ALICE-THAILAND MEETING

SUT:ACTIVITIES AND PLANS

Asst. Prof. Dr. Chinorat Kobdaj
and SUT Team

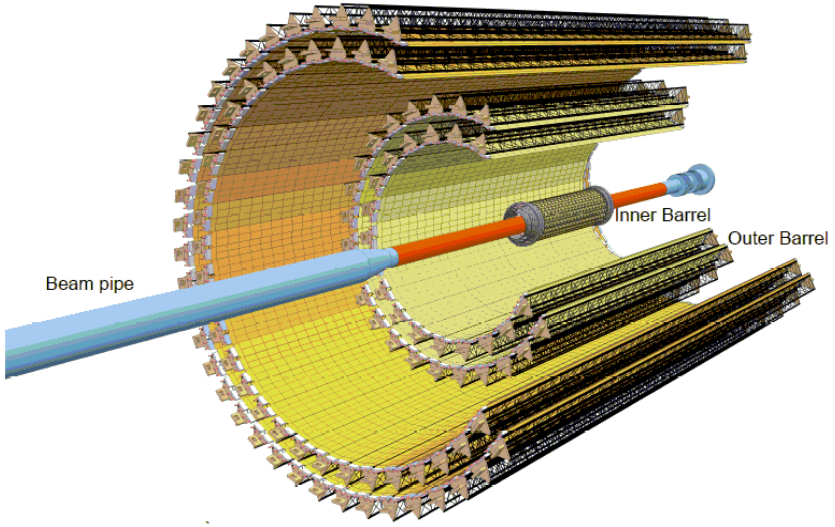
Nuclear and Particle Physis Group
School of Physics, Institute of Science
Suranaree University of Technology

April 1, 2021

Collaboration background

H.R.H. PRINCESS MAHA CHAKRI SIRINDHORN presided over for MOU signing of SUT and ALICE , CERN at Sra Pathum

Research project with ALICE ITS2



The collaboration activities of SUT and ALICE, CERN

1. Material budget
2. Data analysis
3. Sensor characterization

Duration: 2013 – 2019
Budget: Total 5.0 MTHB (NSTDA 50 %, Home-institute 50 %)
Manpower: Ph.D. 2 members
M.Sc. 8

Collaboration Background of Thailand

Design and simulate sensor

Beam Test Facility

Cutting of high resistivity silicon wafer

Develop Control-Configuration-Monitoring

SUT

TMEC

SLRI

KMUTT

SUT Students

1) Parinya Namwongsa / M.Sc / Geometry description of the ALICE Inner Tracking System (ITS) upgrade
2) Natthawut Laojamnongwong/ M.Sc./ Sensor characterization of pALPIDE chip
3) Wanchaloem Poonsawat/ Ph.D./ Detector response simulation of the ALICE ITS upgrade
4) Adisorn Ditjaroen / B.Sc./ The study of X-ray and gamma radiation exposure effect on silicon active pixel sensor using TCAD simulation
5) Anantachai Lakrathok/ M.Sc./ Sensor characterization of pALPIDE chip
6) Sakdinan Naewsupab/ M.Sc./ Study of high resistivity silicon wafer for ALICE pixel detector
7) Jetnipit Kaewjai/ M.Sc./ Upgrade of pixel sensor telescope for the characterization of ALPIDE sensors
8) Tawanchat Srimantathummakun / M.Sc./ Analysis of chamonium production in pp collision at $\sqrt{s}$ = 13 TeV with ALICE at the LHC
9) [illegible]
10) [illegible]
11) Nattapon Sompan/ M.Sc./ Simulation of hypertriton production in Pb-Pb collisions at ALICE using PACIAE model

SUT-ALICE Duties

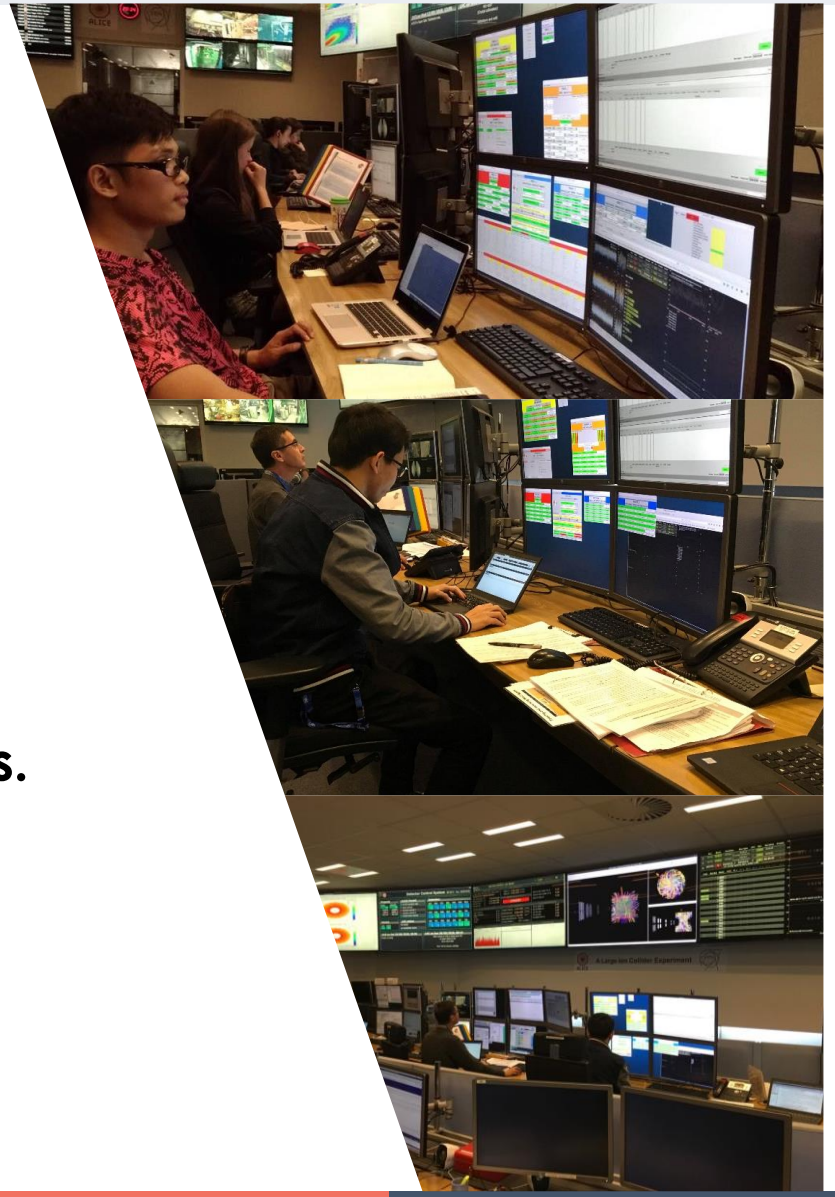
- 3 Shifters of SUT were working at ALICE

Parinya Namwongsa 

Anantachai Lakrathok 

Arnon Songmoolnak 

- We have done 10 shifts for 5 years.



- ITS2 commissioning

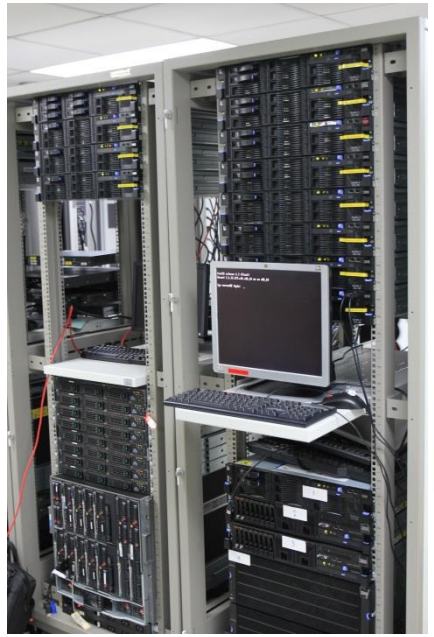
Jetnipit Kaewjai 

ALICE GRID site in Thailand

- Collaborate with National Electronics and Computer Technology Center (NECTEC) to setup a Grid site for ALICE@SUT as part of the Thailand National e-Science Infrastructure Consorti

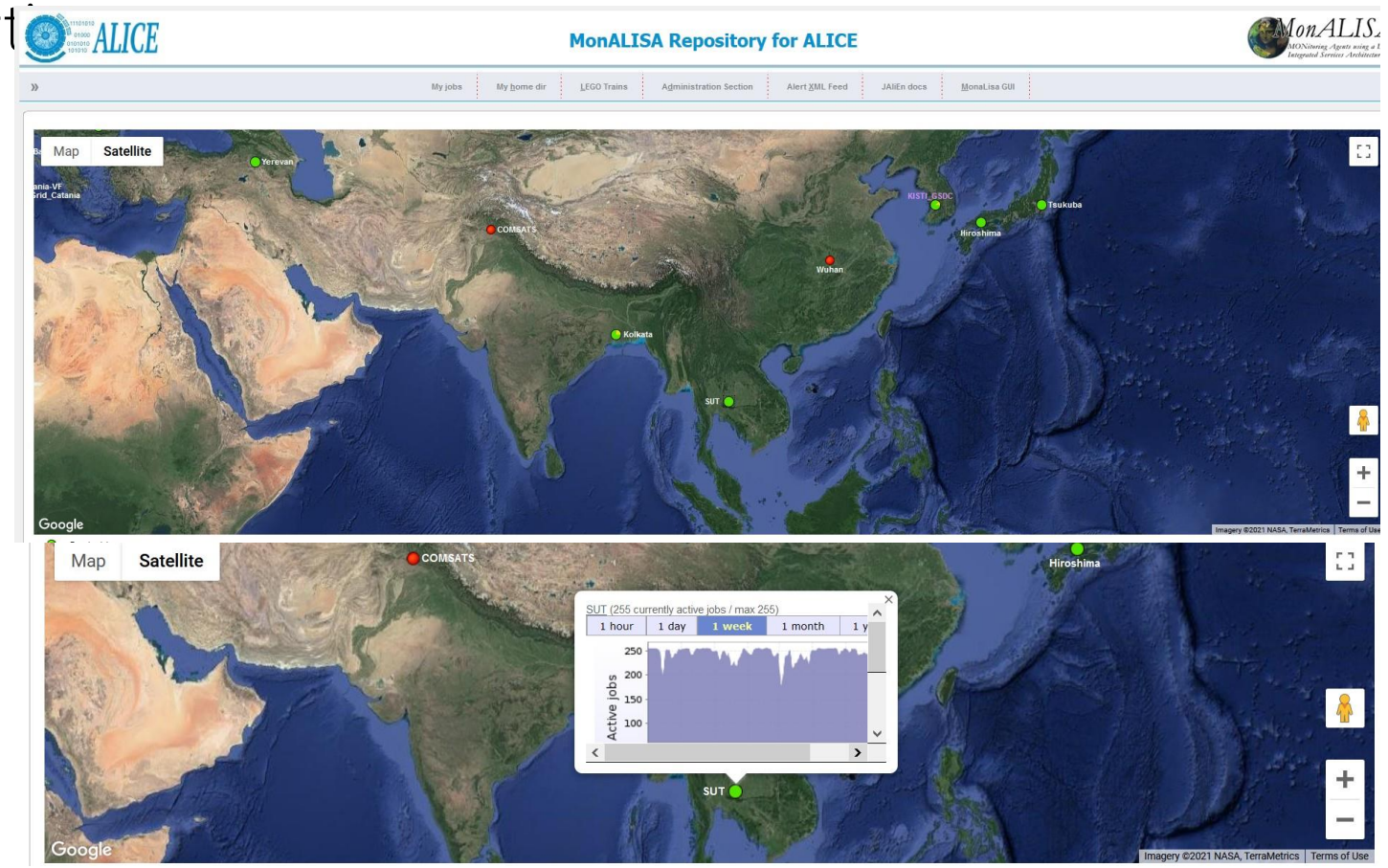
NATIONAL E-SCIENCE INFRASTRUCTURE CONSORTIUM

IBM SEAGATE



256 Cores IBM x3755 M3

100 TB IBM DCS 3700



Internet Connectivities

perfSONAR Toolkit on perfsonar-alice.sut.ac.th

perfsonar-alice.sut.ac.th at 202.28.43.143, 2001:3c8:c301:17::3

Edit

Site : Suranaree University of Technology
Address: Nakhon Ratchasima, Nakhon Ratchasima 30000 TH (map)
Administrator: Chinorat Kobdaj (kobdaj@g.sut.ac.th)

SOURCE	DESTINATION	THROUGHPUT
perfsonar-alice.sut.ac.th 2001:3c8:c301:17::3 Graphs | Traceroute	2001:3c8:1501:298::1501:4	→ 901 Mbps ← n/a
perfsonar-alice.sut.ac.th 2001:3c8:c301:17::3 Graphs | Traceroute	psb01.pic.es 2001:67c:1148:202::2	→ 36.7 Mbps ← n/a
perfsonar-alice.sut.ac.th 202.28.43.143 Graphs | Traceroute	bwctl-10g-ps.singaren.net.sg 203.30.39.12	→ 467 Mbps ← n/a
perfsonar-alice.sut.ac.th 202.28.43.143 Graphs | Traceroute	nms1-10g.jp.apan.net 203.181.249.186	→ 630 Mbps ← n/a
perfsonar-alice.sut.ac.th 202.28.43.143 Graphs | Traceroute	ps-gsdc02.sdfarm.kr 134.75.125.242	→ 713 Mbps ← n/a
perfsonar-alice.sut.ac.th 202.28.43.143 Graphs | Traceroute	ps02.iihe.ac.be 193.58.172.57	→ 523 Mbps ← n/a

ALICE

MonALISA Repository for ALICE

MonALISA

» My jobs | My home dir | LEGO Trains | Administration Section | Alert XML Feed | JAliEn docs | MonaLisa GUI

SUT »

Alternative views: Chart | Map

‹SUT›

Links: FDT, Kernel parameters tuning

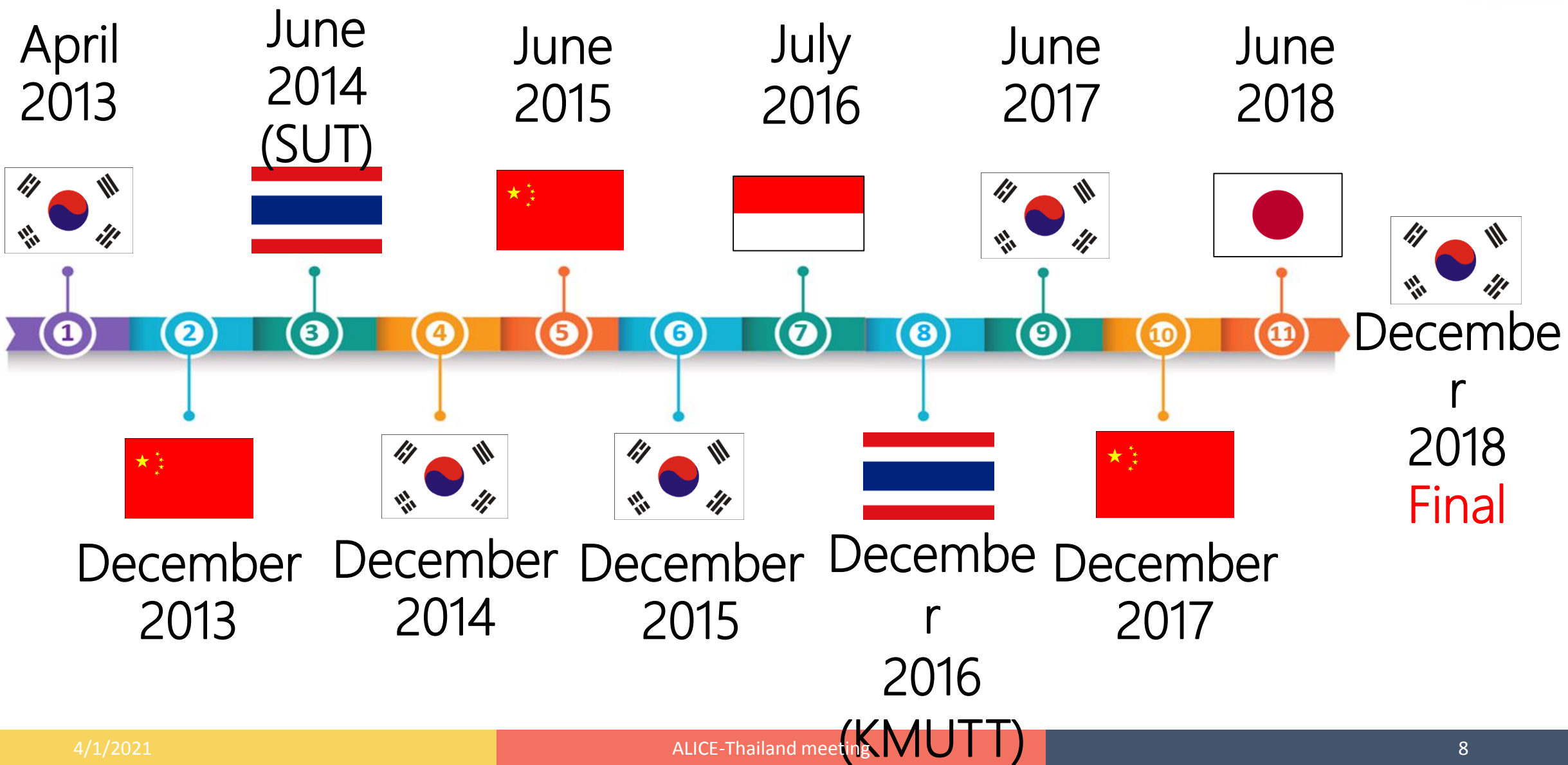
IN from

No.	ID	Site	When	Speed (Mbps)	Hops	RTT (ms)	Streams
1.	2315863	NECTEC	23 Oct 2015 23:17	864.07	8	5.48	1
2.	1976476	KISTI-CREAM	19 Oct 2014 21:49	327.17	12	158.67	1
3.	4052792	KISTI_GSDC	28 Mar 2021 15:50	276.84	13	89.73	1
4.	2272091	LLNL	07 Sep 2015 06:44	226.50	15	247.40	1
5.	3939345	Grenoble	18 Nov 2020 09:34	201.34	16	247.81	1
6.	3952045	IPNL	02 Dec 2020 16:05	201.34	16	244.87	1
7.	4053640	Tsukuba	29 Mar 2021 14:49	201.34	16	123.92	1
8.	4054766	Hiroshima	30 Mar 2021 21:52	192.95	13	127.28	1
9.	3754845	Wuhan	30 Apr 2020 02:21	184.56	27	125.17	1
10.	3906792	BITP	13 Oct 2020 00:14	176.17	13	221.71	1

OUT to

No.	ID	Site	When	Speed (Mbps)	Hops	RTT (ms)	Streams
1.	2313091	NECTEC	21 Oct 2015 00:12	738.24	8	5.41	1
2.	4052185	KISTI_GSDC	27 Mar 2021 22:02	302.01	13	102.62	1
3.	4002039	WUT	29 Jan 2021 01:10	234.89	16	213.96	1
4.	3946214	IPNL	26 Nov 2020 01:37	218.12	17	242.65	1
5.	3946092	Legnaro	25 Nov 2020 22:19	209.73	18	254.18	1
6.	4050966	Tsukuba	26 Mar 2021 12:29	209.73	17	121.93	1
7.	3935013	Grenoble	13 Nov 2020 13:19	201.34			1
8.	2956187	Cagliari	13 Oct 2017 07:49	184.56	16	341.80	1
9.	3690639	Prague_ARC	20 Feb 2020 04:01	184.56	15	293.21	1
10.	4053369	Hiroshima	29 Mar 2021 07:13	167.78			1

Asian ALICE ITS upgrade, MFT and O^2 meetings



ITS3 Contributions

- SUT has already obtained financial support for 5 years (2020-2024)
- We are interested in

1. ALICE Physics - Analysis of Charmonium Production in pp Collision at $\sqrt{s} = 13$ TeV in ALICE at the LHC
2. Upgrades and Detector R&D

    2.1. Monolithic Pixel design

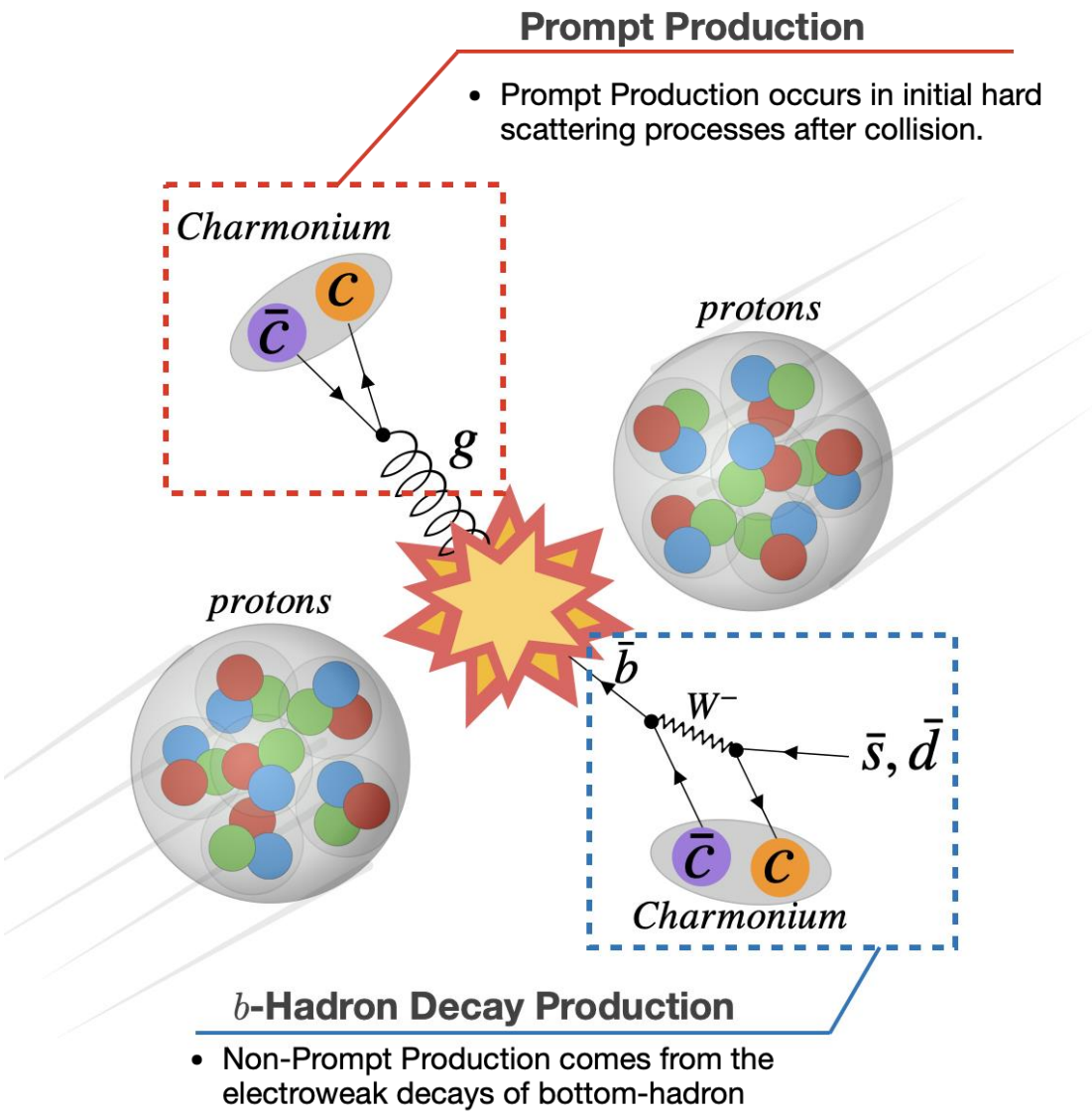
    2.2. Bent ALPIDE characterization with e beam with SLRI – BTF

        A) Beam test analysis with Corryvreckan

        B) Rotational stage design (Solidwork) and ALPIDE holder

1. ALICE Physics

Analysis of Charmonium Production in pp Collision at $\sqrt{s} = 13$ TeV in ALICE at the LHC



Mr. Tawanchat Simantathammakul

Ph.D student in nuclear and particle physics from SUT.

Dr. Benjamin Dönigus

Researcher from Goethe-University, Frankfurt, Germany.

Asst. Prof. Dr. Christoph Herold

Lecturer in nuclear and particle physics from SUT.

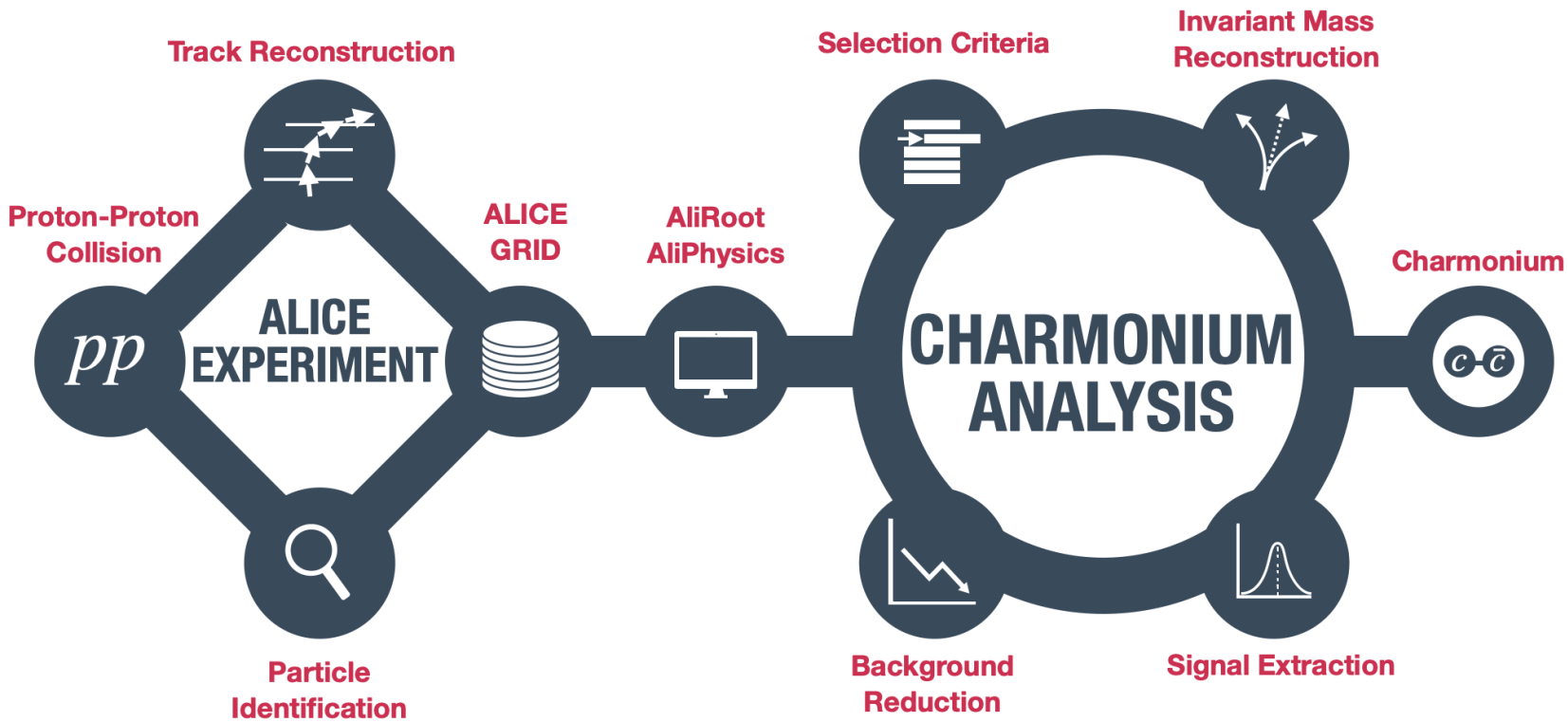
Asst. Prof. Dr. Chinorat Kobdaj

Lecturer in nuclear and particle physics from SUT.

Research Objectives

- Produce data analysis algorithm for investigating inaccessible particles with detector, such as charmed lambda baryon (Λ_c), hypertriton, and charmonium.
- Extract the inclusive production yield of charmed eta mesons (η_c) and J/ψ using the data from pp collision at $\sqrt{s}$ = 13 TeV providing by ALICE experiment at LHC.

Invariant Mass Reconstruction of Charmonium Candidates using $p\bar{p}$-Channel

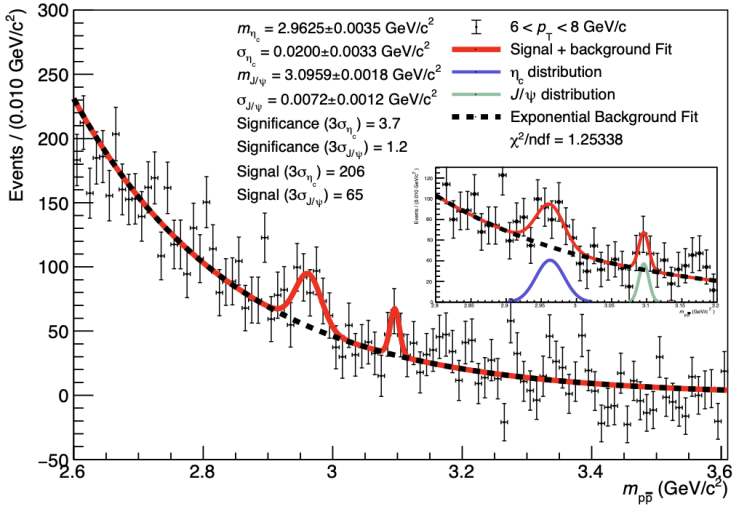


Analysis Procedure

- Data of pp collision at $\sqrt{s} = 13$ TeV from Run 2 (2016 - 2018) are retrieved from ALICE GRID using AliRoot.
- Tracks of proton and antiproton for charmonium candidate reconstruction are selected via using PID in TPC and TOF with cut-base selection criteria.
- The signal of charmonium are extracted from fitting invariant mass spectrum with two different background reduction method.
  - Event-mixing method
  - Track-rotational method

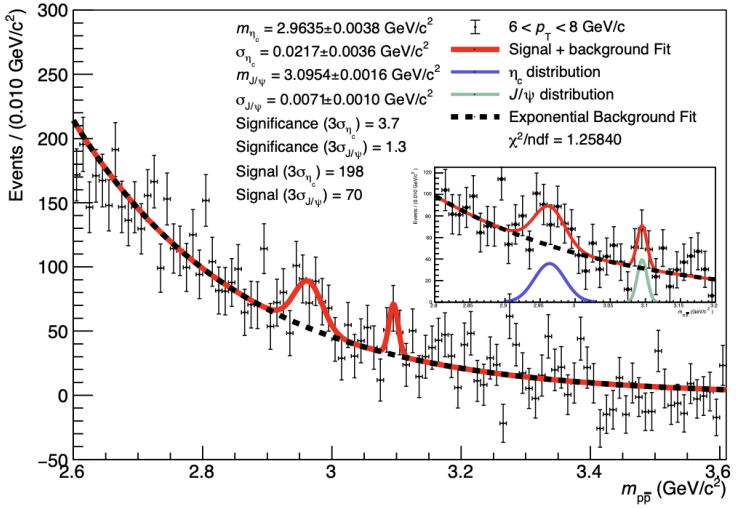
Invariant Mass Spectrum of $\eta_c, J/\psi \rightarrow p\bar{p}$ with Two Methods of Background Subtraction

Event-mixing method



Invariant mass spectrum with integrate over p_T after background subtraction using event-mixing method.

Track-rotational method



Invariant mass spectrum with integrate over p_T after background subtraction using track-rotation method.

Signal+background distribution function

$$f(m) = \underbrace{C_0 exp(-\alpha m)}_{\text{Exponential Background}} + \underbrace{\frac{N_1}{\sigma_1\sqrt{2\pi}} exp(-\frac{(m-m_1)^2}{2\sigma_1^2})}_{\eta_c \text{ Distribution}} + \underbrace{\frac{N_2}{\sigma_2\sqrt{2\pi}} exp(-\frac{(m-m_2)^2}{2\sigma_2^2})}_{J/\psi \text{ Distribution}}$$

- The primary results show invariant mass spectra with two different background subtraction methods and the signal distribution described by double-gaussian.
- The fitting result of invariant mass spectrum are corresponding to PDG.

Activities Plan

2019

- Collecting Run 2 Data
- Develop Classical Analysis Tasks

2020

- Testing and provide primary results

2021

- Report 20 Jpsi2ee PAG
- Confirm results with MC simulation

2022 - 2024

- Develop modern analysis method with ML
- Investigate more particle species
- Ready for publication





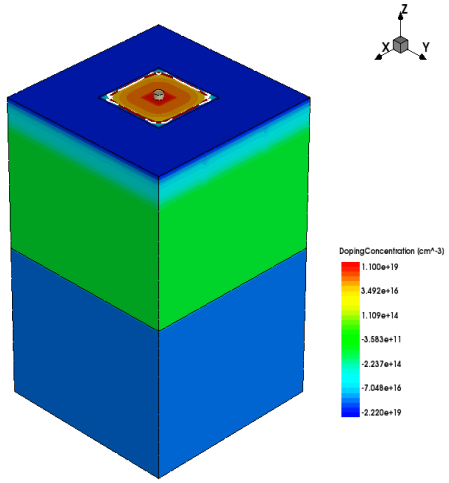
2. Upgrades and Detector R&D

2.1 Monolithic Pixel design : ALPIDE like

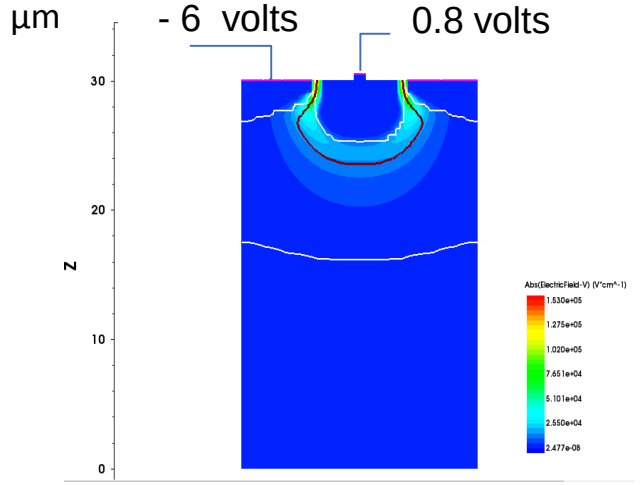
TCAD pixel design (20*20*30 µm^3)

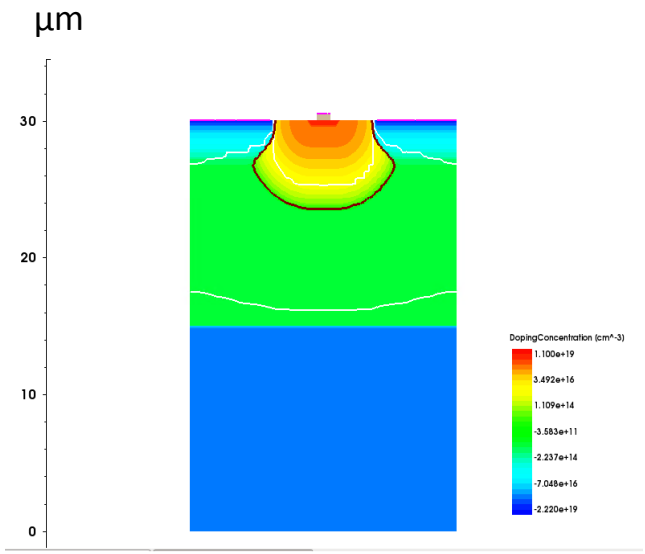
Parameters	Value
P well width	6
Spacing of P well and N well	3
N well radius	1

Type	Doping concentration (cm^{-3})	Depth (µm)	Value at depth (cm^{-3})	Lateral factor
n+/p+	1X10^{19}	0.25	1X10^{14}	0.1
n/p well	1X10^{18}	1.5	1X10^{13}	0.25
Deep p well	1X10^{17}	3.5	1X10^{12}	0.4
Substrate	1X10^{18}	15	constant	
Epitaxial layer	1.4X10^{13}	15	Constant at R= 1048.5 ohm.cm	

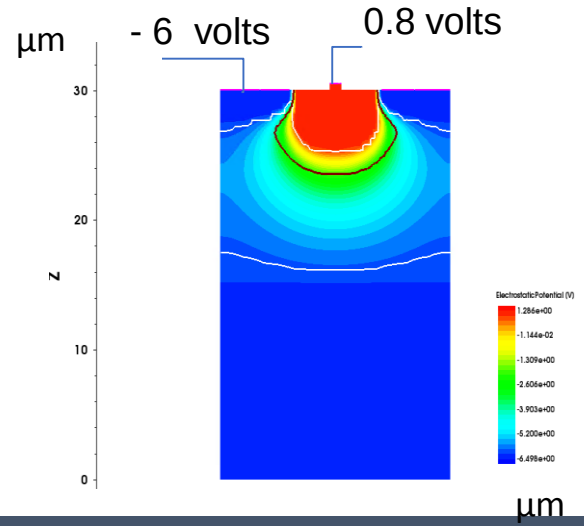


Absolute-Electricfield (V/cm)





ElectricPotential (V)

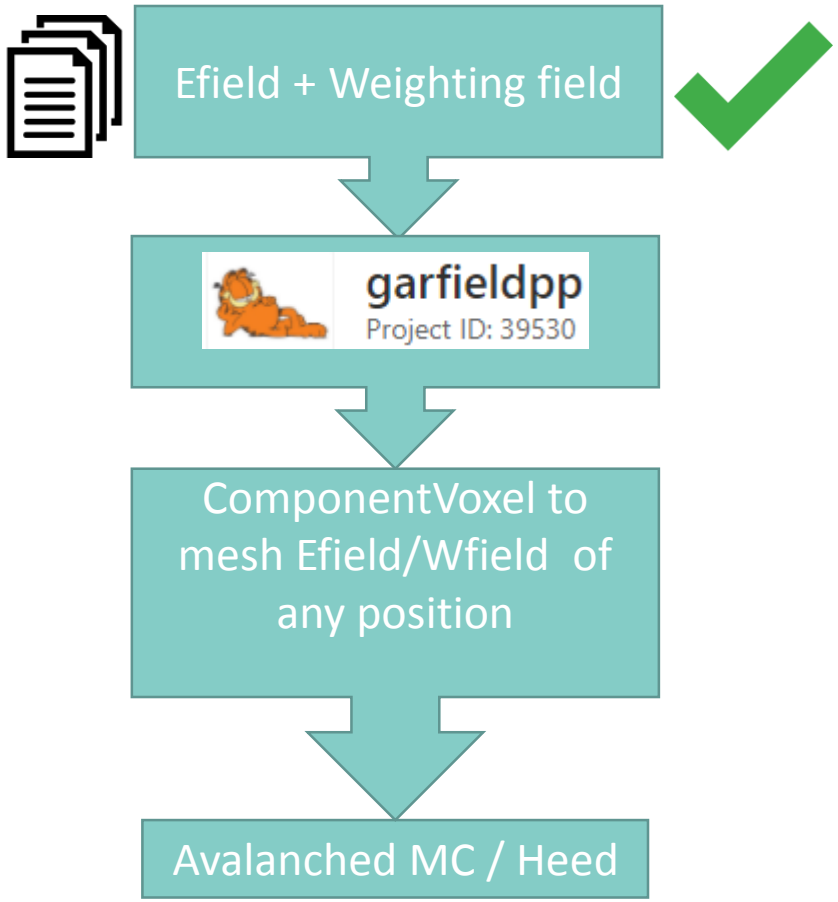


2.1 Monolithic Pixel design : ALPIDE like

CERN open-source framework (Garfield++ and Allpix2)

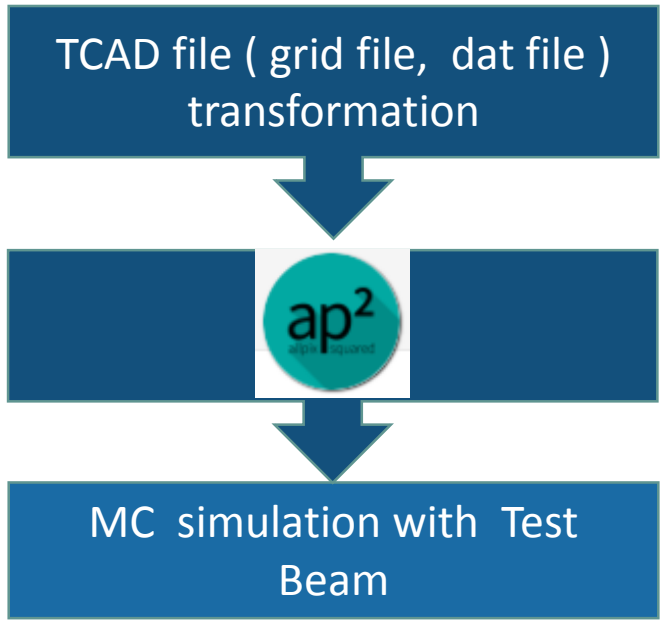
- Problem : Building macro to process on Garfield++

TCAD



Working with **Jan Hasenbichler**, WU

- Problem : learning how to import TCAD file into Allpix2



No contact for Allpix2

2.1 Monolithic Pixel design : Timeline

Sep 2020- April 2021

TCAD Design

April 2021- Jan 2022

Garfield++ and Allpix2

Jan 2022 to ….

65nm MAP simulation

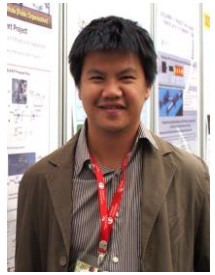
Aim to…..

Simulate this process to contribute with TCAD model of 65 nm MAP ITS3 prototype

- Design TCAD with 65 nm ITS3 prototype like
- Use 2 frameworks for simulation



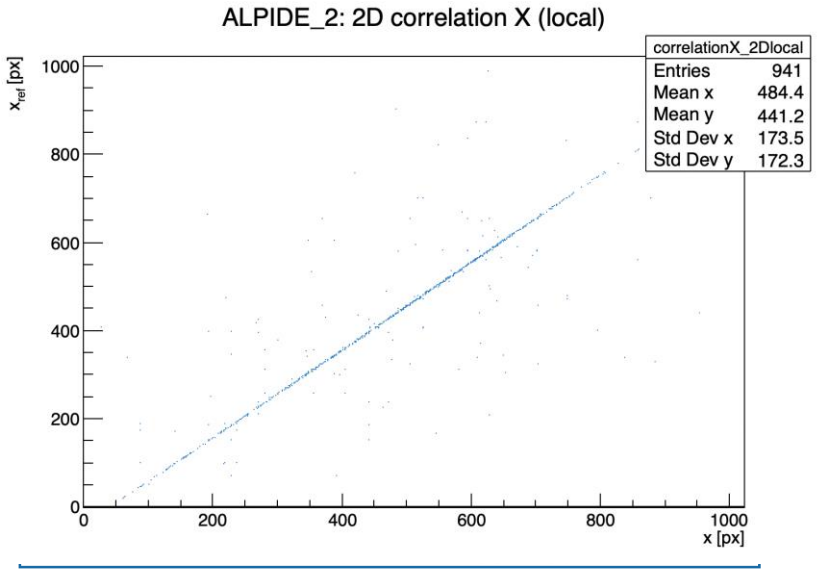


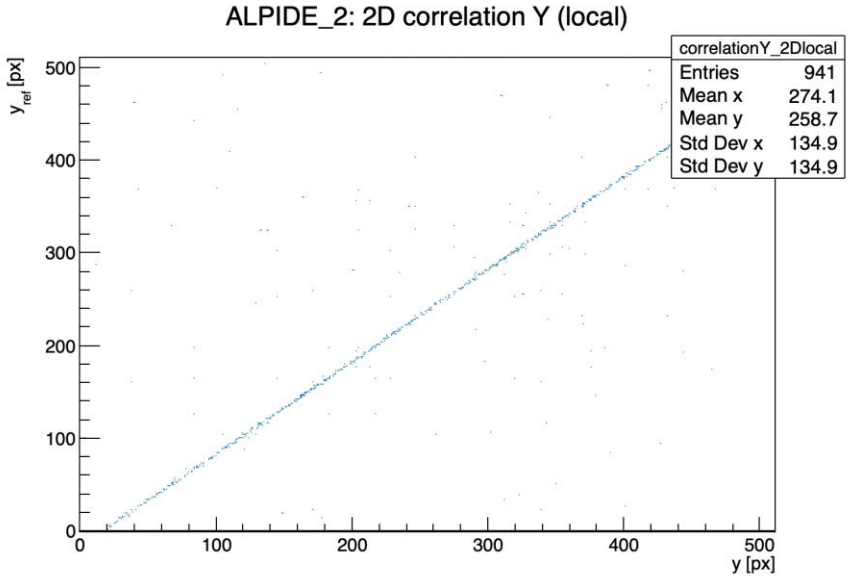



2.2 Bent ALPIDE characterization with e beam with SLRI – BTF

A). Beam test analysis with Corryvreckan (6-plane)

- using the example raw data run355234406_200828234412.raw from: https://twiki.cern.ch/twiki/bin/view/ALICE/GettingStartedWithTestbeamAnalysis
- the config file is 3REF-REFdut-2REF.conf (with no DUT)
- the geometry is : beam in --->> 3 REF + 3 REF --->> beam out
- the analysis processes are completed





A) Beam test analysis with Corryvreckan (7-plane)

- using the example raw data: run355234406_200828234412.raw
- the config file is 3REF-REFdut-2REF.conf with bent DUT
- the geometry has been set as presented in ITS3 WP3 Status by Riccardo Ricci

```
[ALPIDE_1]
type = "ALPIDE"
position = 0um,0um,-75.5mm
number_of_pixels = 1024,512
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian"
orientation_mode = xyz
mask_file = "../masks/ref-plane1.txt"
roi = [200, 100], [200, 400], [800, 400],
[800, 100] # 20% of the CHIP
```

- Thanks to Pascal for the starting configuration!

```
[ALPIDE_3]
type = "ALPIDE"
position = 0mm,0mm,0mm
number_of_pixels = 1024,512
pixel_pitch = 29.24um, 26.88um
spatial_resolution = 5.00um, 5.00um
time_resolution = 2us
material_budget = 0.0005
coordinates = "cartesian-bent"
orientation = 0deg,0deg,270deg
# y_0 = 0mm # Original value of y_0
y_0 = 12.7mm # Updated coordinate
radius = 18mm
orientation_mode = xyz
mask_file = "../masks/dut-plane3.txt"
# roi = [100, 50], [100, 450], [900, 450],
[900, 50] # strict
roi = [0, 0], [0,512],[1024, 512], [1024, 0] #
wide
role = "DUT"
```

A) Technical problem

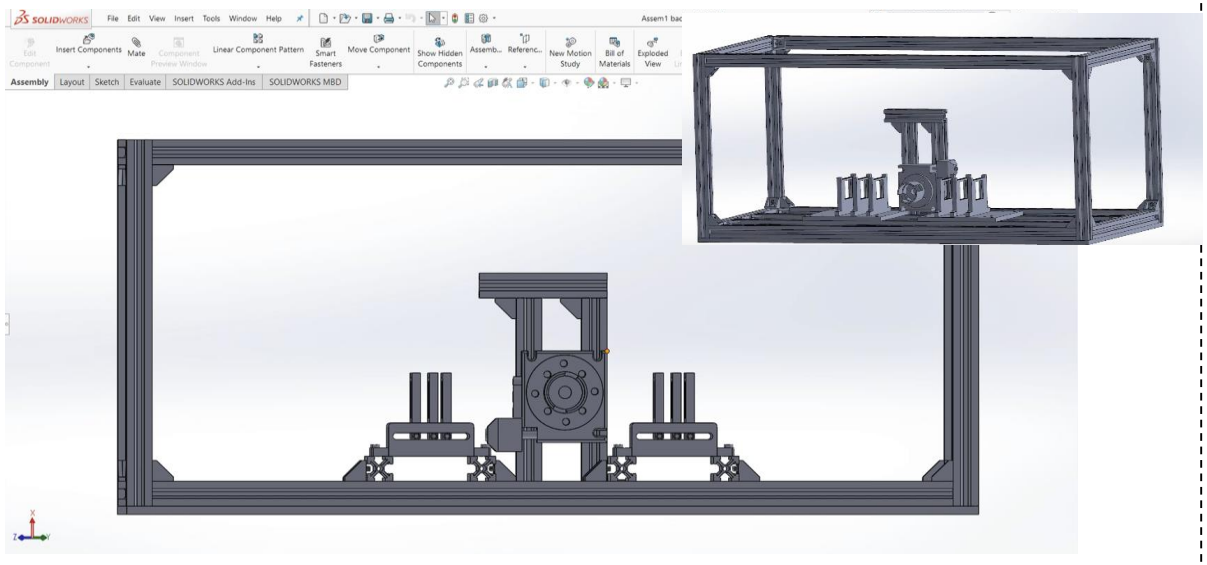
- the error -9 message occurs when analyzing the August bent ALPIDE data of DESY

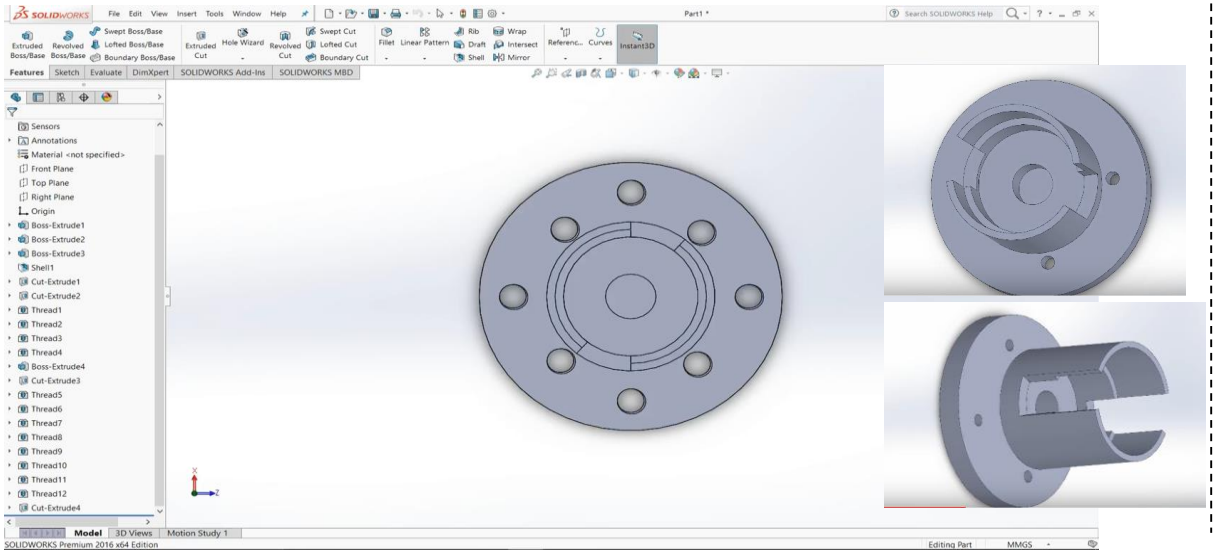
```
jobsub.analyse_run000002(INFO): |15:27:21.967|  (STATUS) [I:Tracking4D] Initializing "Tracking4D"
jobsub.analyse_run000002(INFO): |15:27:21.995|  (STATUS) [I:DUTAssociation:ALPIDE_3] Initializing "DUTAssociation:ALPIDE_3"
jobsub.analyse_run000002(INFO): |15:27:21.998|  (STATUS) [I:AnalysisDUT:ALPIDE_3] Initializing "AnalysisDUT:ALPIDE_3"
jobsub(ERROR): Corryvreckan returned with error code -9
jobsub(INFO): Logs written to ./analyse_run000002.zip
jobsub(WARNING): There were 1 error messages reported
[root@8e0dffc3e5e4 local]#
```

- the output file

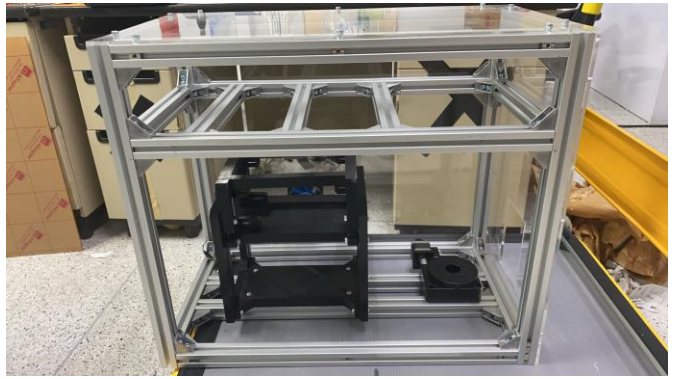
```
nlaojamn@N-Laojamnongwong output % ls
alignment_000002.root    analysis_000002.root     maskcreation_000002.root prealignment_000002.root
nlaojamn@N-Laojamnongwong output %
```

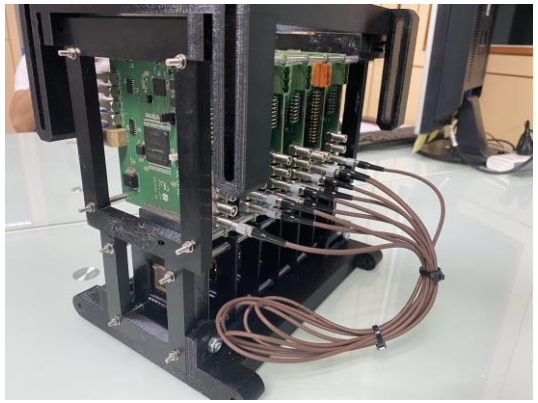
B) Rotational stage design (Solidwork) and ALPIDE holder





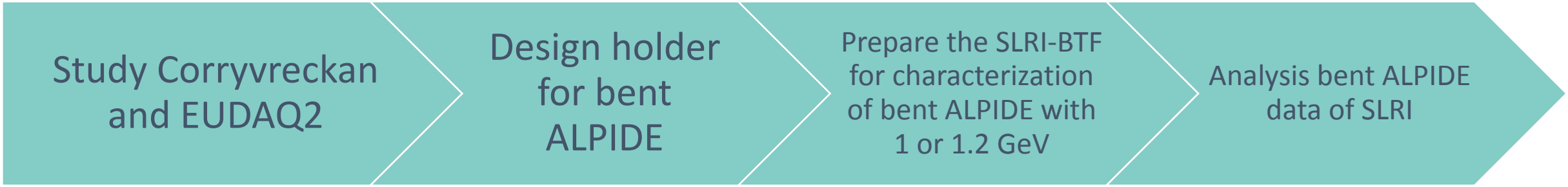
3D printer for the ALPIDE holder construction





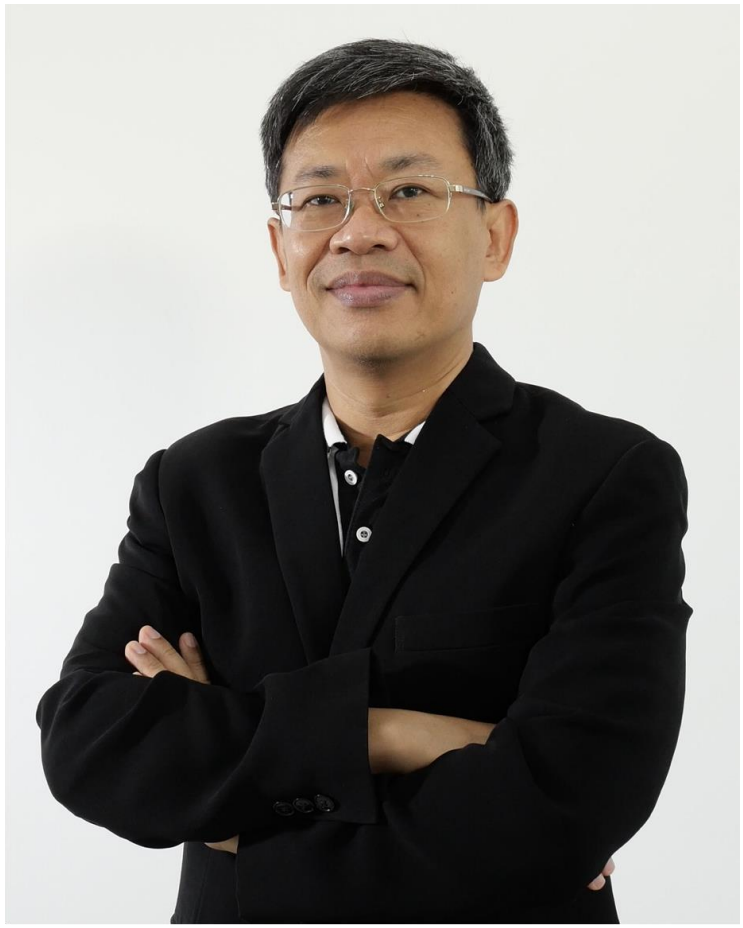
ALPIDE holder with Aluminium support

2.2. Plan and Equipment Needed



What we need?

- 6 DAQ boards of version 3
- 2 Flex2 DAQ boards
- Bent ALPIDE prototype
- Suggestion…



Thank y