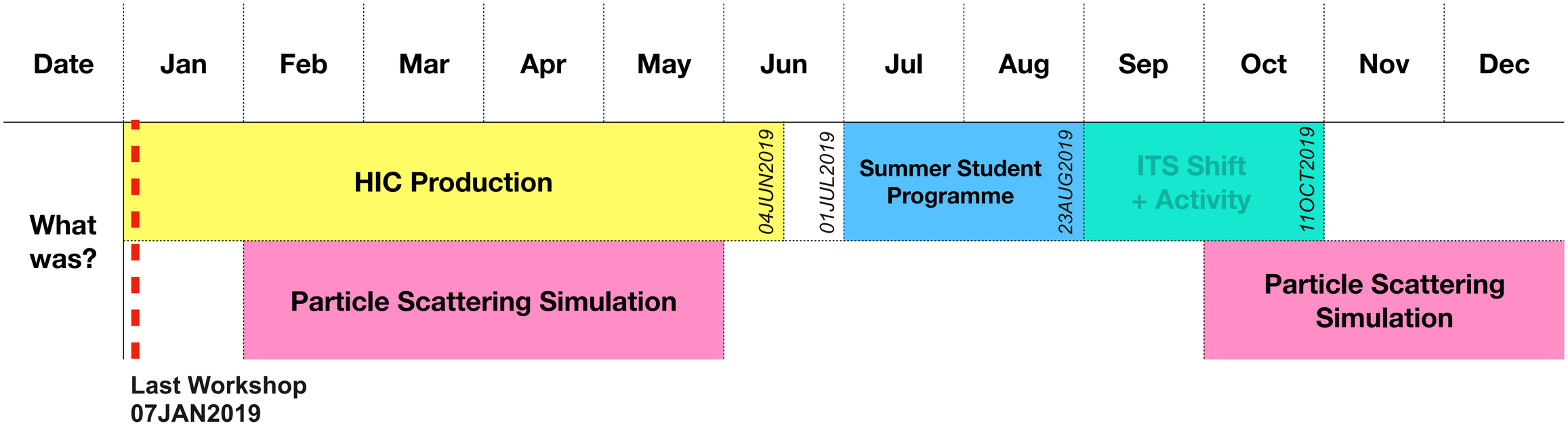
Activity Summary 2019

KoALICE National Workshop, 05JAN2020, High1 Resort (ROK)
MINJAE ISAAC KWON, Pusan National University, Republic of Korea

What was in 2019?



HIC Production

(2018) — 04 JUN 2019

- HIC Production was finished.
  – **ALL WORK FOR ITS² AT PUSAN WAS DONE**
- (Almost all) well produced HICs were delivered to stave production site
- 236 were assembled, 197 were gone to stave.
- Overall production quality: **87.67%**

Total Number Statistics

Impedance	*OK*	**186**			
	BT	**25**	**After BT, Cured_Short : NOK_Cur**		
	NOK_A	**15**	**Qualified (Qualification Tested) : NOK_Cur**		
	NOK_B	**1**	**Cannot be qualified (Cannot Power on) : NOK_NCur**		
	total	**227**			
				waiting endurance	
Qualification	*GOLD*	**1**		**0**	
	SILVER	**157**	should be Enduranced	**0**	
	BRONZE	**16**		**0**	
	NOBB	**29**		**0**	
	PARTIAL	**2**			
	NOBB_B	**1**	should not be Enduranced		
	PARTIAL_B	**1**			
	failed	**19**			
	reject	**0**	will be qualified in DB		
	total	**226**			
			Under Test		
Endurance	*OK*	**199**	**0**		
	NOK	**4**			
	total	**203**			

Ratio Table | Each Test

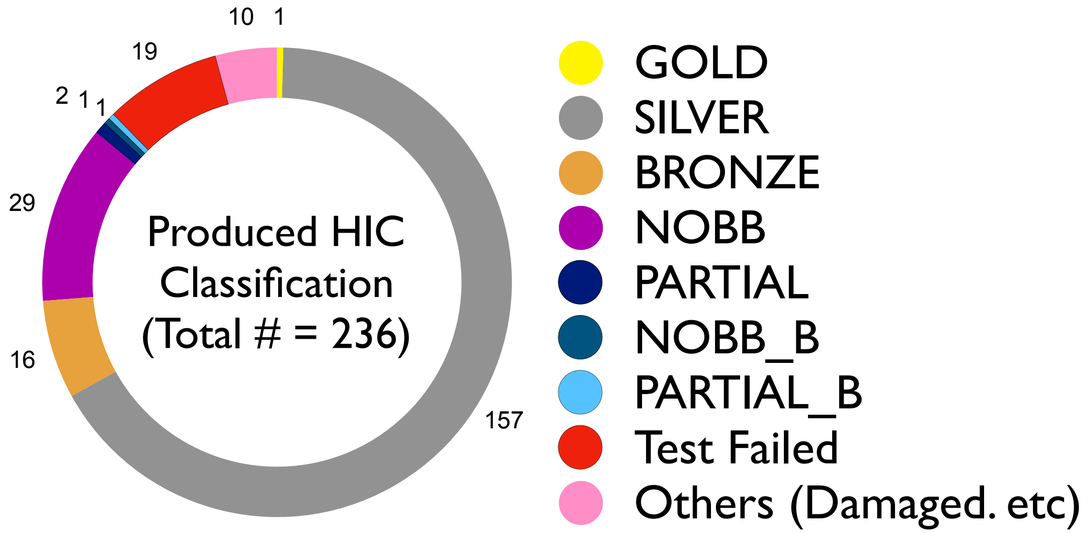
Impedance		
Total Participants	**227**	
OK	**81.94%**	
BT	**11.01%**	
NOK_A	**6.61%**	
NOK_B	**0.44%**	
Qualification		
Total Participants	**226**	
GOLD	**0.44%**	
SILVER	**69.47%**	
BRONZE	**7.08%**	Working Ratio
NOBB	**12.83%**	**89.82%**
PARTIAL	**0.88%**	
NOBB_B	**0.44%**	
PARTIAL_B	**0.44%**	
failed	**8.41%**	
reject	**0.00%**	
total	**100.00%**	
Endurance		
Total Participants	**203**	
OK	**98.03%**	
NOK	**1.97%**	

Ratio Table | Total Yield

Total Input			
227	OK Impedance	**81.94%**	
	OK Qualification	**89.43%**	
	OK Endurance	**87.67%**	except waiting endurance, Under Test

	Assembled	**Qualified** (Endurance)		**Delivered**	
Numbers	236	OK	199	Amsterdam	10
				Berkeley	91
				Daresbury	21
		NOK	37	Frascati	55
				Torino	20
				Total	**197**

2 NOBBs are not shipped

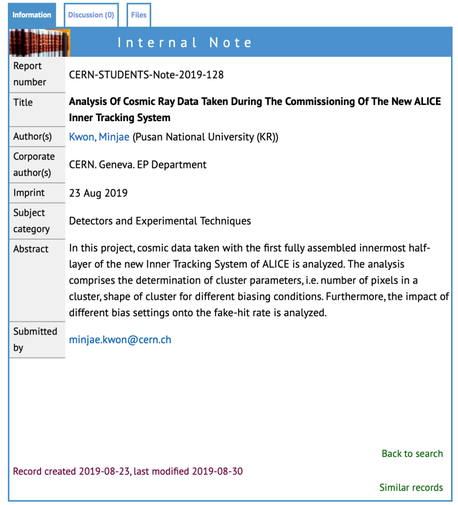


CERN Summer Student Programme 2019

01JUL2019 — 23AUG2019

Lecture + Workshops + Project + Alcohol

Summer Student Report



Information | Discussion (0) | Files

Internal Note

Report number	CERN-STUDENTS-Note-2019-128
Title	**Analysis Of Cosmic Ray Data Taken During The Commissioning Of The New ALICE Inner Tracking System**
Author(s)	Kwon, Minjae (Pusan National University (KR))
Corporate author(s)	CERN. Geneva. EP Department
Imprint	23 Aug 2019
Subject category	Detectors and Experimental Techniques
Abstract	In this project, cosmic data taken with the first fully assembled innermost half-layer of the new Inner Tracking System of ALICE is analyzed. The analysis comprises the determination of cluster parameters, i.e. number of pixels in a cluster, shape of cluster for different biasing conditions. Furthermore, the impact of different bias settings onto the fake-hit rate is analyzed.
Submitted by	minjae.kwon@cern.ch

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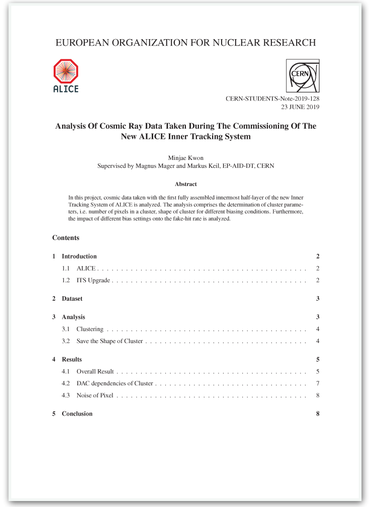


EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

ALICE

CERN-STUDENTS-Note-2019-128
23 JUNE 2019

Analysis Of Cosmic Ray Data Taken During The Commissioning Of The New ALICE Inner Tracking System

Minjae Kwon
Supervised by Magnus Mager and Markus Keil, EP-AID-DT, CERN

Abstract

In this project, cosmic data taken with the first fully assembled innermost half-layer of the new Inner Tracking System of ALICE is analyzed. The analysis comprises the determination of cluster parameters, i.e. number of pixels in a cluster, shape of cluster for different biasing conditions. Furthermore, the impact of different bias settings onto the fake-hit rate is analyzed.

Contents

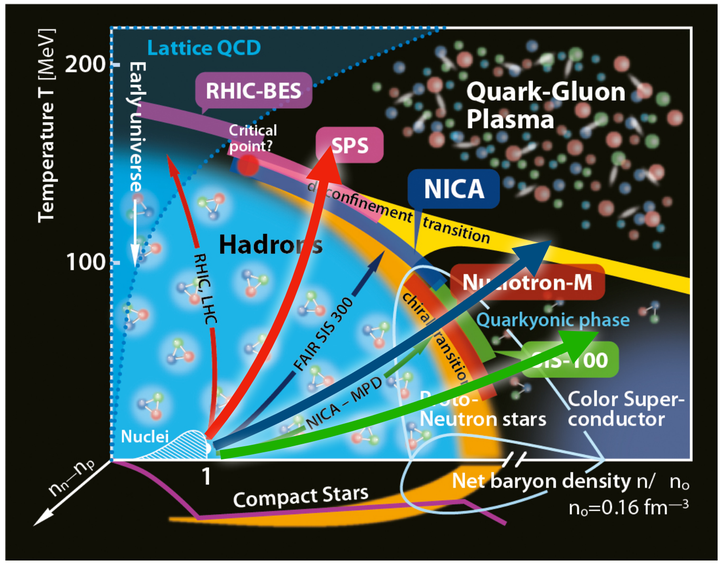
https://cds.cern.ch/record/2687398

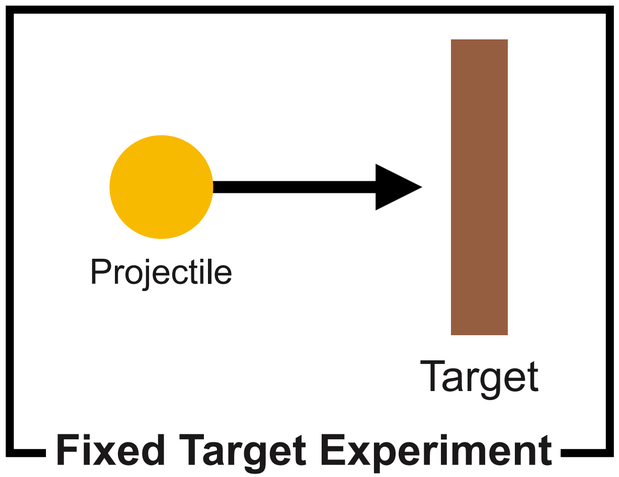
You can find all of Summer Student Reports in CDS (https://cds.cern.ch/) with keyword :
CERN-STUDENTS-Note-2019

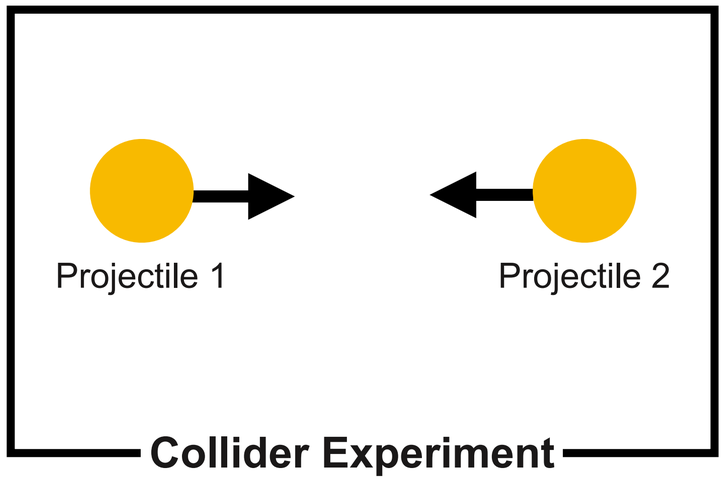
3 Body Collision, Particle Scattering Simulation : Motivation

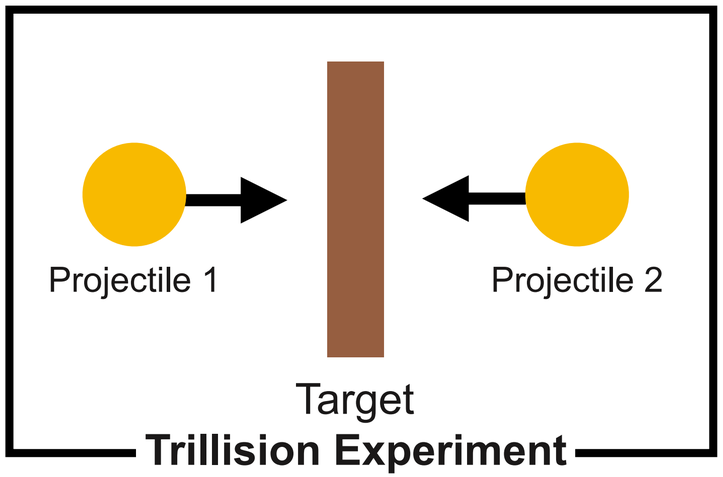
- *MORE DENSITY*: **Trillision Experiment** (3-body colliding)
- There's no simulator
  - 3 body problem…
  - GEANT4?
    - Not for particle-particle interaction…
- **Cannot do analytic calculation (3-body problem)**
  - **Should make simulator (Numerical)**

QCD Phase Diagram







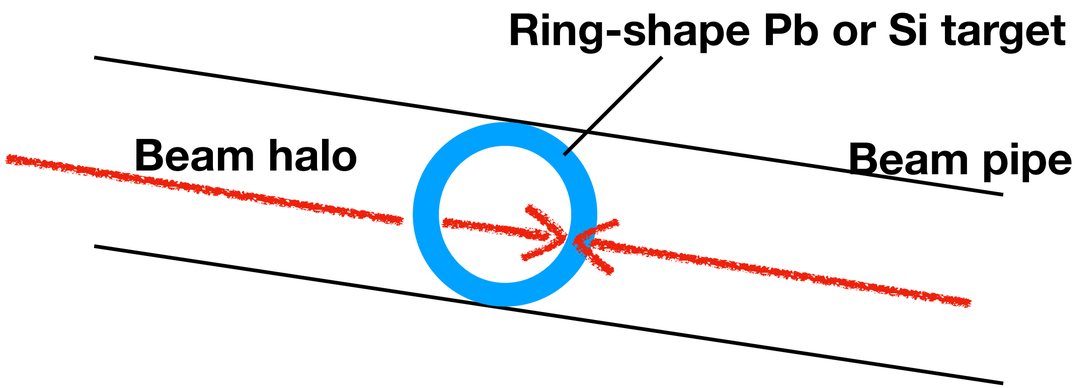


ALITE in RUN4

KoALICE2030

KoALICE

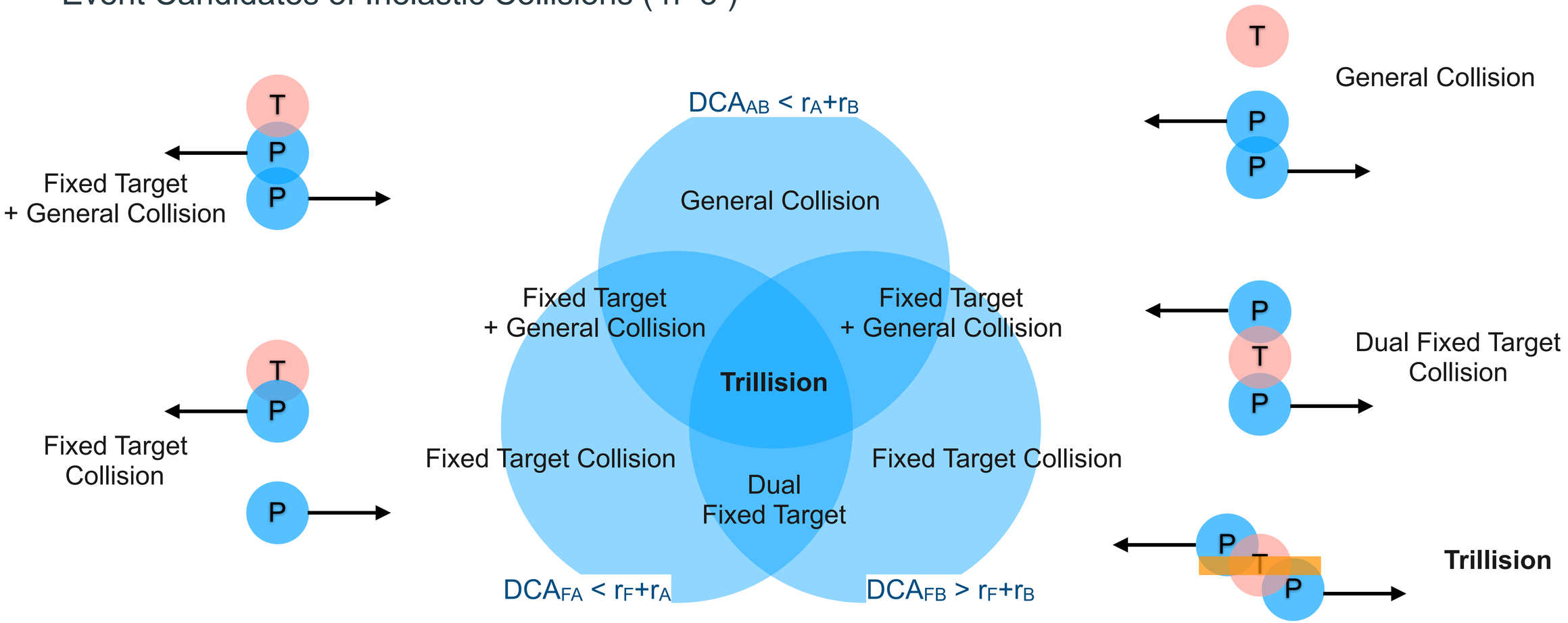
$\sqrt{s_{NN}}$ = 60 .. 75 GeV



- ALI Target Experiment
  - A short period of Target (Test) Experiment (in RUN5-6 with ALICEs)
  - Higher Interaction rate at (little) lower $\sqrt{s_{NN}}$
  - Closer IP
  - Trillision (3 nuclei collision) event?
- Silicon R&D + Production for ALICEs in RUN5-6
  - ITS3 + 7 tracking barrel layers +
  - (Active Target Experiment at SPS)
- Exploring QCD diagram with Charm

3 Body Collision : In-Elastic Collisions

Event Candidates of Inelastic Collisions (n=3)



T : Target

P : Projectile

Particle Scattering Simulation : Simulator

- Simulation Framework : **RooParticle**
  - https://github.com/isaac-kwon/RooParticle
  - On Compiled C++ Code with ROOT Framework (not in ROOT CInterpreter)
  - Why Not Python?
    - Simulation Rate (Test Event)
      - C: 1.8s / 100 event
      - Python: 134.9s / 100 event **(~75x)**

C

```
~/Documents/RooParticle/build(master*) » make -j9 && time ./main

Scanning dependencies of target main
[ 16%] Building CXX object CMakeFiles/main.dir/main.cpp.o
[ 33%] Linking CXX executable main
[100%] Built target main
EVENT 0
./main  1.80s user 0.11s system 86% cpu 2.203 total

~/Documents/RooParticle/build(master*) » cd ../test/testplot

~/Documents/RooParticle/test/testplot(master*) » time python3 collision_new.py
RANDOM IMPACTING in 40fm

python3 collision_new.py  134.94s user 9.36s system 88% cpu 2:43.45 total
```

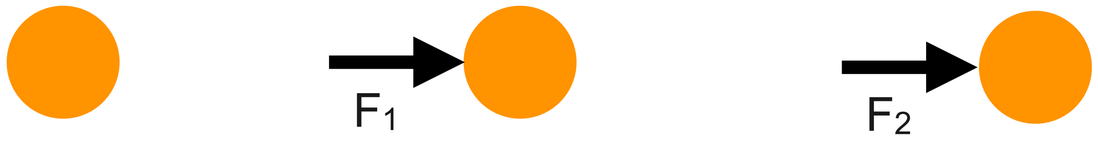
Python

Simulation Method Method

Original, t = 0
for mass=m

t = 1

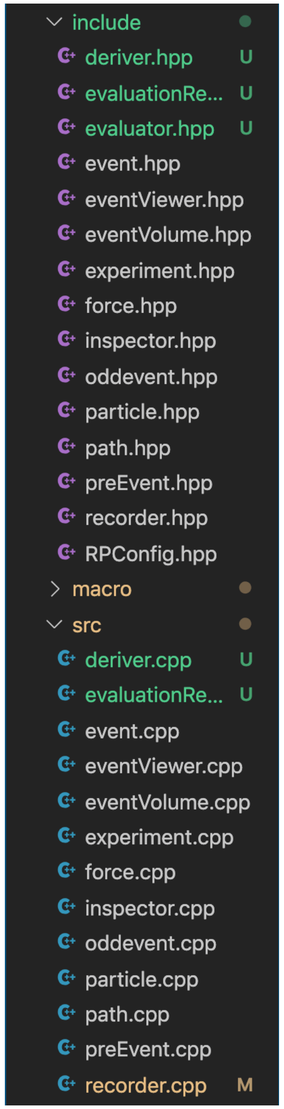
t = 2



x_0
v_0

$x_1 = x_0$
$v_1 = v_0$

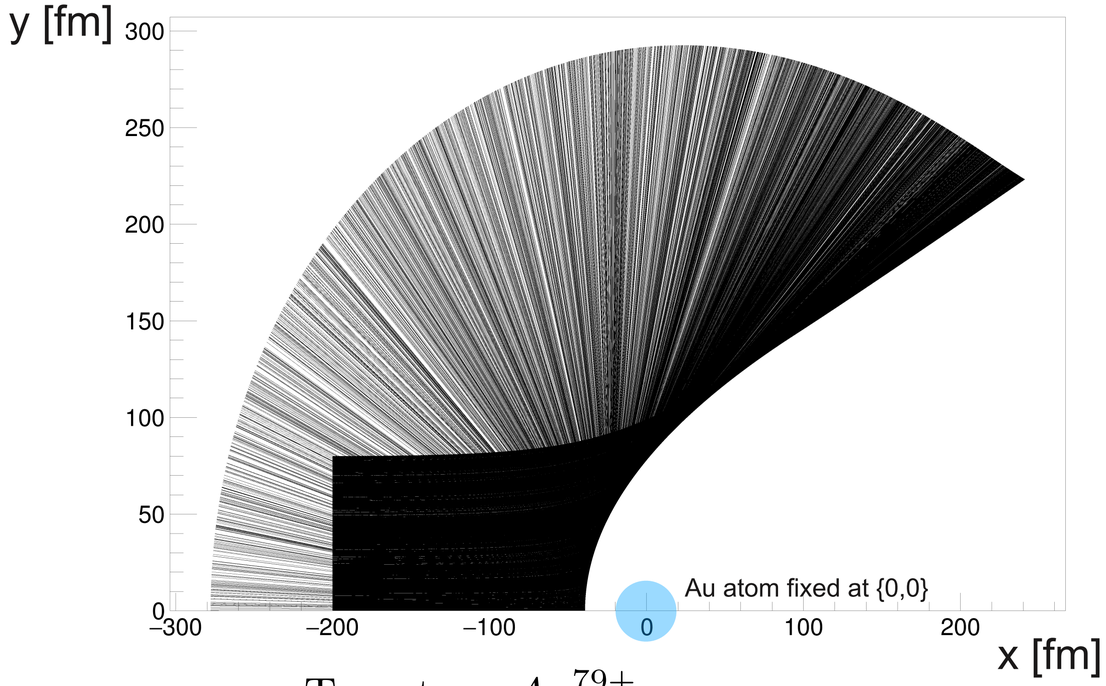
$x_2 = x_0 + v_0\,dt + F_1/m\,(dt^2/2)$
$v = v_0 + F_1/m\,dt$



Framework Code

Particle Scattering Simulation : Sample

SAMPLE of Monte-Carlo with Electric Force (Fixed Target Experiment)



$$\text{Target} : {}_{79}Au^{79+}$$

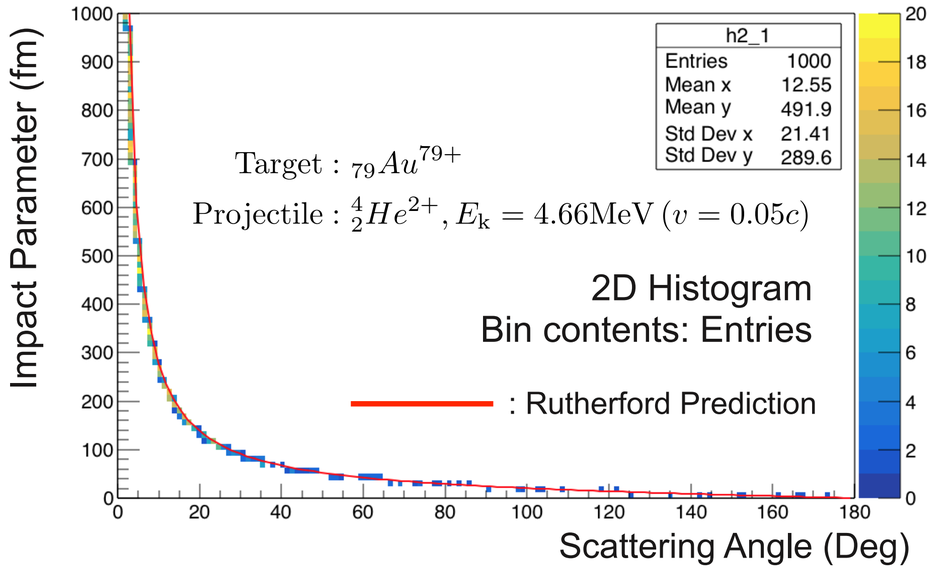
$$\text{Projectile} : {}^{4}_{2}He^{2+}, E_{\text{k}} = 4.66\text{MeV}\ (v = 0.05c)$$

$$\text{Impact Parameter b} : [0, 80]\ \text{fm}$$

$$\text{Simulation Time Range} : [0, 10000]\ \text{fm}/c$$

$$\text{Number of Projectiles} : 4\ 000$$

Framework Performance



$$\text{Impact Parameter b} : [0, 1000]\ \text{fm}$$

$$\text{Simulation Time Range} : [0, 100000]\ \text{fm}/c$$

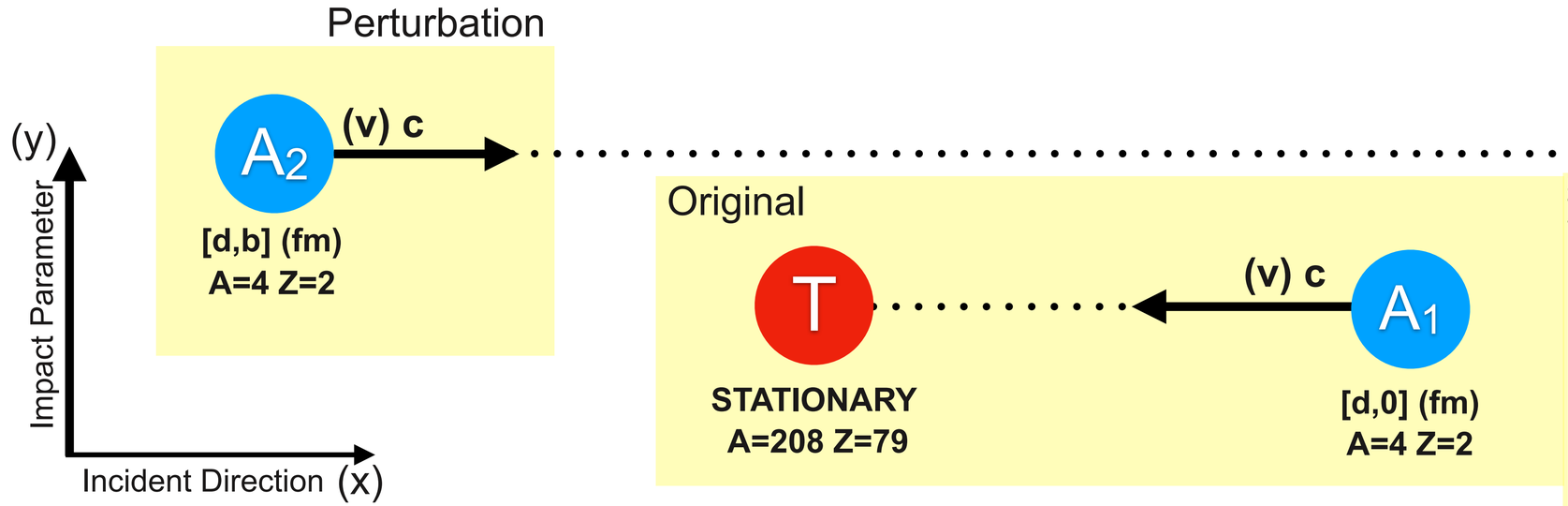
$$\text{Simulation StartingX} : -1000\text{fm}$$

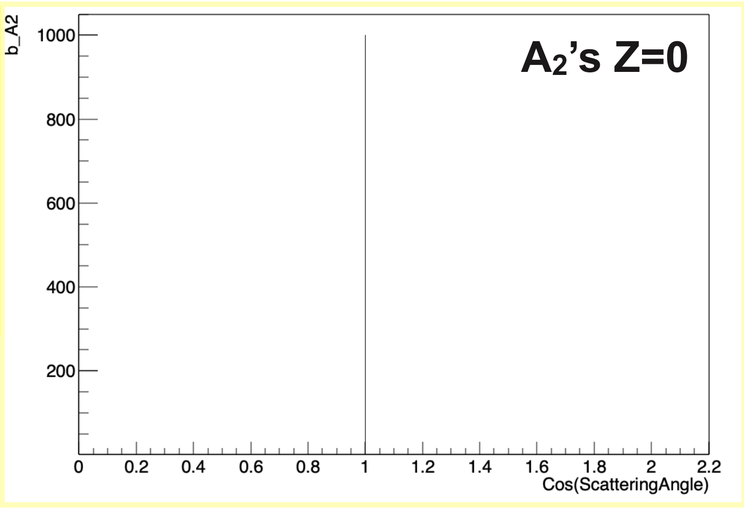
$$\text{Nominal Travel Length} : 0.05c \times 10^{5}\text{fm} = 5000\text{fm}$$

$$\text{Number of Projectile} : 1000$$

Perturbed Fixed Target Experiment

Overall Scheme / Controlled Multibody Scattering



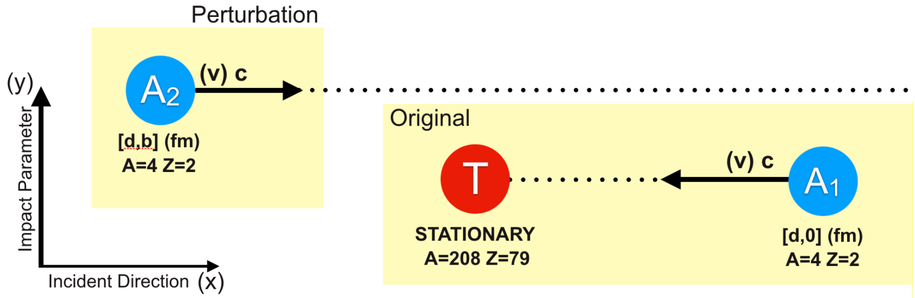


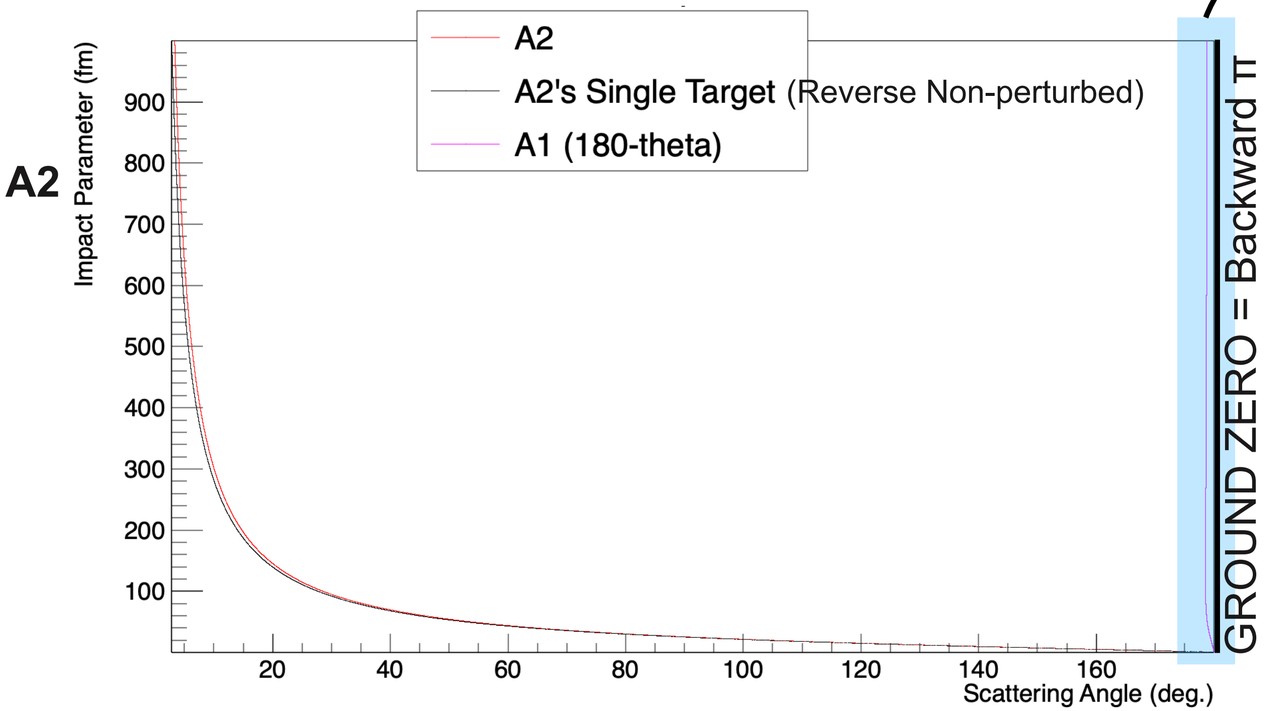
- Compare A_1's scattering angle between
  - A_2's **Z=0** and **Z=2** (Perturbation : A_2's Z)

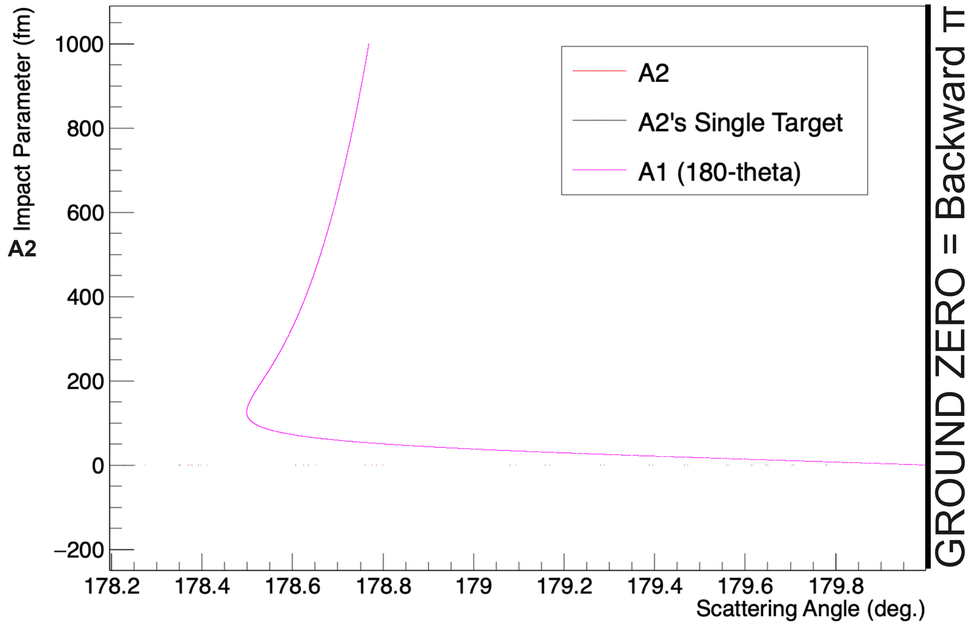
(Before Perturbation)
Scattered perfectly backward.

Perturbed Fixed Target Experiment

After perturbation





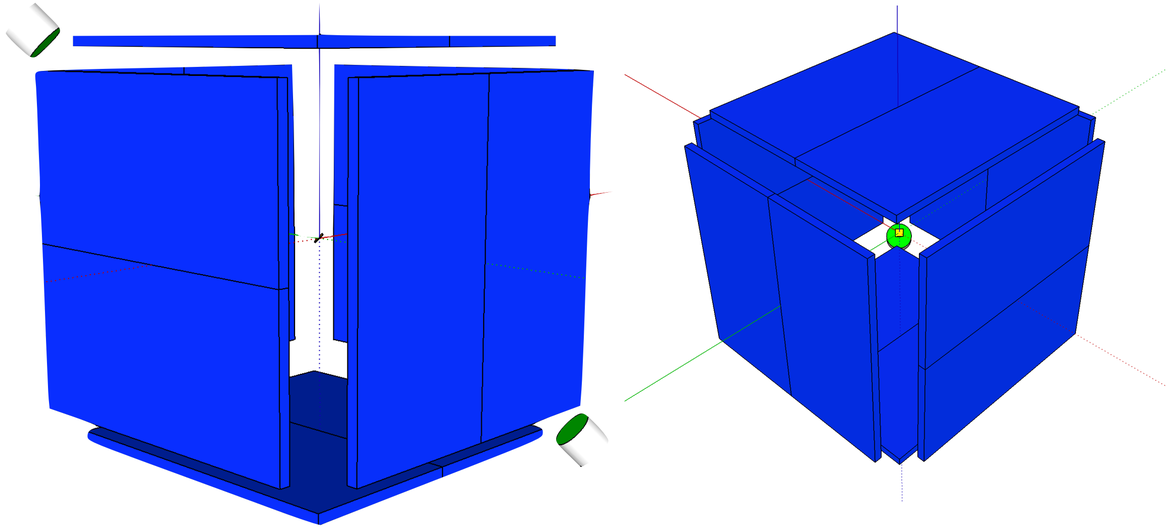


NEED TO KNOW WHAT IS HAPPENED

3 Body Collision : Experiment Design

Toward Reality

Conceptual Design of Detector Setup



Out of target plane **On target plane**

Blue: Silicon pixel detector
Green: α Source (collimators are skipped in visual)
Yellow: Gold foil

- **GOAL: Double Alpha Scattering = 2 x Rutherford scattering?**

- Needed Research
  - Cross-section calculation
    - TRC = Rutherford + bi-Projectile + **Triple**
  - Target event detection efficiency/background calculation
  - Detection Efficiency of ALPIDE
  - NIEL Effect of Ultra Low Energy α
  - Mechanical Design
  - Circuit Design (PCB + Detectors + DAQ Board)
  - Install setup into vacuum environment

Summary & Outlook

- HIC Production was finished
  - 그동안 ITS^2 로 고생하셨던 분들께 감사드립니다…~~(하지만 이젠 ITS^{3}이 있습니다)~~
- Went to CERN Summer Student Programme 2019
- NEW Physics experiment is designed
  - Its simulation is now doing…

¡Thank You!

Backup

Analysis Scheme

Raw Data

▼

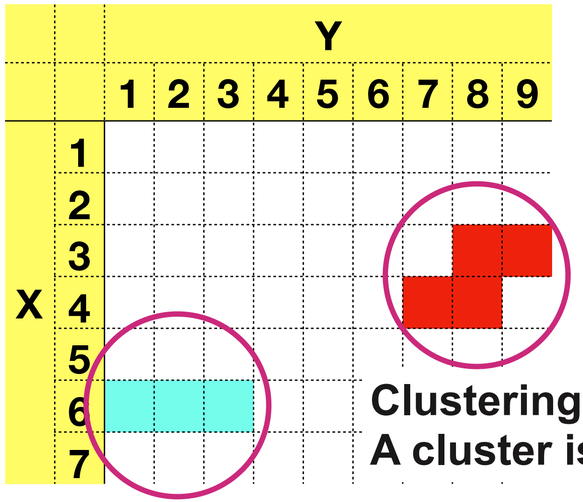
Tree Data

Raw Data (RUN # 00)

Event No.	Pix. X	Pix. Y
1	1	1
2	3	5
3	7	7
3	8	7
4	3	3
5	5	4
6	8	3
6	9	3
6	7	4
6	8	4
6	1	6
6	2	6
6	3	6

Procedure to Write TTree

1. Separate data Event by Event
2. Clustering pixels in a event
3. Analyze clusters
4. Write data into TTree



Clustering with all pixels nearby
A cluster is saved in TTree in a row

Recorded Data (for each cluster)

1. Run Number
2. Event Number
3. Number of Cluster in a Event
4. Number of Pixels in the Cluster
5. Pixel Number in Cluster
6. Shape of Cluster
   Shape-Record syntax: **Next Slide**

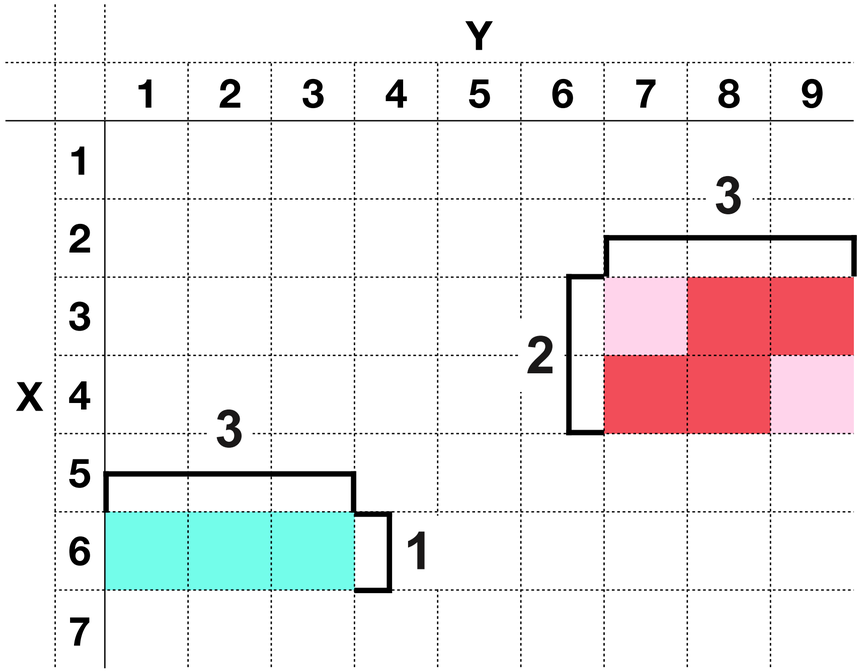
How to Save Shapes

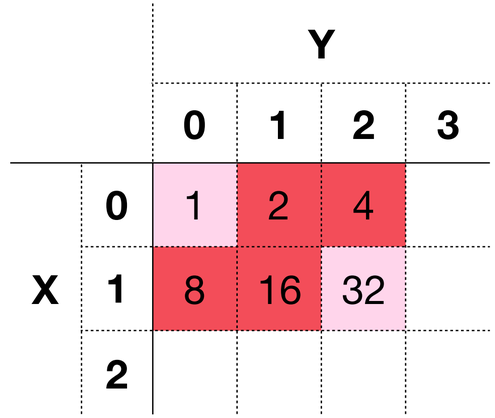
Raw Data

▼

Tree Data

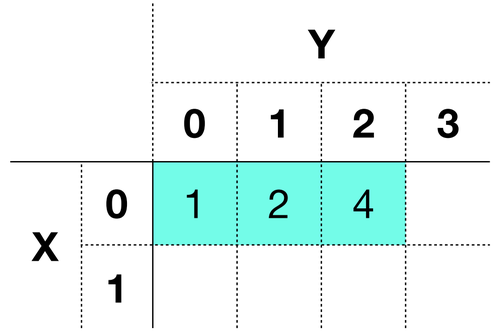
- All shapes are saved with 3 numbers
  - [Width for X, Width for Y, Shape Number]





Shape Number = 2+4+16+32 = 30

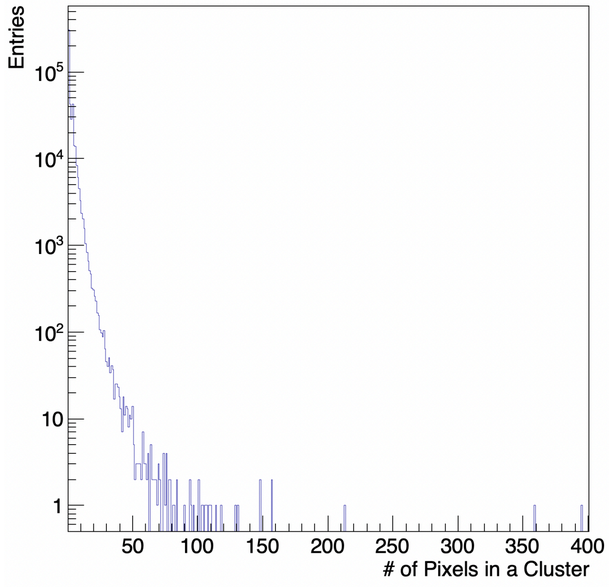
[2, 3, 30]



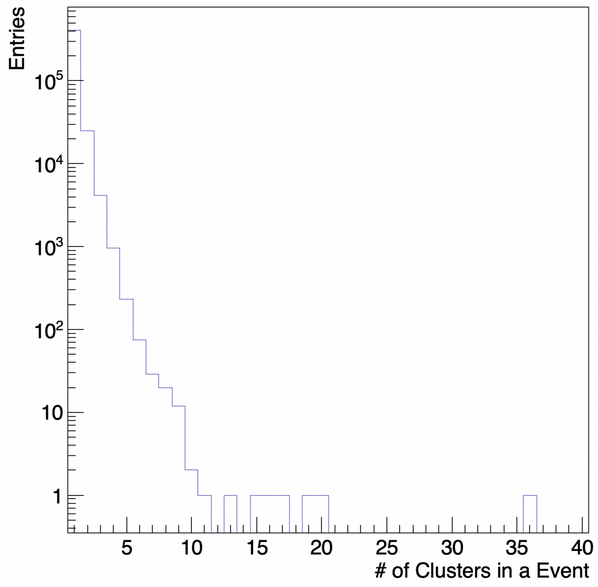
Shape Number = 1+2+4 = 7

[1, 3, 7]

nPixel in a Cluster



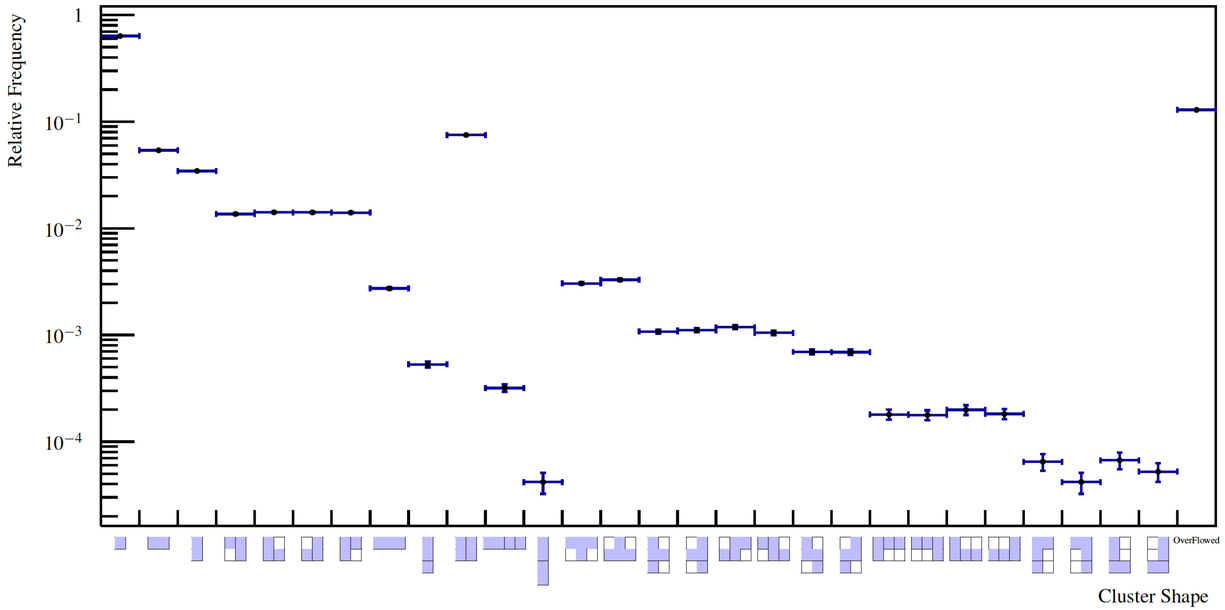
nCluster in a Event



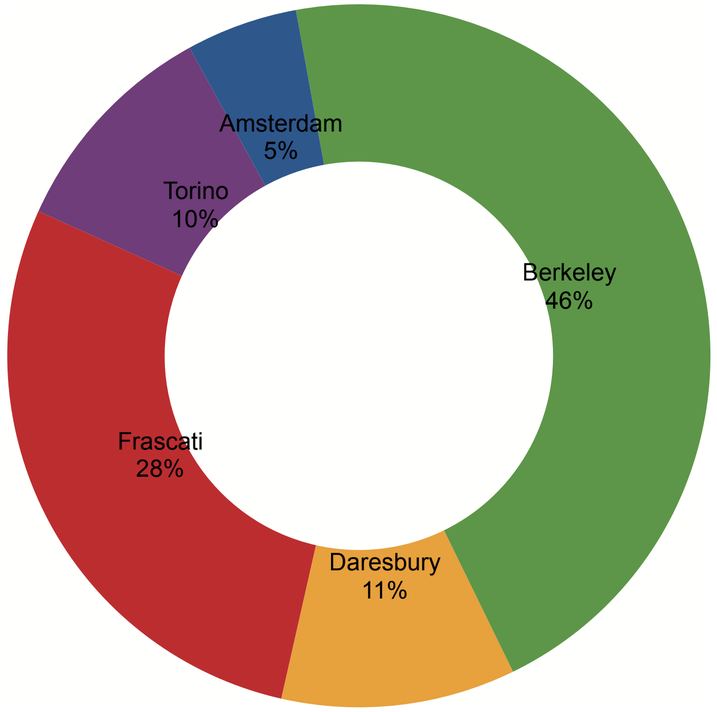
Single Pixel Cluster is Dominant
Pixels per Cluster = [1 : ~400]

Single Cluster Event is Dominant
Pixels per Cluster = [1 : ~36]

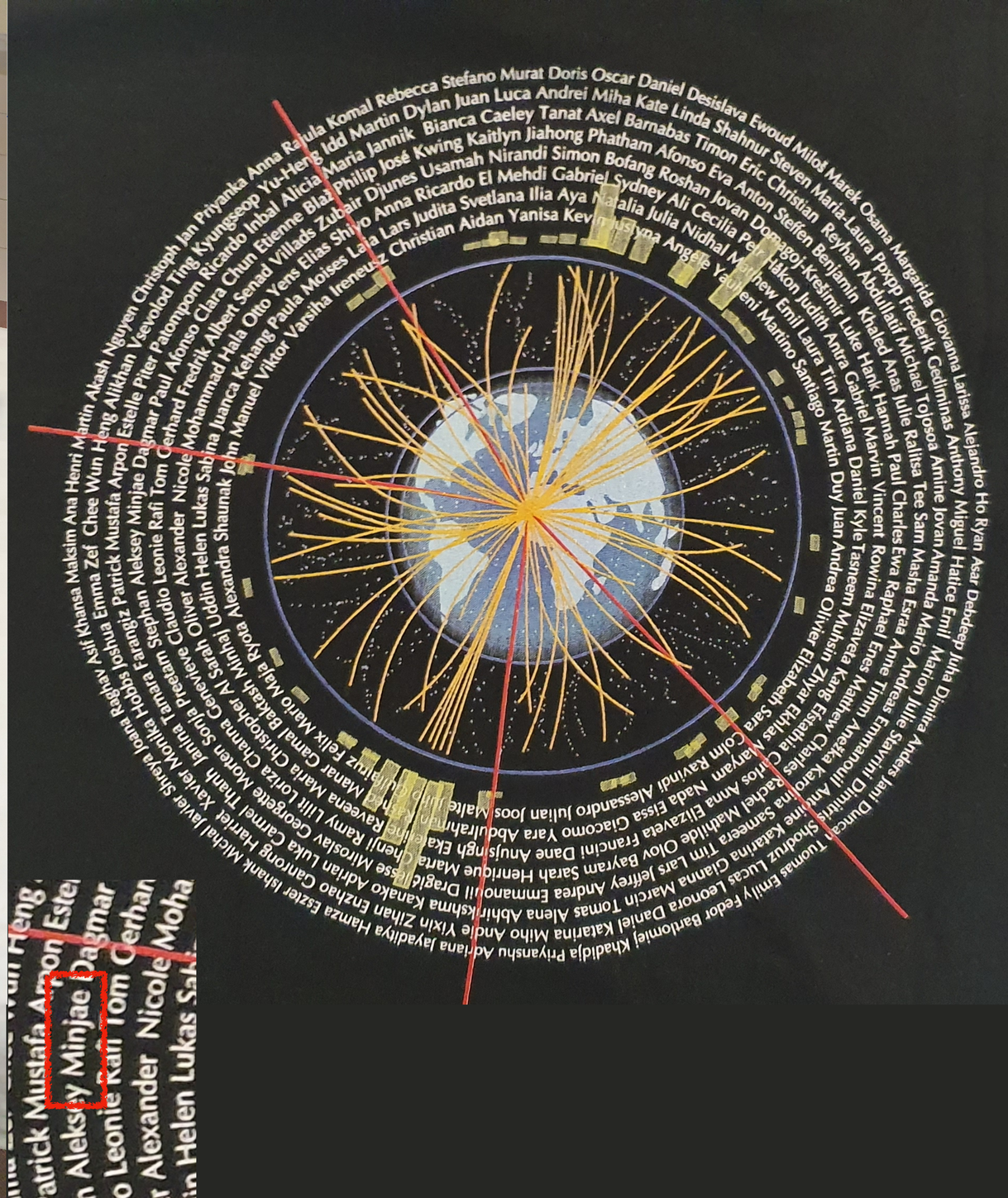
Shape



1. If mirror symmetry → Similar Frequency
2. If rotational symmetry but not mirror symmetry
   → Different, frequencies depend on axes pixels spreaded


Amsterdam
5%
Torino
10%
Berkeley
46%
Frascati
28%
Daresbury
11%

Summer Student T-Shirts



Simulation Method

How to describe physics

Original, t = 0
for mass=m

t = 1

t = 2

x_0
v_0

$x_1 = x_0$
$v_1 = v_0$

$x_2 = x_0 + v_0\,dt + F_1/m\,(dt^2/2)$
$v = v_0 + F_1/m\,dt$

. . .

End when …
particles are over volume
OR
simulation time is over

(dt = 1)

Collect data **Collect data** **Collect data** . . .

Record on Tree

and same on all dimensions (y, z)

Summer Student Report

Home > Analysis Of Cosmic Ray Data Taken During The Commissioning Of The New ALICE Inner Tracking System

Information | Discussion (0) | Files

Internal Note

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Submitted by	minjae.kwon@cern.ch

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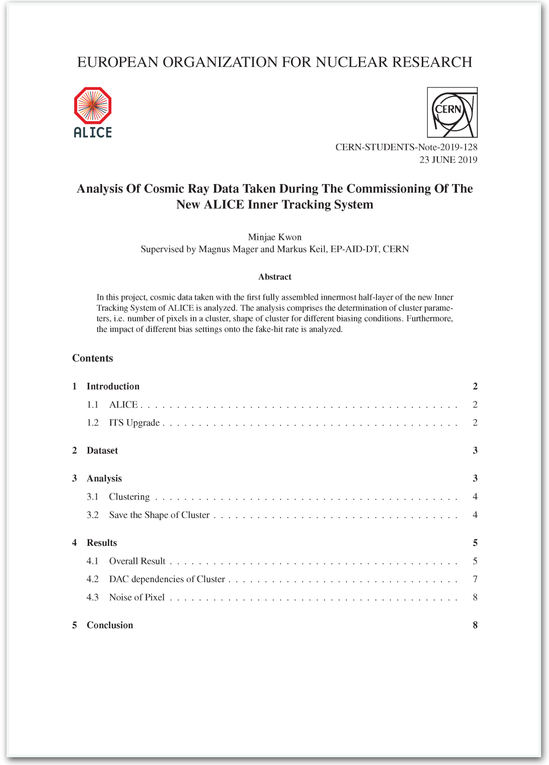

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ALICE

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CERN-STUDENTS-Note-2019-128
23 JUNE 2019

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Contents

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- The report was uploaded.
  - Everybody can read the report from CDS
- Analysis of Followings are done.
  - Relative Frequencies of
    - Number of clusters
    - Number of pixels in each cluster
    - Shapes
  - Number of pixels in each cluster with different DAC setting
    - VCASN
    - ITHR
  - Noise Analysis (Fake Hit Rate)

You can find all of Summer Student Reports in CDS (https://cds.cern.ch/) with keyword : ***CERN-STUDENTS-Note-2019***

Activity Summary 2019

KoALICE National Workshop, 05JAN2020, High1 Resort (ROK)

MINJAE ISAAC KWON, Pusan National University, Republic of Korea