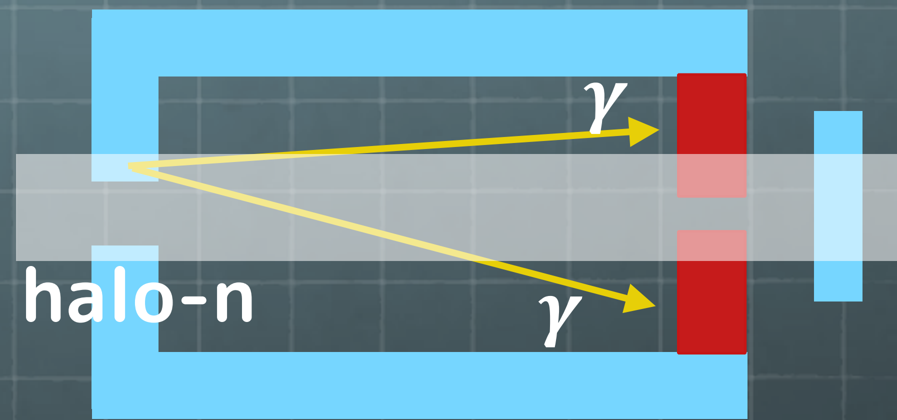
Schedule


4
5
6
7
8
9
10
11
12
Installation
Performance test
Coll. Meeting
Fabrication
Purchase
R&D
Design

Air Run

Backgrounds related neutrons



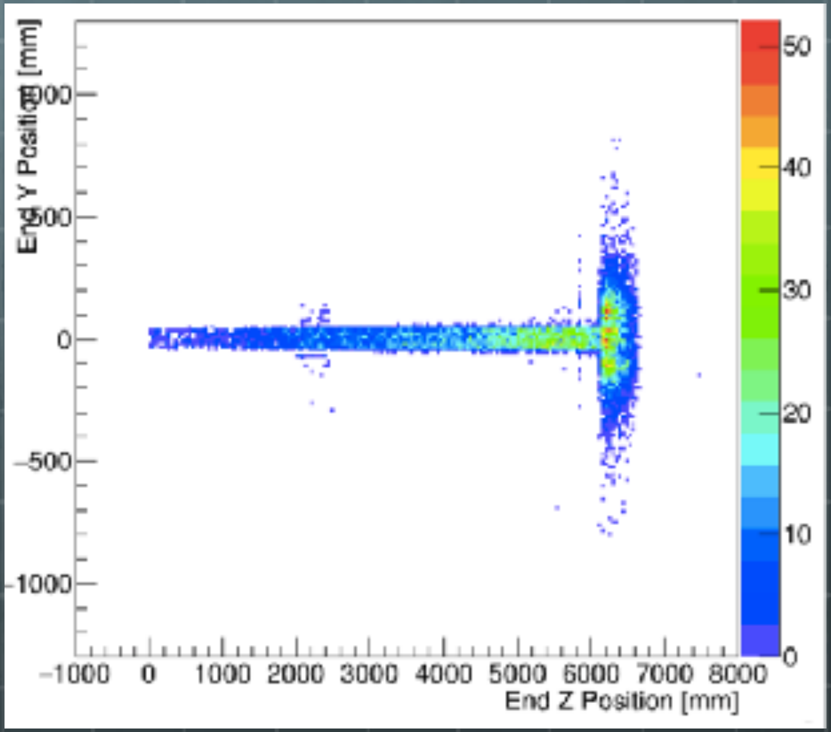


Interaction with air
⇨ Evacuate decay region

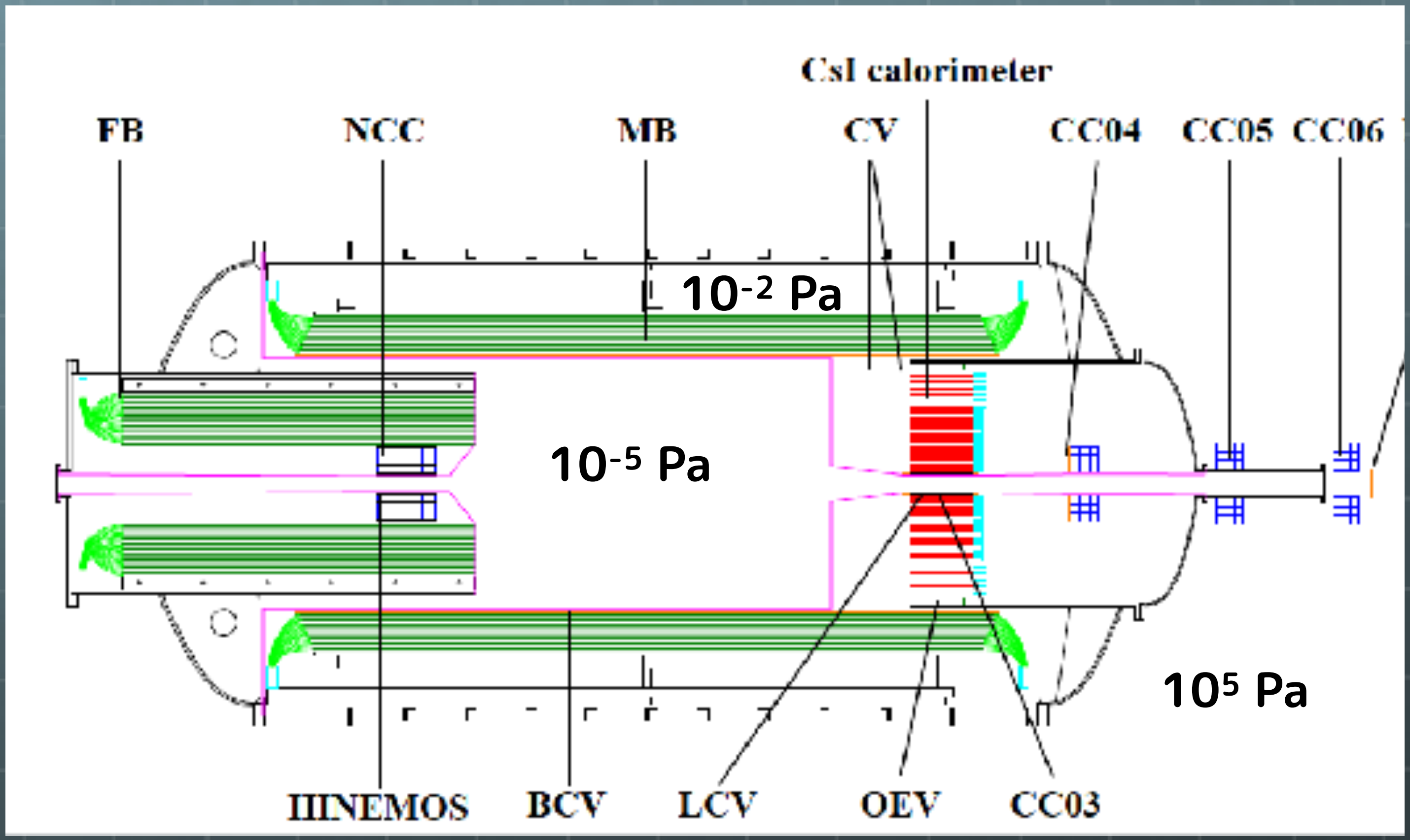
Interaction with detector
⇨ Pencil Beam

We can calculate the neutron interaction with GEANT4.
- Question is how to confirm the M.C. results are true.

- Neutron interact with air
  - produce the pi0 with additional particles
  - scattered and enter the CsI



Highly evacuated decay volume



Option 1: connect decay volume to detector region.

Option2 : return to the pressure.

We can connect decay volume (high vacuum region : 10^{-5} Pa) to the upstream region (1×10^{-2} Pa) by opening the valve between them. (We will turn off the Turbo molecular pump (TMP) before opening the valve). In order to protect cookies of CsI from outgas generated IMB and NCC, the GV2 will remain closed. It will take $20 \sim 30$ minutes to be stable.

Letting motivation of the *low vacuum run* as a proof that the 10^{-5} Pa is good enough in Step-1, we might estimate how many data is needed. Assuming 3 snowmass-year (350 days) data taking with 100kW beam and background level as 0.1, we expect 1 event from the data taken during 7-day *low vacuum run* with 50 kW beam. That is, we needs 16-day run to set upper limit of the background level as 0.1.

- 12.6 events per year with low vacuum.

We need too long beam time only to study the backgrounds.

3 Concerns on the air run

In order to accumulate enough statistics of the π^0 events, we need to perform the *air run*. The *air run*, however, has some difficulties we have to solve.

The first thing is that we need 2-day purge to return 1 atm, and have to suffer loss of beamtime. Even though we start to break vacuum at the beginning of the 1-day maintenance day, we have to wait another 1 day to be ready for data taking. We need to find a way to return to the 1 atm within one day.

The next concern is vacuum window which is a thin polymid window in order to separate beam line and decay volume. When the decay region becomes 1 atm, the beamline should be done also otherwise the window will be broken. As a result, beam halo increases a order of magnitude and we have to study carefully its effect.

We also have to take care of operation on the MPPC for the CV. The feed-back system to supply high-voltage to the MPPC is very sensitive to the temperature, and there is a possibility not to work properly in the *air run*.

Concern the triggering rates in the *air run* , we can expect 30 % of the 5-mm UDV Al target from the ratio of interaction length of air to that of the Al as a factor of 1884. However, counting rate on the Front Barrel and NCC would be high due to interaction at the upstream, which is needed careful study, too.

4 Possibility of the low vacuum run

It seems hopeless to collect meaningful number of π^0 event with 10^{-2} Pa. From the estimation of 0.38 events per second in *air run* , it needs 300-day data taking for 1 event! However, we can expect 3 events from 1-day data taking if we can make decay volume as 10 Pa. Since the decay volume is separated from the low vacuum region, we can change its vacuum level independently and 10 Pa will be not too high to damage the membrane (I wonder that the polymid window is safe too or not). One concern is that the higher vacuum on decay volume will affect the vacuum level of the low vacuum region. We may collect tens of events with few days of data taking, and I believe it would be acceptable after to make clear motivation and goal of the π^0 production study.

Schedule

4	5	6	7	8	9	10	11	12

Making proposal

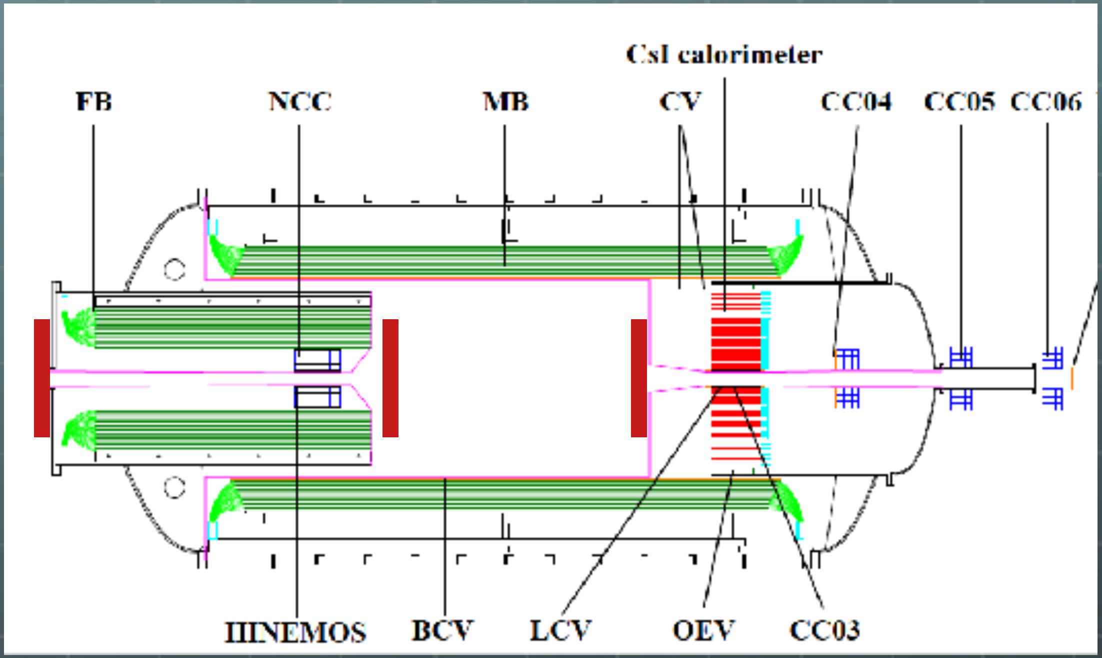
Data analysis

Coll. Meeting

For proposal

- Motivation
  - To confirm no B.G. from neutron interaction with residual gas.
- Method
  - How to produce 10 Pa condition.
  - What kind of risk is expected.
- Expected results (M.C. study)
  - How many events we can obtain during 1-day run.
  - How to identify the pi0 events and extrapolate to the B.G. level
  - Which variables will be used to monitor data taking

B.G. estimation related to the neutron



- 4 different data sets
- Observables
  - pi0 yields, energy
  - pi0/eta rati
  - Counting rates on veto counters
- Not clear
  - Neutron momentum
  - Cross section
  - Angular distribution

Fine tuning M.C. results to reproduce observables.

Lambda production study …

Accidental Loss

- Number of proton :25E12 Hz
- Yield of Kaon : 3.9E7/2E14 -> 4E6
- Decay probability : 10% -> 4E5

Veto window : 30s

- Accidental rates : 30E-9X4E5 =
  120E-4~ 10%
- Acceptance : 0.08(geo)*0.5*0.9=4E-3
- In reality : 3E-4