国立大学法人
奈良女子大学
Nara Women's University

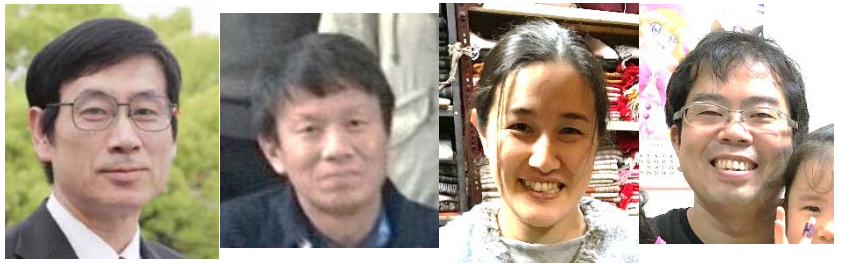
FOCAL activity and others at Nara Women's University

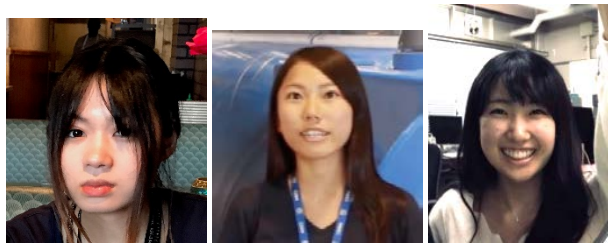
Takashi Hachiya

Nara Women's University

ALICE

Staffs and Students





Research topics are on Belle/Belle II and ALICE/PHENIX

Staffs：Prof. Hayashii, and Prof. Miyabayashi for Belle/BelleII

: A. Prof. Shimomura (maternity leave by 2019 fall),

A. Prof. Hachiya (joint with RIKEN)

2018 year: Students working for ALICE/PHENIX

Dc. St : 0

M2 (4) : 2 Nishitani(PHENIX-vn), Ishimaru(ALICE-EMC, PHENIX-HF vn)

M1 (5) : 3 Minato(ALICE-FOCAL),

Kamano (ALICE-MFT),

Suzuki (sPHENIX-INTT)

UD4 : 7, Isshiki, others

Other students works on Belle/BelleII

Activities at NWU

- ALICE FOCAL
  - Simulation study on pi0-pi0 correlation with FOCAL
  - Beam Test at CERN-PS and SPS (2018 July and August)
    - Construction and preparation of mini-FOCAL at Tsukuba U
    - Data analysis
      - MIP peak by punch through hadrons and Shower profile by e-
  - MFT tracking
  - HF->e analysis in p+p 14TeV
- sPHENIX/PHENIX
  - Test bench construction of sPHENIX silicon tracker
  - Testing the silicon ladders at NWU
  - R & D for very long and hi-dense data cable for the silicon tracker
  - HF->e analysis in p+p and Au+Au 200GeV
- Belle II
  - EMCal(CsI crystal), the beam BG monitor (secondary particles from beam)

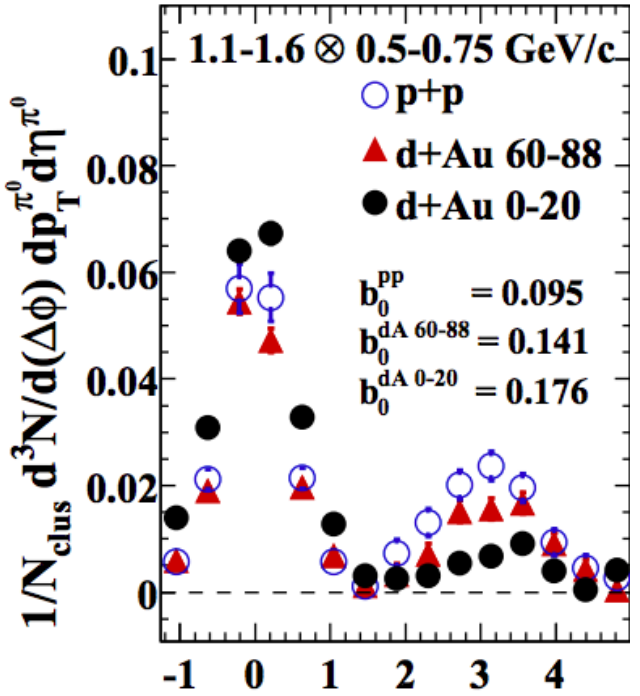
Pi0-pi0 correlation with FOCAL

Tomoko's work

- Why Pi0-pi0 correlation ?
  - Direct photon is golden channel

- The CGC effect at small-x
  - ✓away side peak is suppressed. [NPA748, 627-640]
  - ✓away side peak is broadened. [NPA796, 41-60]

[PRL107, 172301]
PHENIX p-p, d-A@$\sqrt{s_{NN}}$ 200GeV
acceptance : $3.0 < \eta < 3.8$



Target:
Compare π^0- π^0 correlations in p-p and p-A at forward rapidity by ALICE- FoCal.

- Develop the analysis method to extract the signals from the BG in p-p simulation with good precision

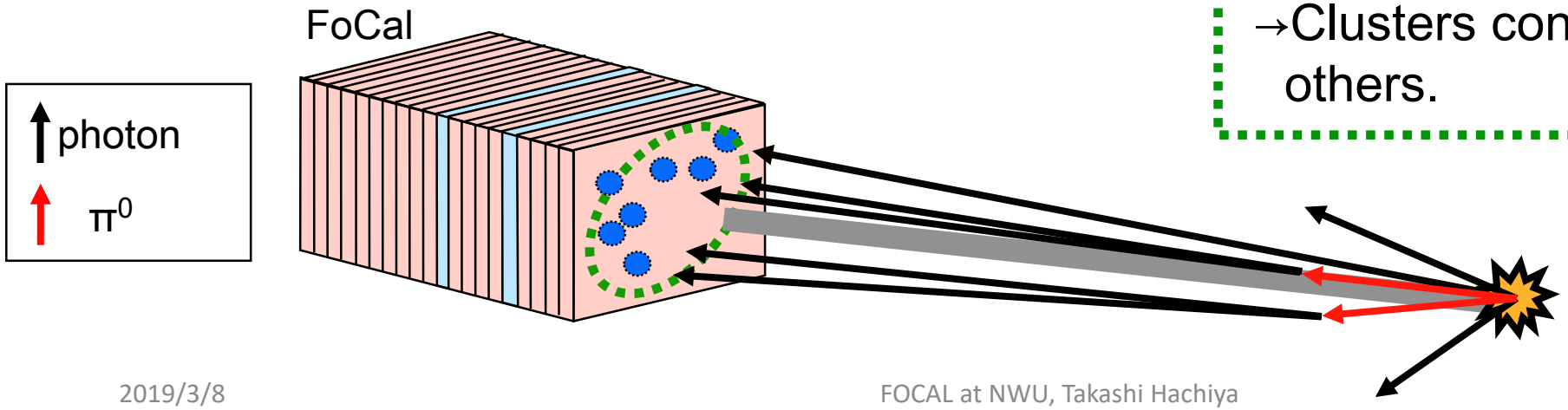
Simulation: π^0 from p+p 14 TeV (PYTHIA)

- Simulation Setup
  - PYTHIA:
    - 1M events in $\sqrt{s}$ = 14TeV p+p
  - GEANT3 + Reconstruction
    - FOCAL at 7m from IP ($3.3 < \eta < 5.3$)
    - FOCAL-E (W + Si) 20 layers : 18 LGL + 2 HGL

True π^0
→π^0 generated in PYTHIA

Pythia π^0
→Reconstructed from true photons
→True π^0 + Comb. BG
- require 2 photons enter FOCAL

Cluster π^0
→Reconstructed from E-clusters
→Clusters contains photons, electrons, others.

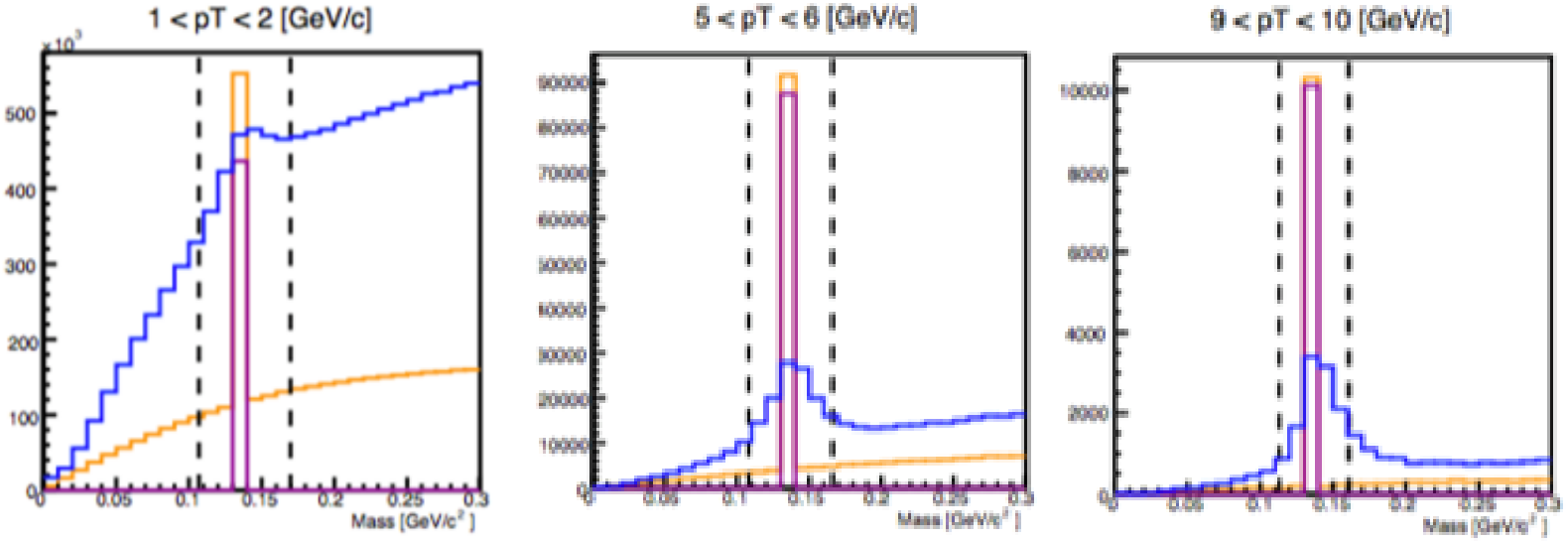


π^0 reconstruction

True π^0
Pythia π^0
Cluster π^0

$$M_{\gamma\gamma} = \sqrt{2E_1E_2(1-\cos\theta)}$$

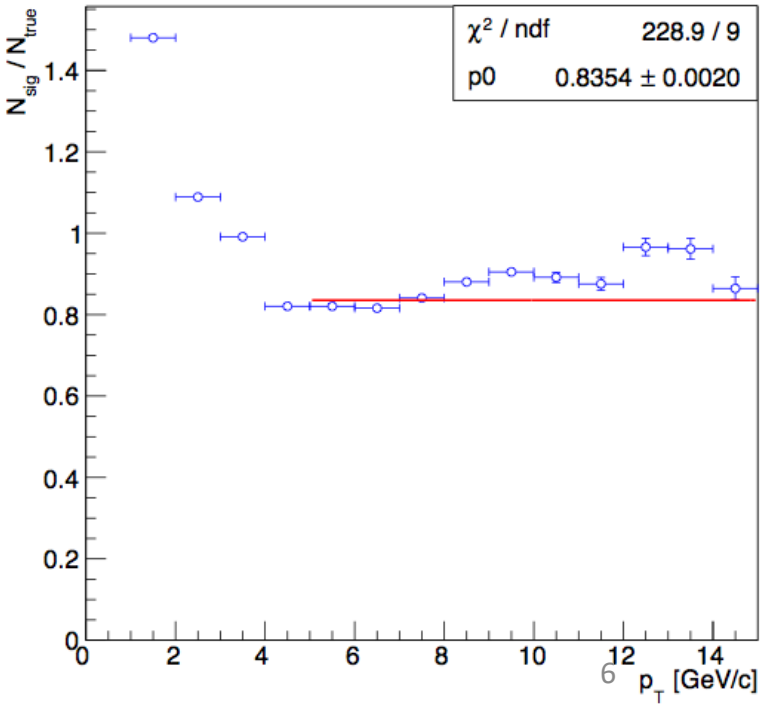
E1, E2: cluster-E



- π^0 peak is clearly seen in p_T>1 [GeV/c]
- Cluster π^0 at 5<p_T<15 [GeV/c]
  - S/N>1 with 2σ mass windows
  - Stable π^0 efficiency (cluster π^0 / true π^0) ~ 0.84

→Use 5 <pT<15 GeV/c for π^0 - π^0 correlation

cluster π^0 / true π^0

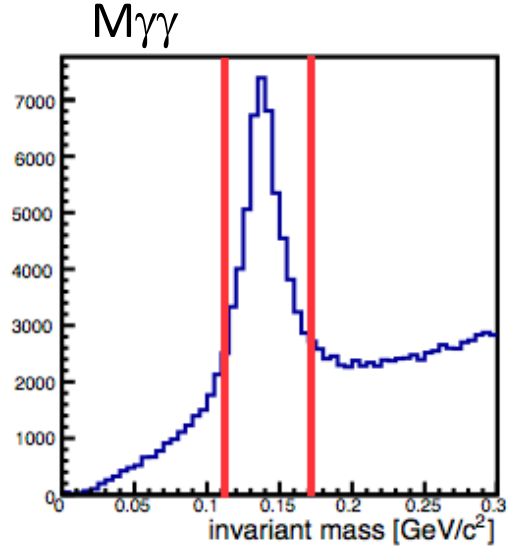


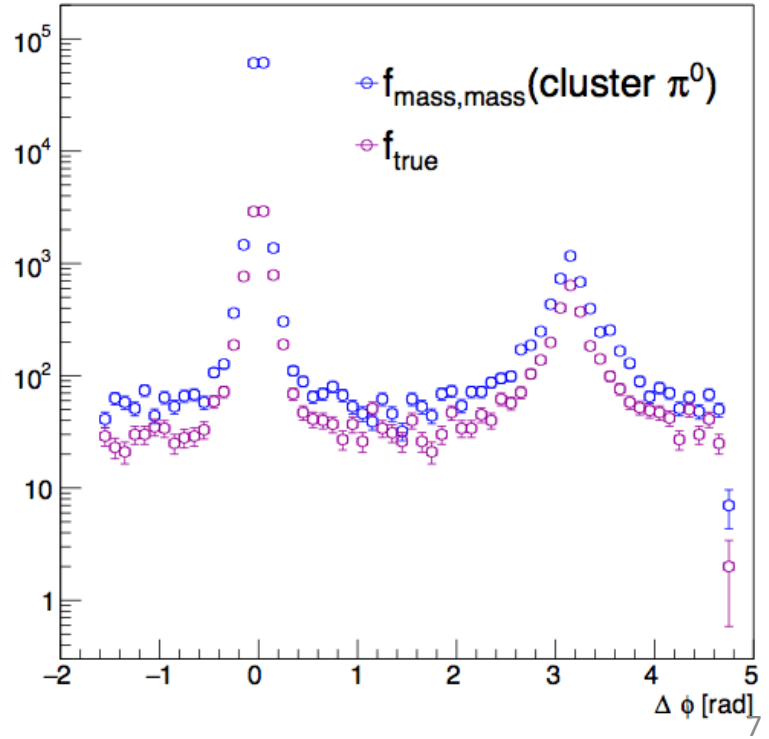
π^0- π^0 angular correlation

1. Choose all reco-π^0s
   - 2σ mass windows
   - $5 < p_T^{\pi 0} < 15$ GeV/c
2. Measure $\Delta\varphi$ of all π^0 pairs

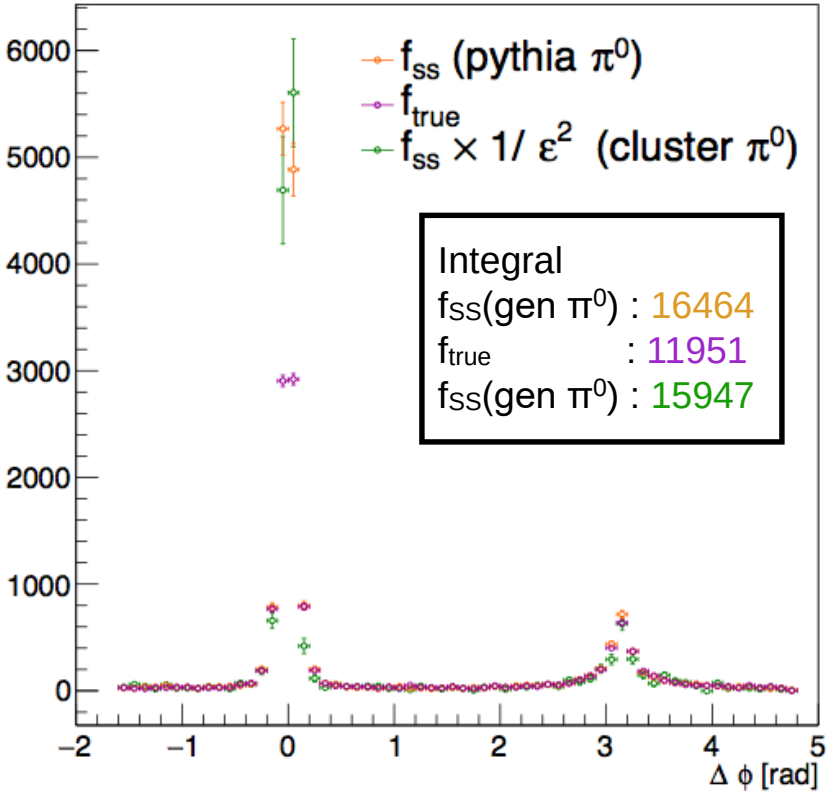
   $\Delta\varphi = \varphi_{trig}^{\pi 0} - \varphi_{asso}^{\pi 0}$

   Trigger and associate π^0 : $5 < p_T^{\pi 0} < 15$
3. Subtract comb. BG

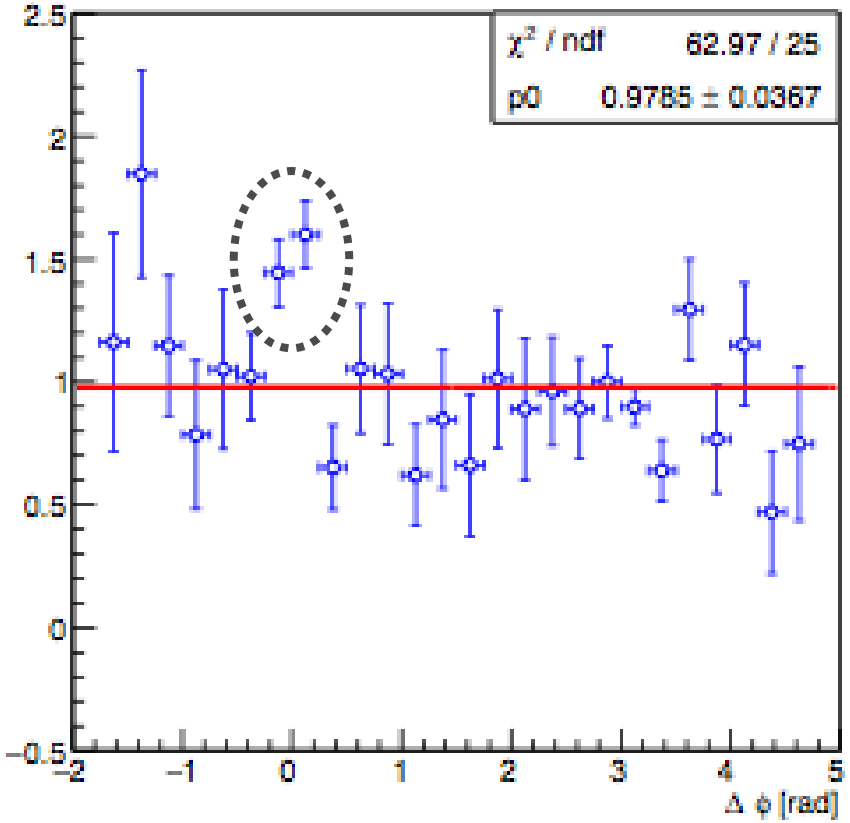




Results



$R=f_{SS}$(cluster π^0) / f_{true}

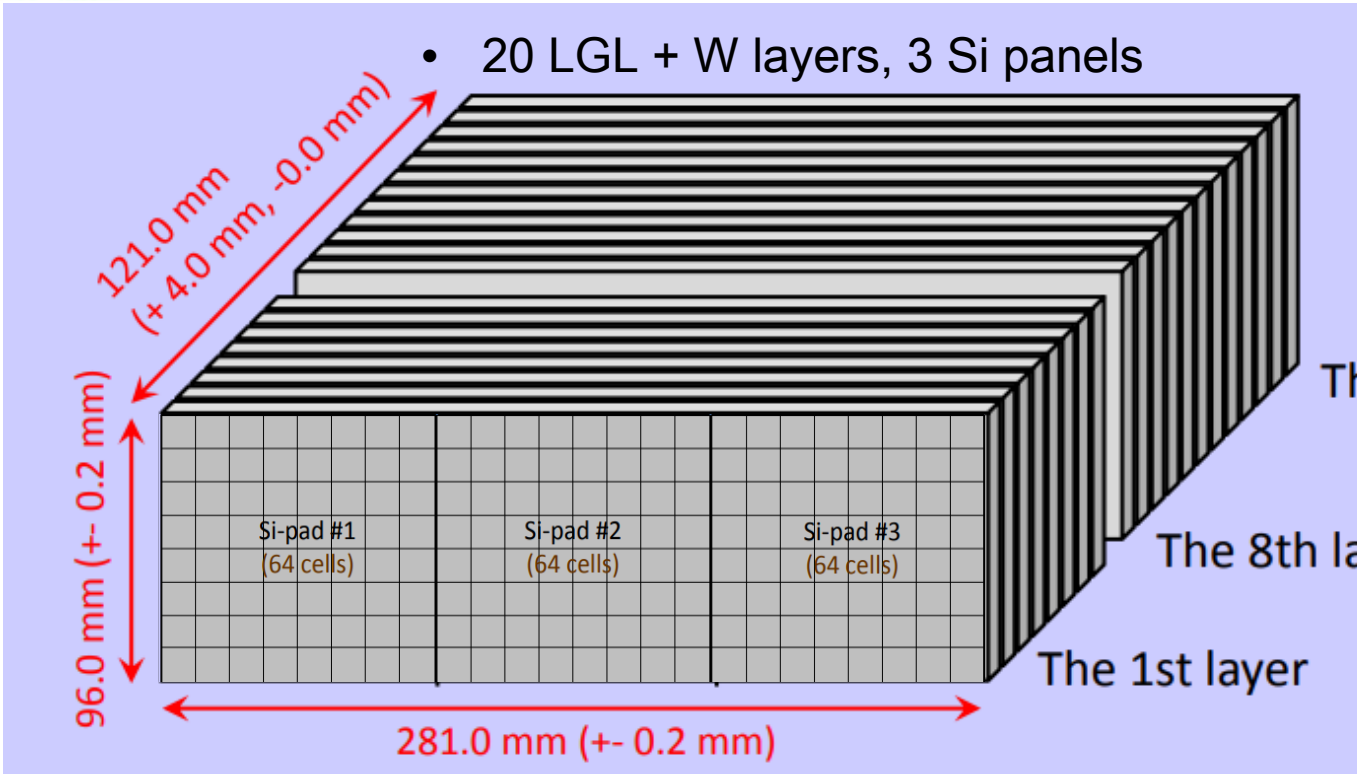


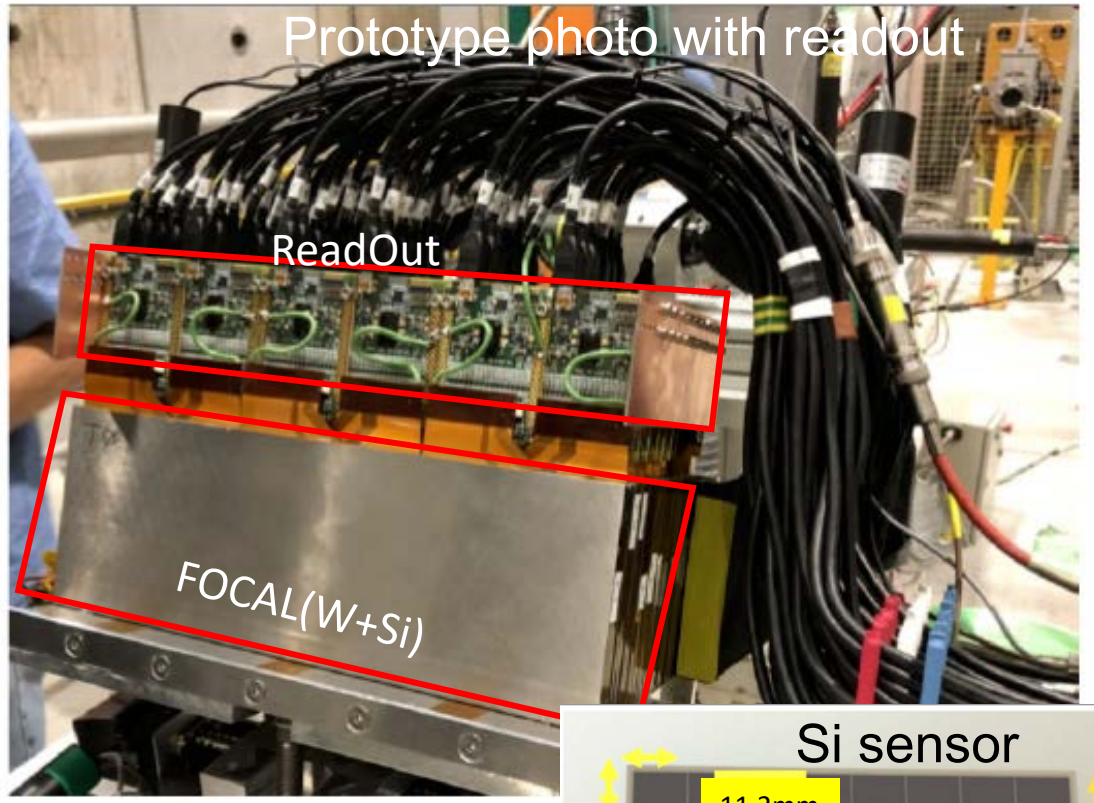
- Cluster $\pi^0(f_{SS})$ is consistent with Pythia π^0
  - Comb. background subtracted
  - Reco. effect increases the near side peak.
- R is mostly consistent with 1 within errors
  - BG might be underestimated at near side.
  - BG subtraction method is studied in detail (not shown)

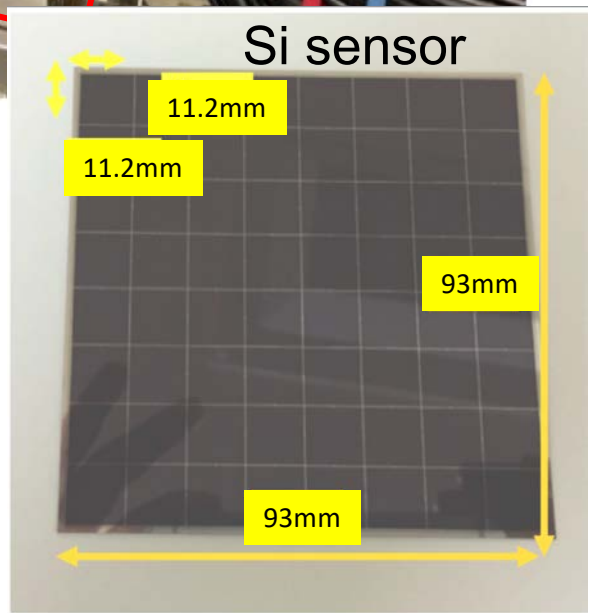
Analysis method works nicely

Next step is to implement/measure the broadening effect in the simulation

FOCAL prototype and beam test



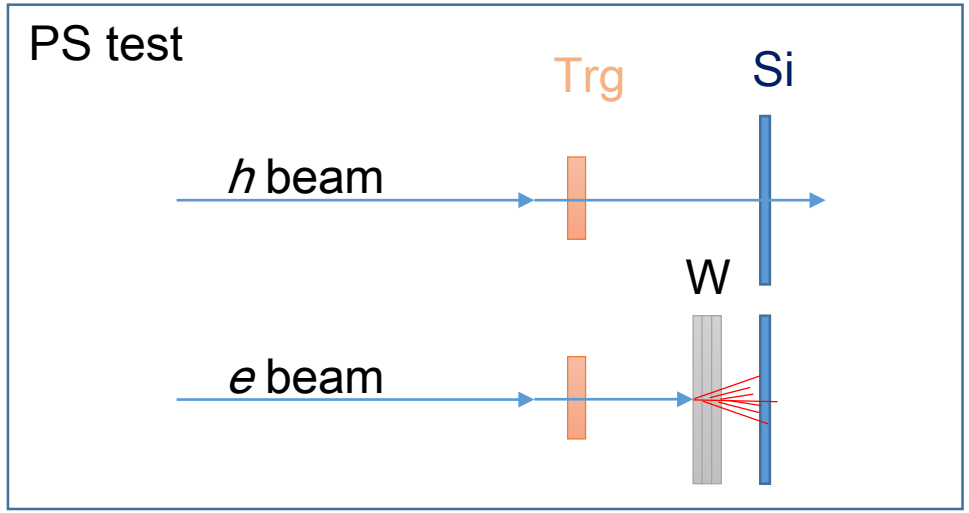


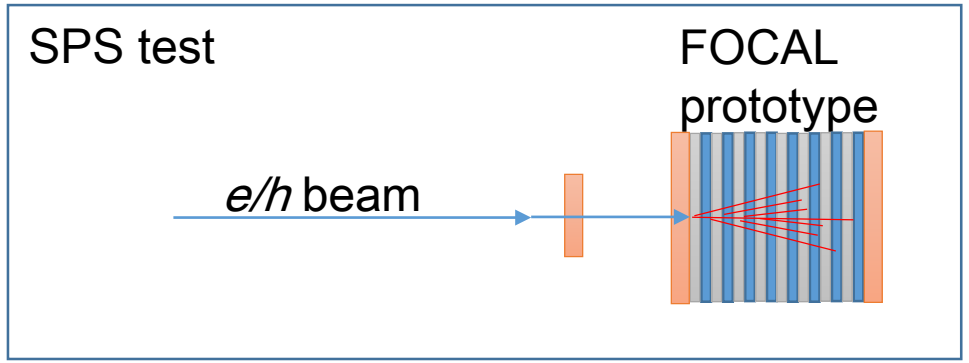


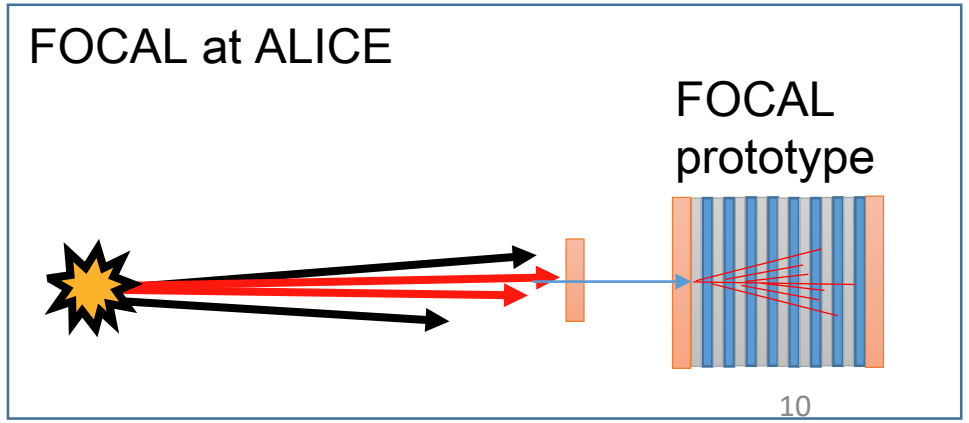
Time Line	Jul	Aug	Sep	Oct
Setup	to PS	To SPS	To ALICE	
PS	h/e beam			
SPS		h/e beam		
ALICE			P+p with FOCAL prototype	

Beam Test at PS, SPS, ALICE

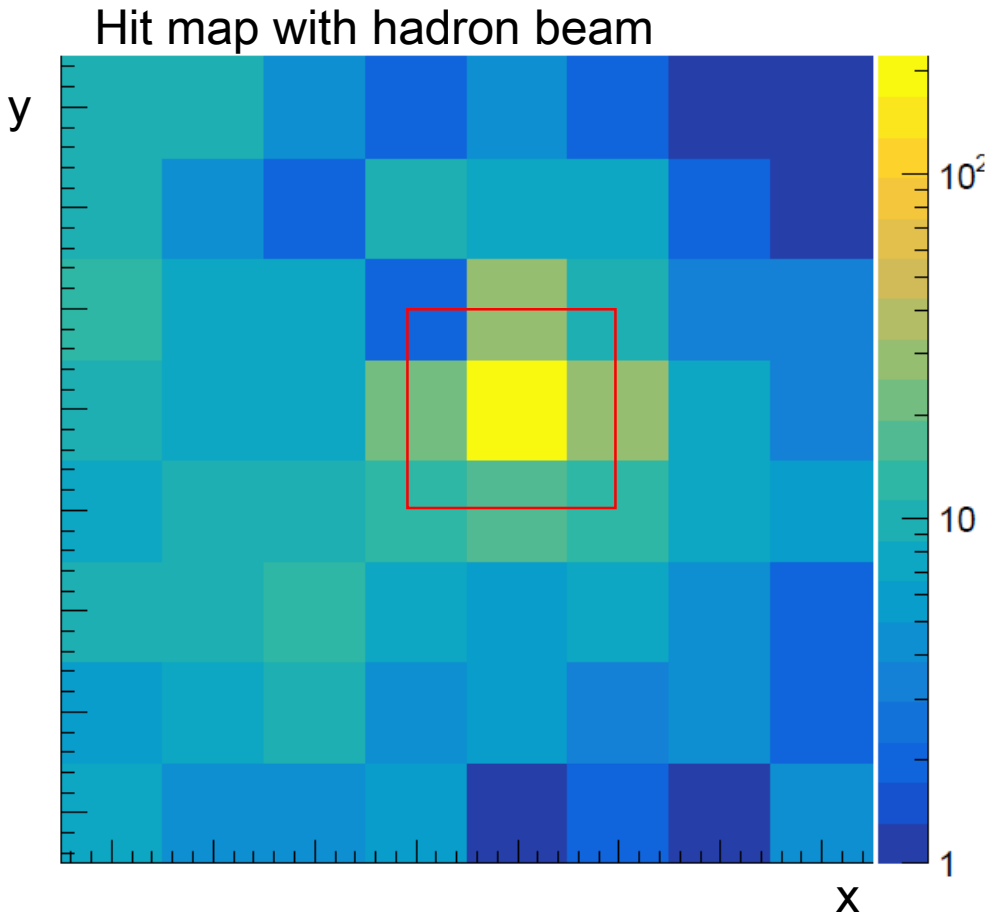
- PS (July)
  - *e* beam with 1, 2, 3, 4, 5 GeV, and *h* beam with 8 GeV
    - Cherenkov trigger was available for e/h separation
  - Single Si sensor response (Yoko)
    - Noise level, channel mapping with hadron beam
    - MIP signal with hadron
    - Shower signal with electron and 1/2/3 W plate (X_0~1)
- SPS (Aug)
  - e/h mixed beam with 100, 110, 120, 150, (250 h only)
  - FOCAL prototype installed (20 layers) (Saori)
    - Shower development
    - Energy resolution by e+ beam
- ALICE (Sep-Oct)
  - First measurement with p+p 14 TeV (Norbert)
  - Multiple particles and pi0

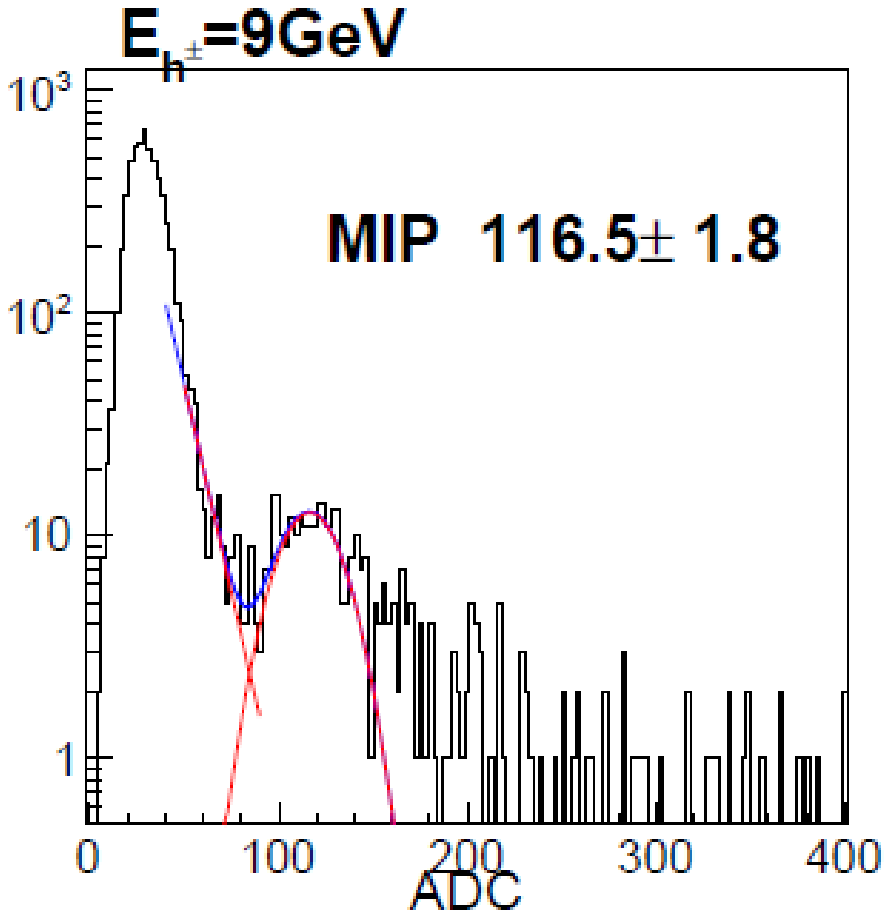






PS results (Yoko's work)

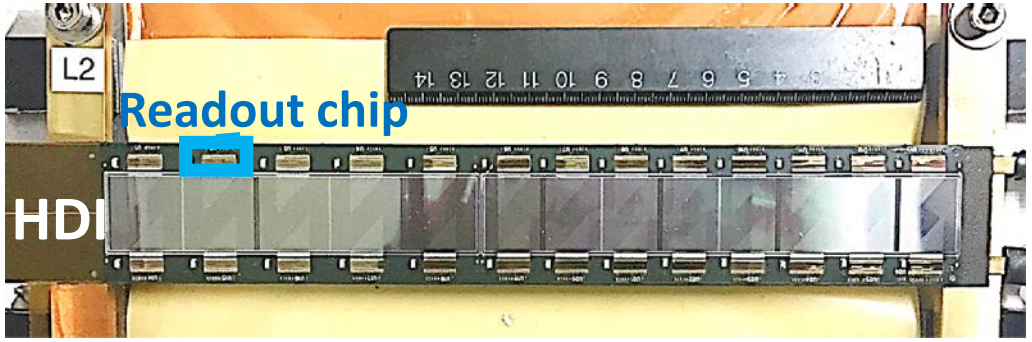


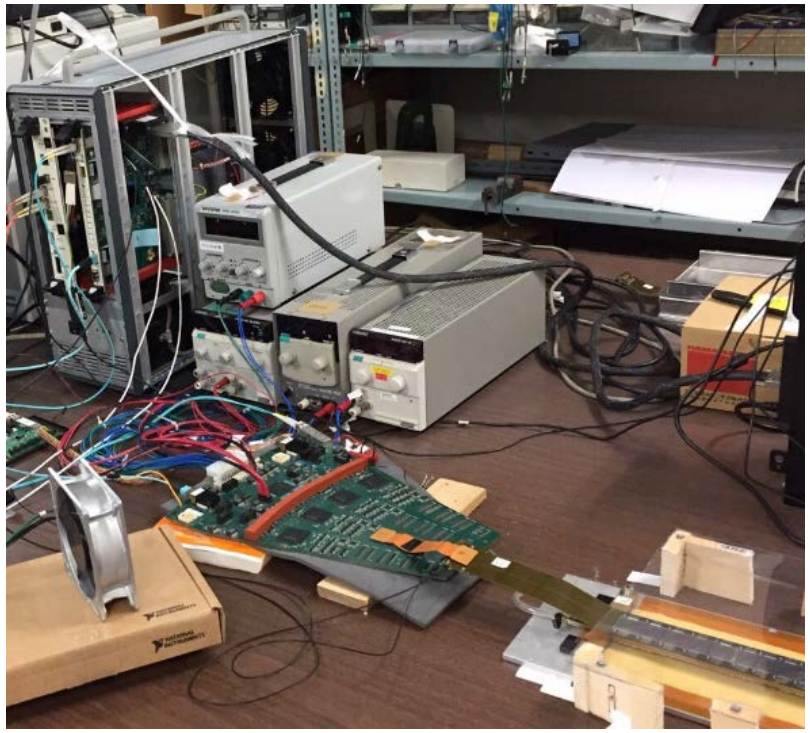


- A clear MIP peak with hadron beam at single channel after subtracting pedestal and common mode noise
- Yoko explains her analysis in more detail

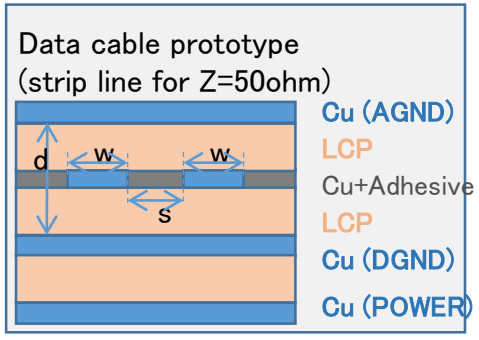
sPHENIX activity

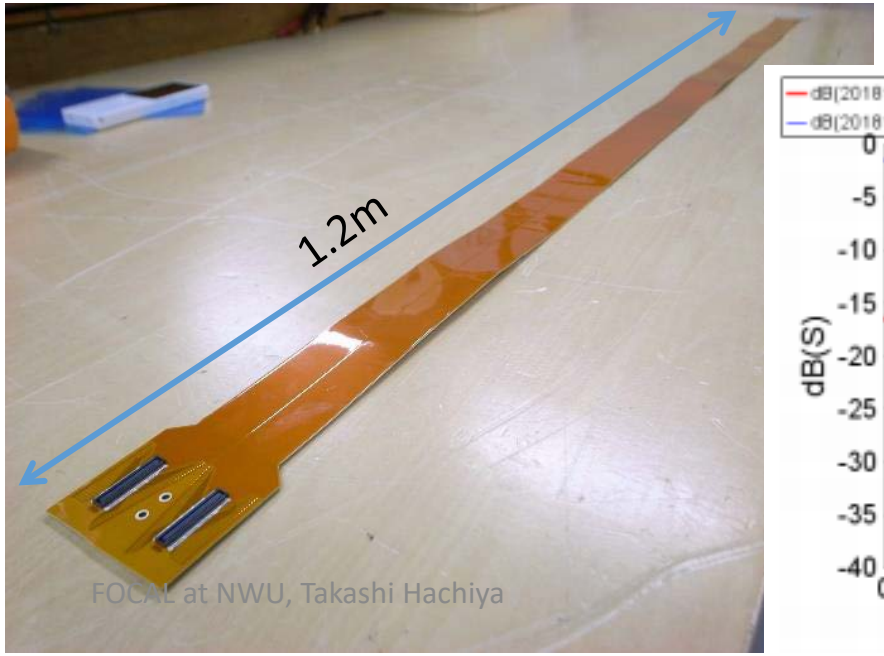
- Sensor testing at NWU
  - Si sensor for sPHENIX tracker
  - Noise, MIP with cosmic ray, β source

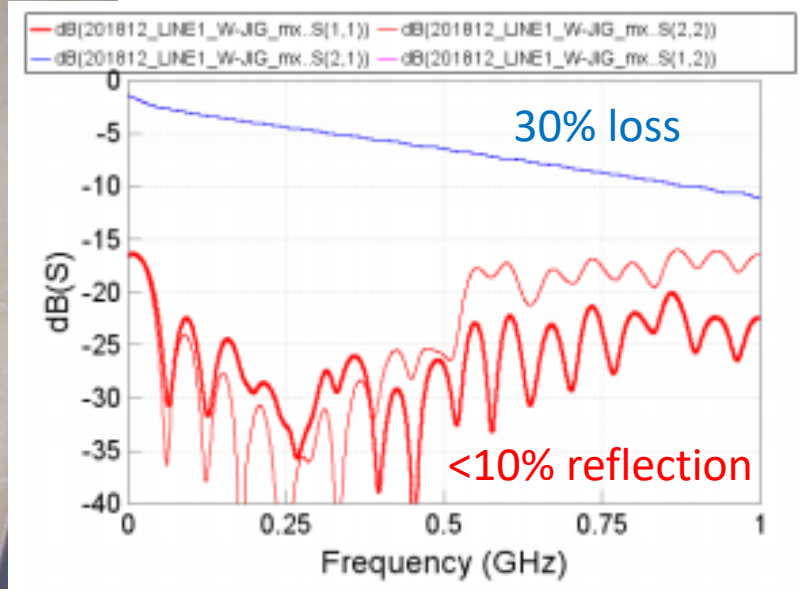




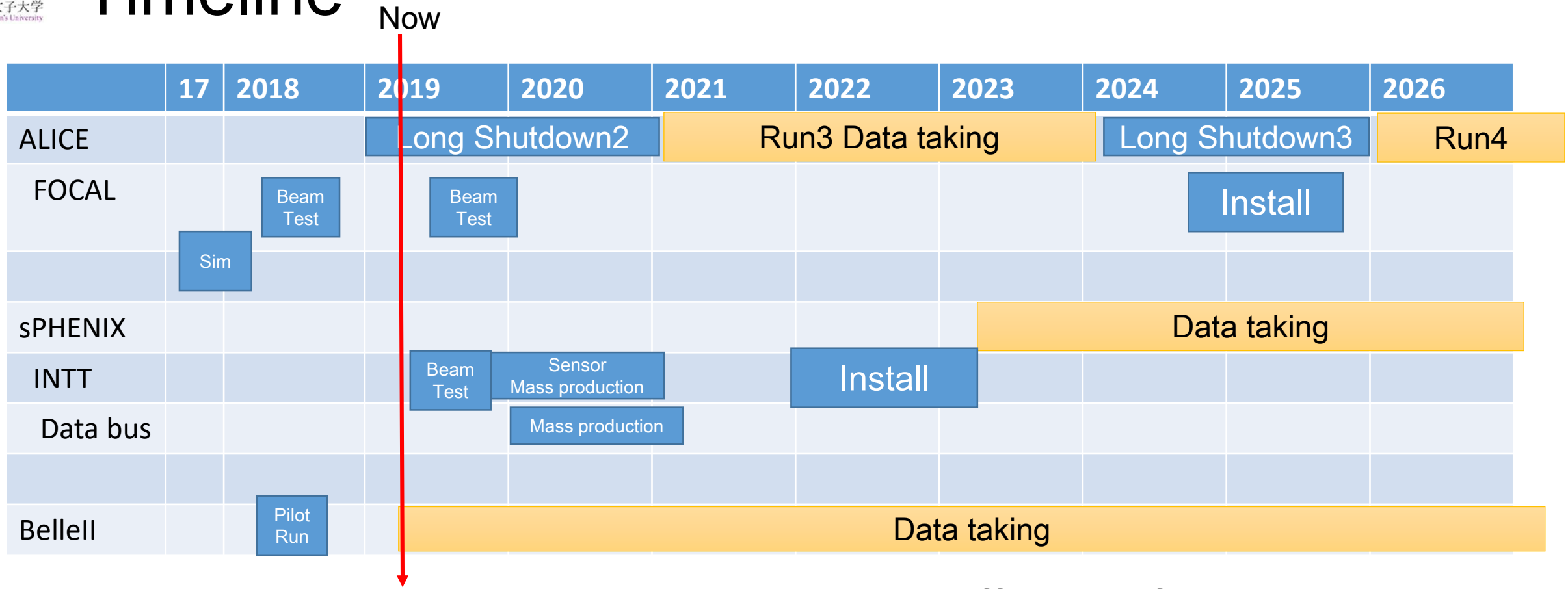
- Long data cable
  - 120cm FPC (LCP film)
  - 200Mbps
  - 62 LVDS pairs with 200Mbps







Timeline



- It would be good to organize analysis efforts/software/macros
- What we do / prepare for run3 ?

- We are happy to work on both analysis and hardware R&D

Summary

- NWU group works FOCAL
  - Belle/BelleII and PHENIX/sPHENIX as well
- Analysis method of pi0 – pi0 correlation developed
  - Comb. BG subtraction works with 98 $\pm$ 4%
- FOCAL Beam test at PS and SPS
  - Clear MIP peak with pedestal and noise subtraction
  - Analysis efforts/software/macros needs to be organized
- Si test bench for sPHENIX-INTT at NWU
  - Testing Si sensors
  - Very long data cable is in progress