



KoALICE

Activity at SKKU

KoALICE National Workshop 2021
4 Jan 2022



Beomkyu Kim
Sungkyunkwan University

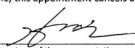
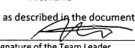
Registration

Join
KoALICE
(24 Sep 2021)

Admission
by ALICE CB
(3 Dec 2021)

ALICE MoU
(Ongoing)

Institution registration

Team Leader Deputy Team Leader		Appointment of a Team Leader and Deputy Team Leader from an Institution collaborating in an Experiment or Project	
<p>This appointment form implements the instructions set out in the document "Responsibilities of the Home Institution, the CERN Team Leader and the Safety Correspondent", regarding the Team Leader and the Deputy Team Leader(s). http://usersoffice.web.cern.ch/sites/usersoffice.web.cern.ch/files/pdf/Home_inst_CERN_TL_SC_Responsibilities.pdf hereinafter "the document".</p>			
To be completed by an authorized representative of the institution collaborating in an experiment or project			
Experiment/Project	ALICE		
Institution	Sungkyunkwan University		
	Full name (name as used for scientific publications)		
	Suwon City	South Korea	
	Town	Country	
Authorised representative	Kang	Dae Joon	
	Name	First name	
	Head of Department of Physics		
	Position held in the Institution (e.g. Head of Department/Head of Administration)		
	I have taken note of the Institutes' responsibilities and the responsibilities of the Team Leader and the deputies, as described in the document, and hereby appoint the person(s) mentioned below to act on behalf of the Institution in the indicated roles. If applicable, this appointment cancels and replaces any previous appointments.		
	15 Dec 2021		
	Date	Signature of the representative	
Team Leader	Start Date: 15 Dec 2021		
	Kim	Beomkyu	106415
	Name	First name	CERN id
	I have taken note of the responsibilities of the Team Leader as described in the document, and agree to fulfil them to the best of my abilities.		
	15 Dec 2021		
	Date	Signature of the Team Leader	
1 st Deputy Team Leader	Start Date:		
	Name	First name	CERN id
	I have taken note of the responsibilities of the Deputy Team Leader as described in the document, and agree to fulfil them to the best of my abilities.		
	Date	Signature of the 1 st Deputy Team Leader	
2 nd Deputy Team Leader	Start Date:		
	Name	First name	CERN id
	I have taken note of the responsibilities of the Deputy Team Leader as described in the document, and agree to fulfil them to the best of my abilities.		
	Date	Signature of the 2 nd Deputy Team Leader	
To be completed by the spokesperson or the contact person of the experiment or project, for appointment of Team Leader and/or Deputy Team Leader(s), only:			
Spokesperson/ Contact Person	Name	First name	CERN id
	I agree with the appointment of the Team Leader and/or the Deputy Team Leader(s).		
	Date	Signature of the spokesperson/contact person	

Team account registration in the CERN database

MoU between the representative of the funding agency at SKKU and the CERN Director for Research and Computing

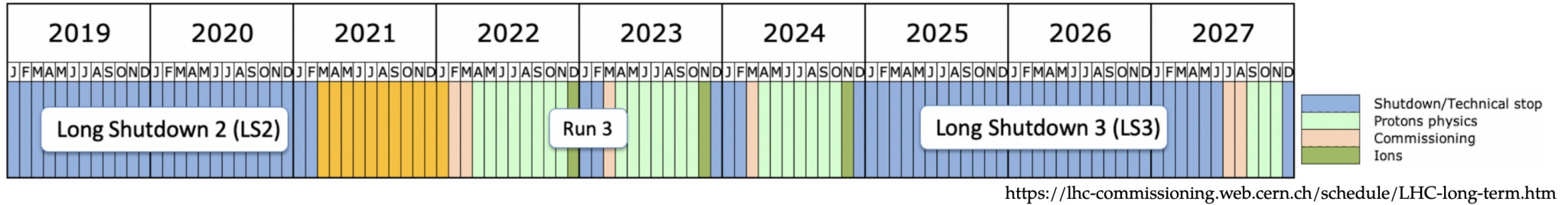
A minimum initial contribution of 50,000 CHF an annual contribution to the Maintenance and Operation Category A

Team leader appointment

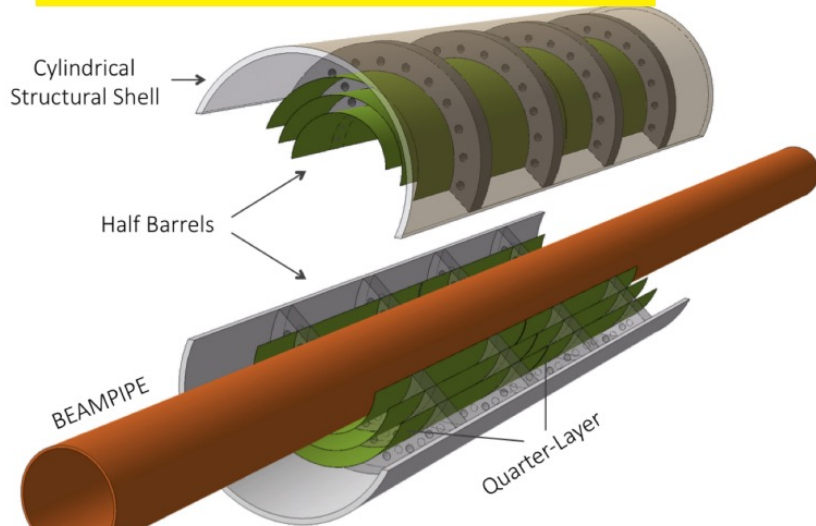
Laboratory build-up

Position	Members
Team Leader Deputy Team Leader	Beomkyu Kim 1 Postdoc (recruiting)
PhD course MS and undergraduate internship	Joonsuk Bae (1 st March 2022) Up to 5 people

Laboratory build-up



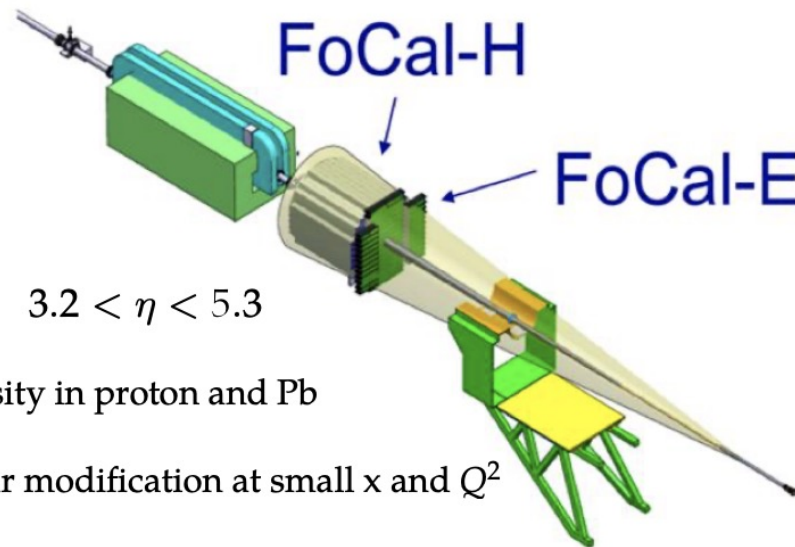
Ultra-light Inner Tracking System 3



Three inner-most layers replaced
ALICE-PUBLIC-2018-013

Forward Calorimeter

LoI CERN-LHCC-2020-009



$$3.2 < \eta < 5.3$$

g-density in proton and Pb

nuclear modification at small x and Q^2

Jet quenching at forward in Pb-Pb

Research Achievement

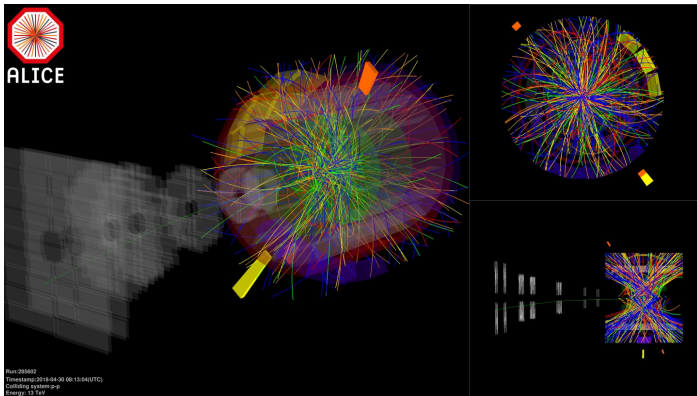
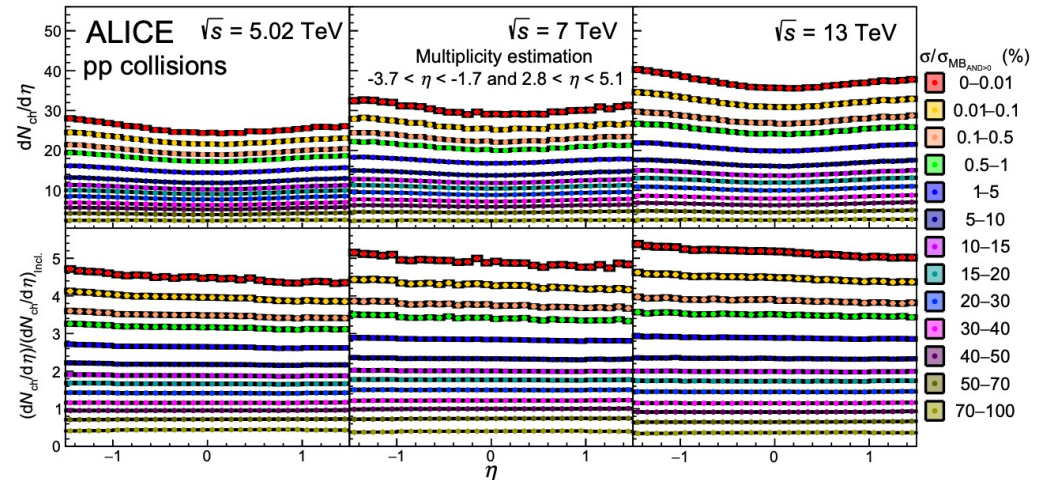
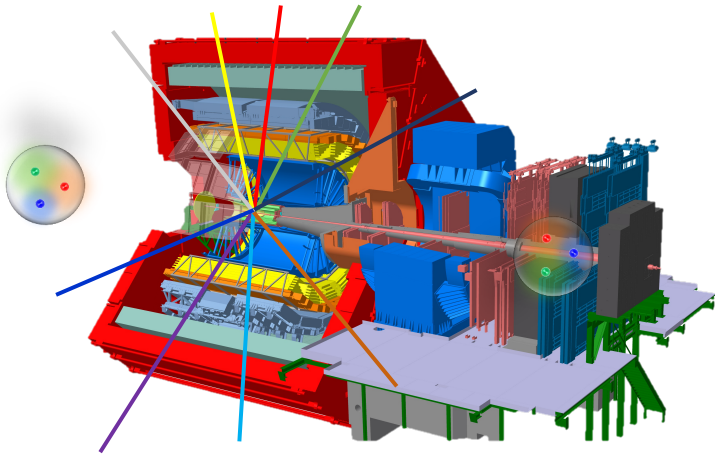


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Research achievement



Eur.Phys.J.C 81 (2021) 7, 630 (19 July 2021)



$\Delta\sigma / \sigma_{MB,AND>0}$	Forward Multiplicity Estimator			Midrapidity Multiplicity Estimator		
	\sqrt{s} (TeV)					
	5.02	7	13	5.02	7	13
	$(dN_{ch}/d\eta) \pm \text{uncorrelated systematic uncertainty} \pm \text{correlated systematic uncertainty}$					
0-0.01%	24.53±0.23±0.31	29.13±0.25±0.44	35.82±0.33±0.33			
0.01-0.05%	22.42±0.21±0.23	26.27±0.23±0.30	32.21±0.29±0.29			
0.05-0.1%	21.14±0.20±0.22	24.70±0.22±0.25	30.13±0.27±0.27			
0.1-0.1%	21.71±0.20±0.21	25.40±0.22±0.26	31.05±0.28±0.28			
0.1-0.5%	19.08±0.18±0.17	22.24±0.19±0.20	26.91±0.24±0.27			
0.5-1%	17.34±0.16±0.15	20.11±0.18±0.18	24.26±0.22±0.26			
0-1%	18.50±0.17±0.16	21.55±0.19±0.19	26.01±0.24±0.24	24.74±0.23±0.52	27.80±0.24±1.08	32.70±0.29±0.60
1-5%	14.51±0.14±0.12	16.85±0.15±0.11	19.99±0.18±0.16	17.66±0.16±0.29	19.97±0.18±0.56	23.21±0.21±0.40
0-5%	15.30±0.14±0.13	17.80±0.16±0.11	21.18±0.19±0.17	19.08±0.18±0.4	21.46±0.20±0.59	25.08±0.20±0.38
5-10%	11.93±0.11±0.10	13.82±0.12±0.09	16.18±0.15±0.13	13.71±0.13±0.19	15.64±0.14±0.35	18.03±0.17±0.33
10-15%	10.30±0.10±0.09	11.89±0.11±0.07	13.78±0.13±0.12	11.40±0.11±0.13	13.06±0.12±0.26	14.94±0.14±0.27
15-20%	9.12±0.09±0.08	10.49±0.10±0.06	12.01±0.11±0.11	9.81±0.09±0.11	11.27±0.10±0.22	12.69±0.12±0.24
20-30%	7.76±0.08±0.07	8.90±0.08±0.05	10.03±0.10±0.09	8.07±0.08±0.08	9.29±0.09±0.18	10.33±0.10±0.20
30-40%	6.34±0.06±0.06	7.24±0.07±0.04	7.95±0.08±0.07	6.30±0.06±0.06	7.30±0.07±0.15	8.03±0.08±0.16
40-50%	5.22±0.05±0.05	5.92±0.06±0.03	6.32±0.06±0.06	4.98±0.05±0.05	5.76±0.06±0.12	6.18±0.06±0.12
50-70%	3.94±0.04±0.04	4.39±0.04±0.02	4.49±0.05±0.04	3.45±0.04±0.04	3.97±0.04±0.09	4.05±0.04±0.08
70-100%	2.42±0.02±0.03	2.40±0.02±0.01	2.54±0.03±0.02	1.69±0.02±0.05	1.84±0.02±0.06	1.80±0.02±0.05
0-100%	5.48±0.05±0.05	5.94±0.06±0.03	6.93±0.07±0.06	5.48±0.05±0.05	5.94±0.06±0.03	6.93±0.07±0.06

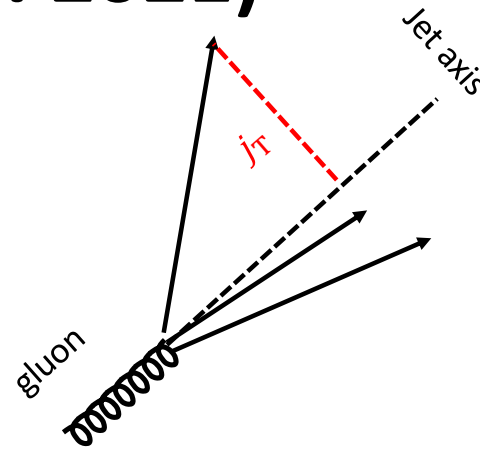
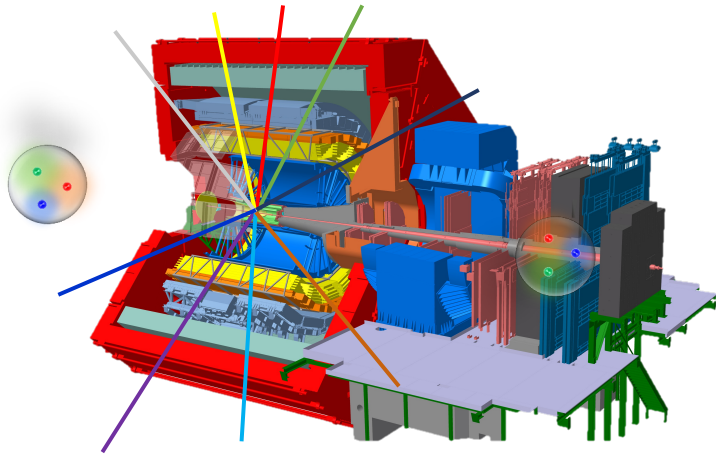


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Research achievement

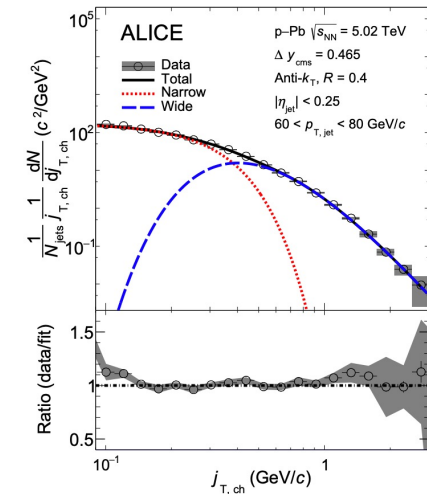
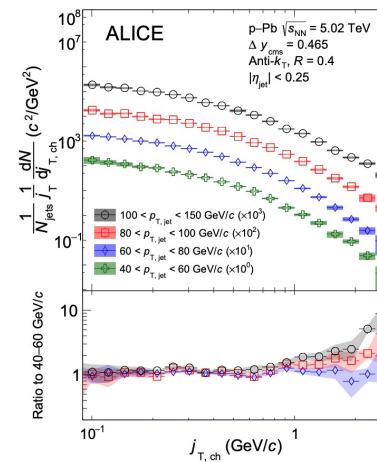
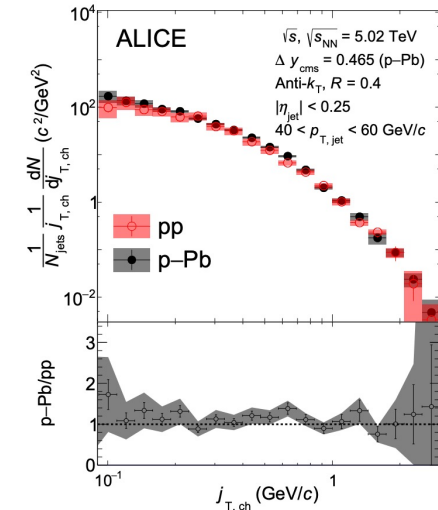


JHEP 09 (2021) 211 (30 Sep. 2021)



Jet reconstruction

- Jets reconstructed in ALICE ITS/TPC(charged tracks) ($|\eta| < 0.9, 0 < \phi < 2\pi$), EMCal(neutral tracks) ($|\eta| < 0.7, \Delta\phi = 110^\circ$)
- Anti- k_T algorithm with $R = 0.4$
- Only accept jets within $|\eta| = 0.25$ (Full jet)
- Minimum p_T cut = 0.15 GeV/c for charged particles measured by ITS and TPC
- Minimum cluster energy = 0.3 GeV for energy clusters measured by EMCal



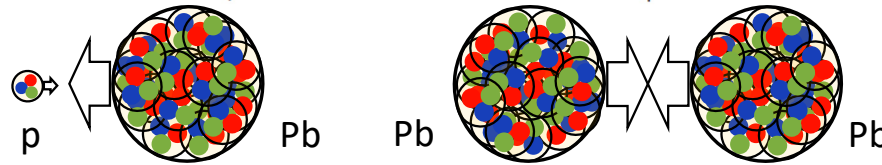
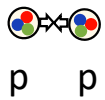
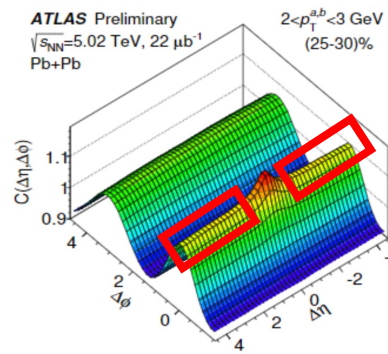
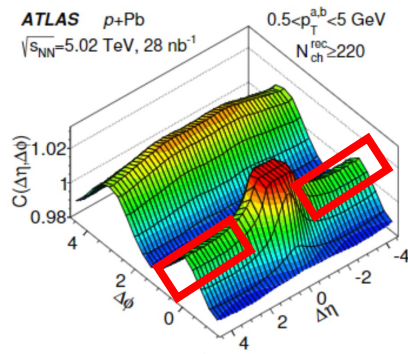
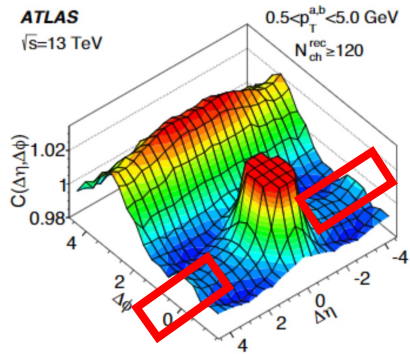


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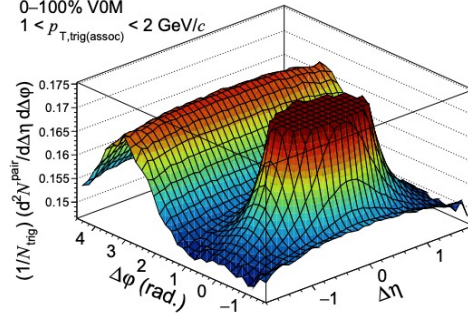
Research achievement



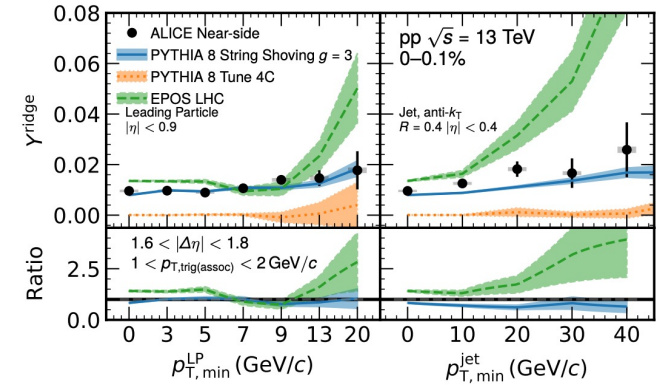
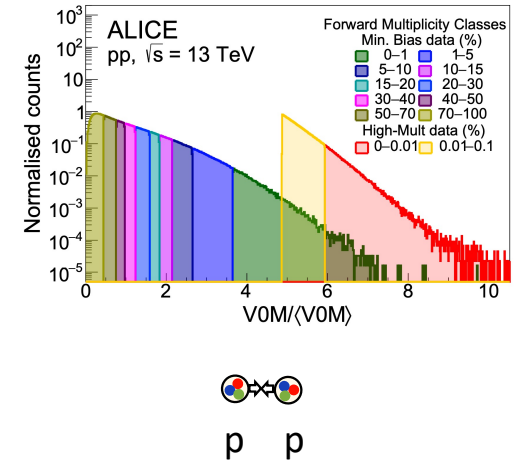
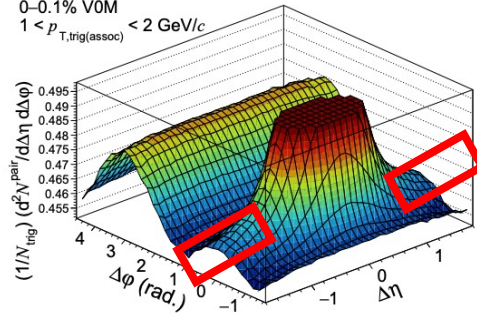
JHEP 05 (2021) 290 (31 May 2021)



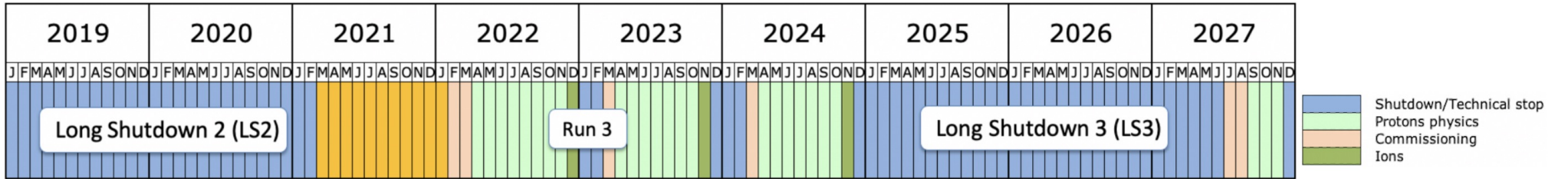
ALICE, pp $\sqrt{s} = 13$ TeV
0-100% VOM
 $1 < p_{T, \text{trig(assoc)}} < 2$ GeV/c



ALICE, pp $\sqrt{s} = 13$ TeV
0-0.1% VOM
 $1 < p_{T, \text{trig(assoc)}} < 2$ GeV/c



Research plan



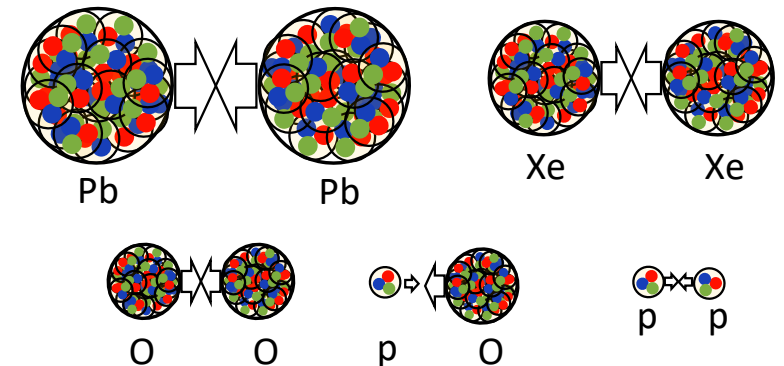
- New data at different $\sqrt{s_{NN}}$ energies

<https://lhc-commissioning.web.cern.ch/schedule/LHC-long-term.htm>

Year	Systems, $\sqrt{s_{NN}}$	Time	L_{int}
2022	Pb-Pb 5.5 TeV	3 weeks	2.3 nb^{-1}
	pp 5.5 TeV	1 week	3 pb^{-1} (ALICE), 300 pb^{-1} (ATLAS, CMS), 25 pb^{-1} (LHCb)
2023	Pb-Pb 5.5 TeV	5 weeks	3.9 nb^{-1}
	O-O, p-O	1 week	$500 \mu\text{b}^{-1}$ and $200 \mu\text{b}^{-1}$
2024	p-Pb 8.8 TeV	3 weeks	0.6 pb^{-1} (ATLAS, CMS), 0.3 pb^{-1} (ALICE, LHCb)
	pp 8.8 TeV	few days	1.5 pb^{-1} (ALICE), 100 pb^{-1} (ATLAS, CMS, LHCb)

- Reference papers from 2022 to 2024

논문 게재 년도	충돌계	질량중심에너지 ($\sqrt{s_{NN}}$)
2022	납-납 (Pb-Pb)	5.5 TeV
2022-2023	양성자-양성자 (pp)	5.5 TeV
2023	산소-산소 (OO) 그리고 양성자-산소 (pO)	미정
2024	양성자-양성자 (pp) 그리고 양성자-납 (p-Pb)	8.8 TeV

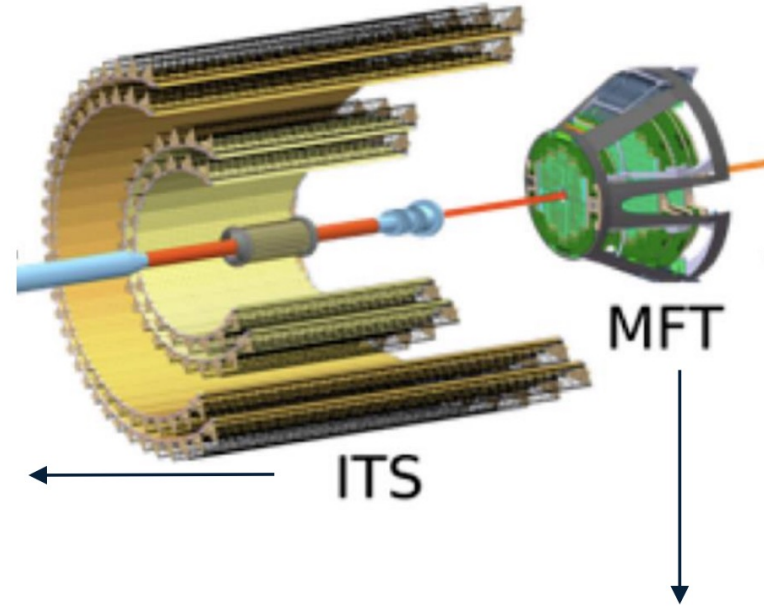


- QGP search in small systems



Multiplicity-LHC RUN3

Measurement of multiplicity with **full tracking capability** extended to forward on the C side

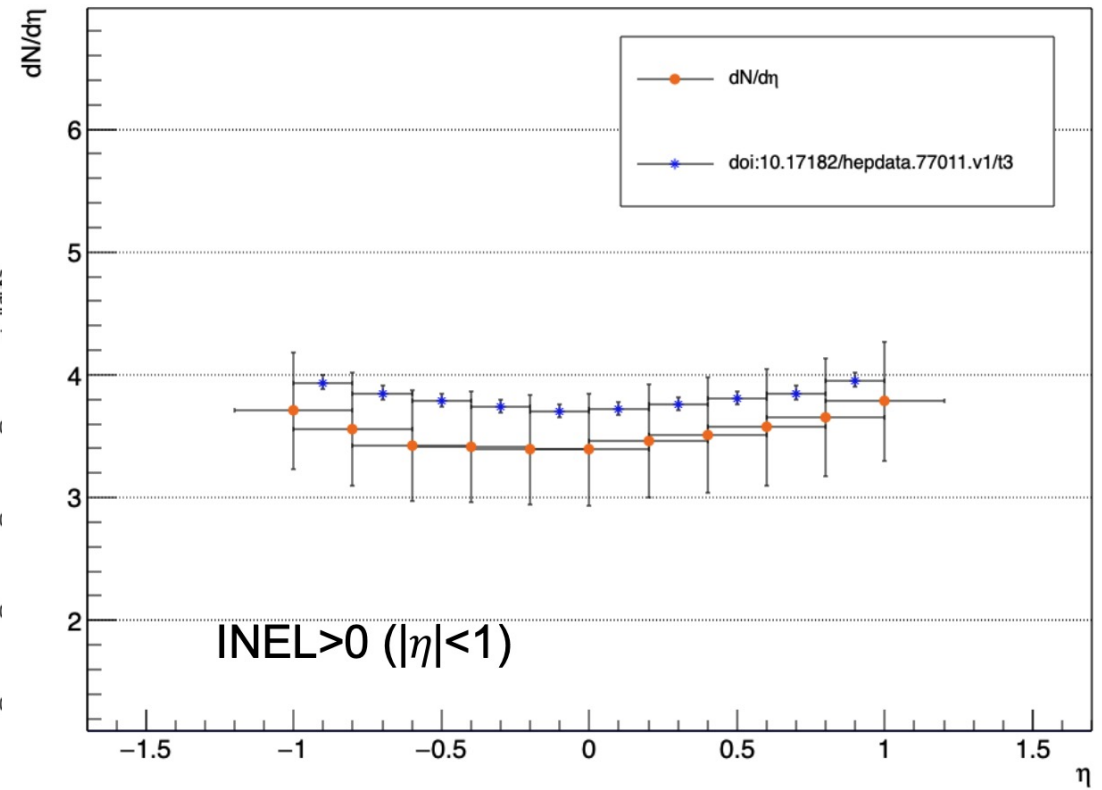
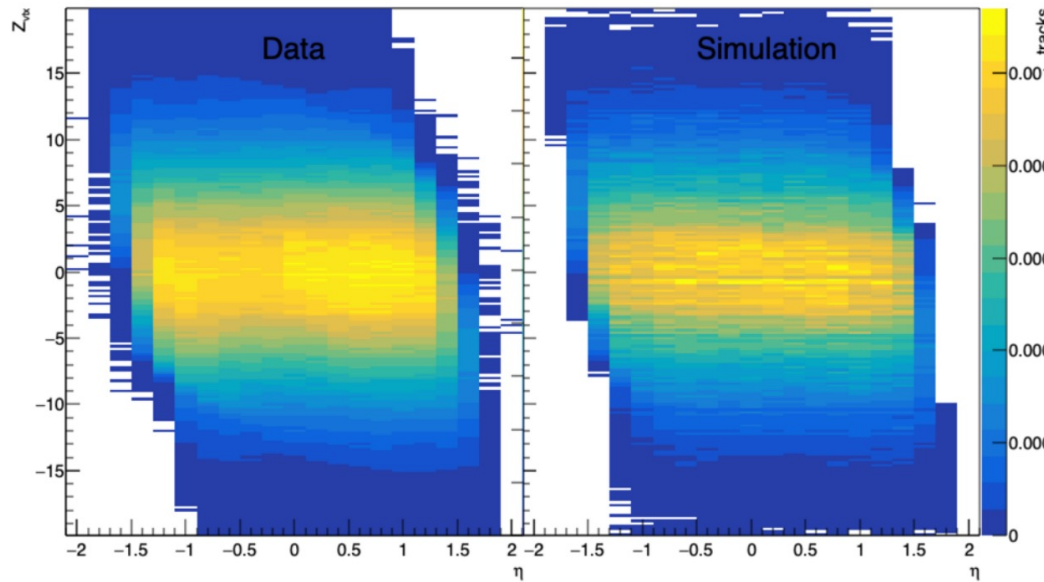


	Inner Barrel			Outer Barrel			
	Inner Layers			Middle Layers		Outer Layers	
	Layer 0	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
Radial position (min.) (mm)	22.4	30.1	37.8	194.4	243.9	342.3	391.8
Radial position (max.) (mm)	26.7	34.6	42.1	197.7	247.0	345.4	394.9
Length (sensitive area) (mm)	271	271	271	843	843	1475	1475
Pseudo-rapidity coverage ^a	±2.5	±2.3	±2.0	±1.5	±1.4	±1.4	±1.3

Half-Disk	0	1	2	3	4	Full MFT
Inner radius (mm)	25.0	25.0	25.0	38.2	39.2	-
Outer radius ^a (mm)	92.6	98.0	104.3	130.1	143.5	-
z-position (mm)	-460	-493	-531	-687	-768	-
No. sensors	64	64	76	112	132	896

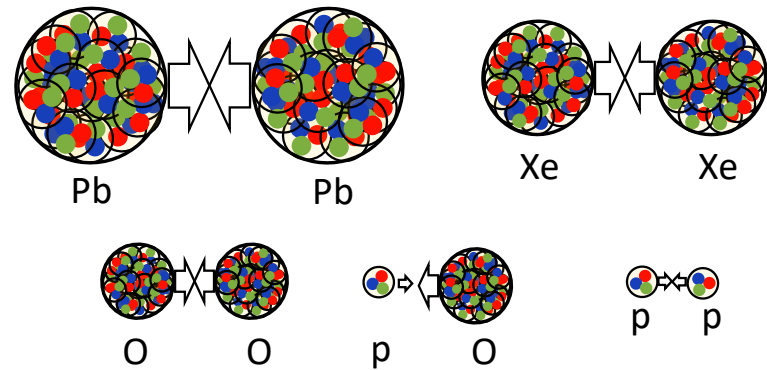
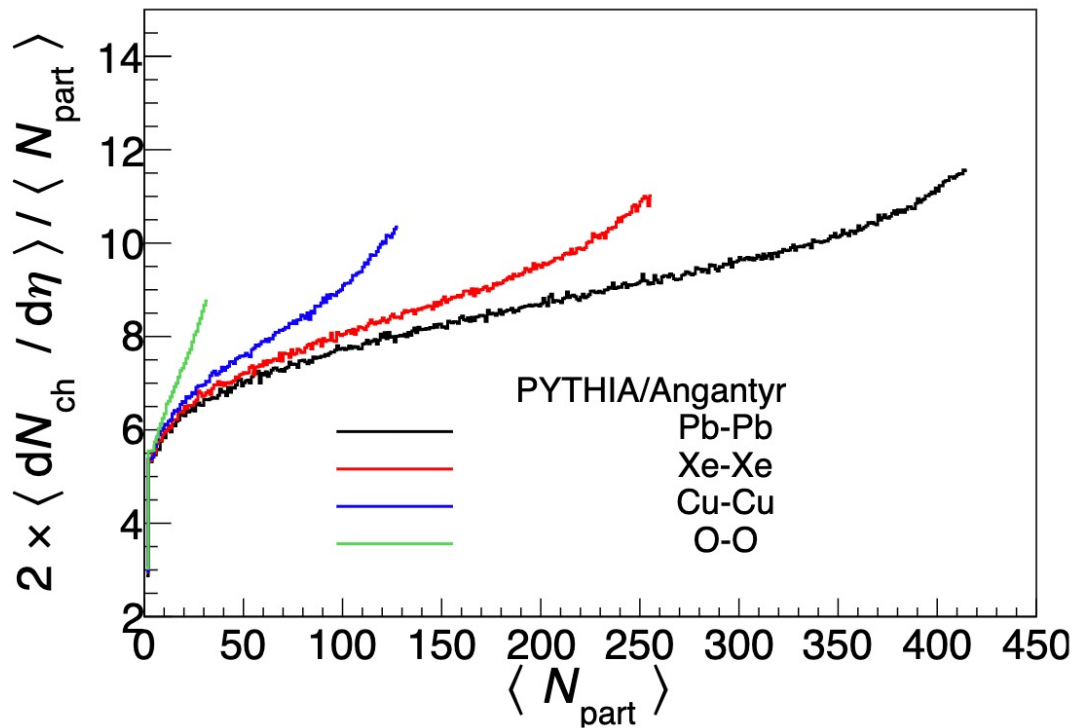
$$-3.6 < \eta < -2.5$$

- **Normalization**
 - split vertices/pile-up
 - **biased sample ($N_{\text{contrib}} > 2$)**
 - misalignment affects vertex finding

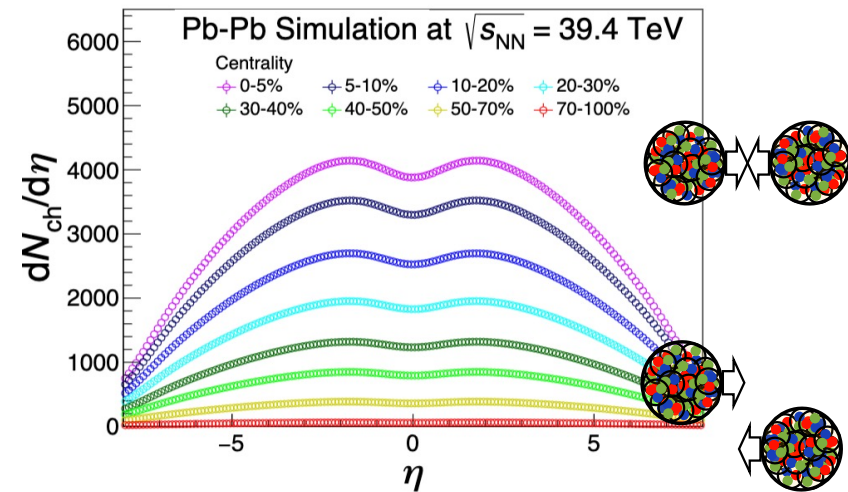
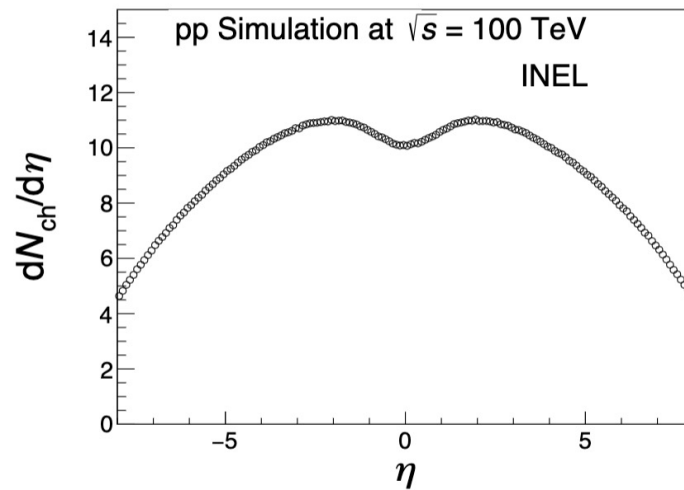
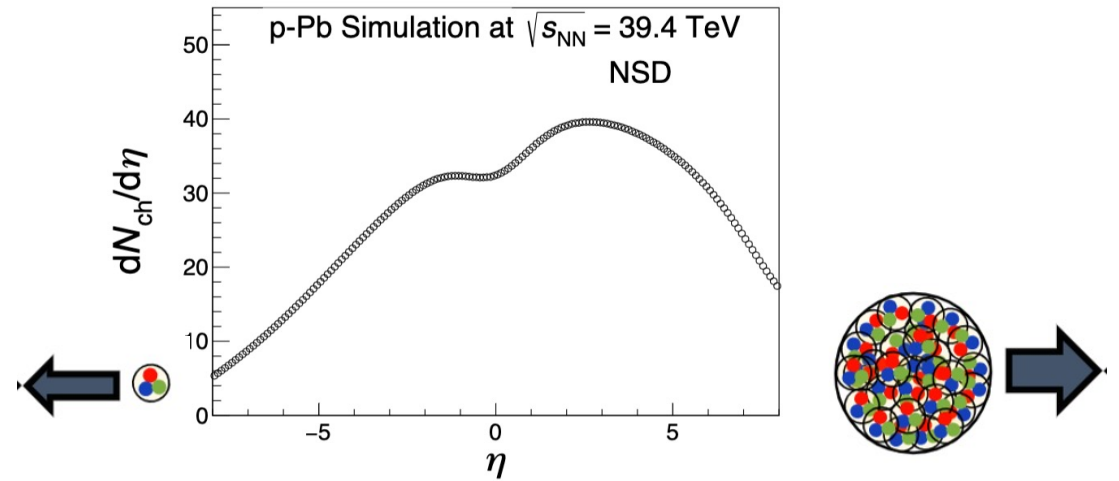
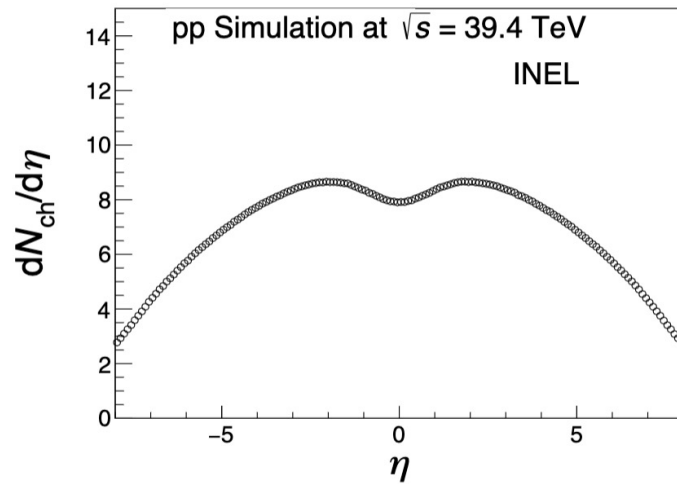


Multiplicity-MC simulation

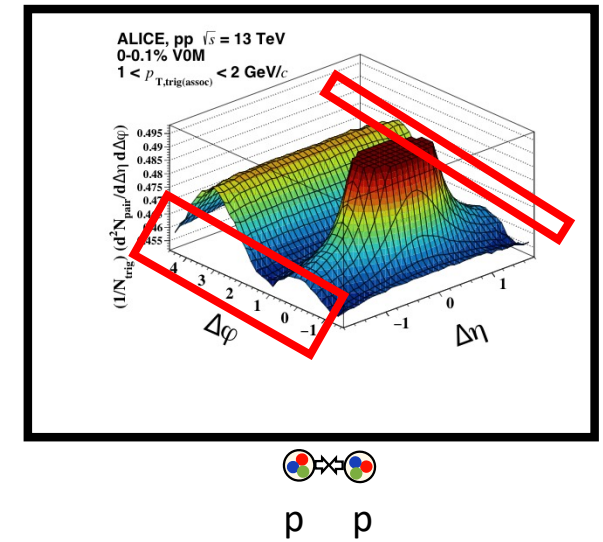
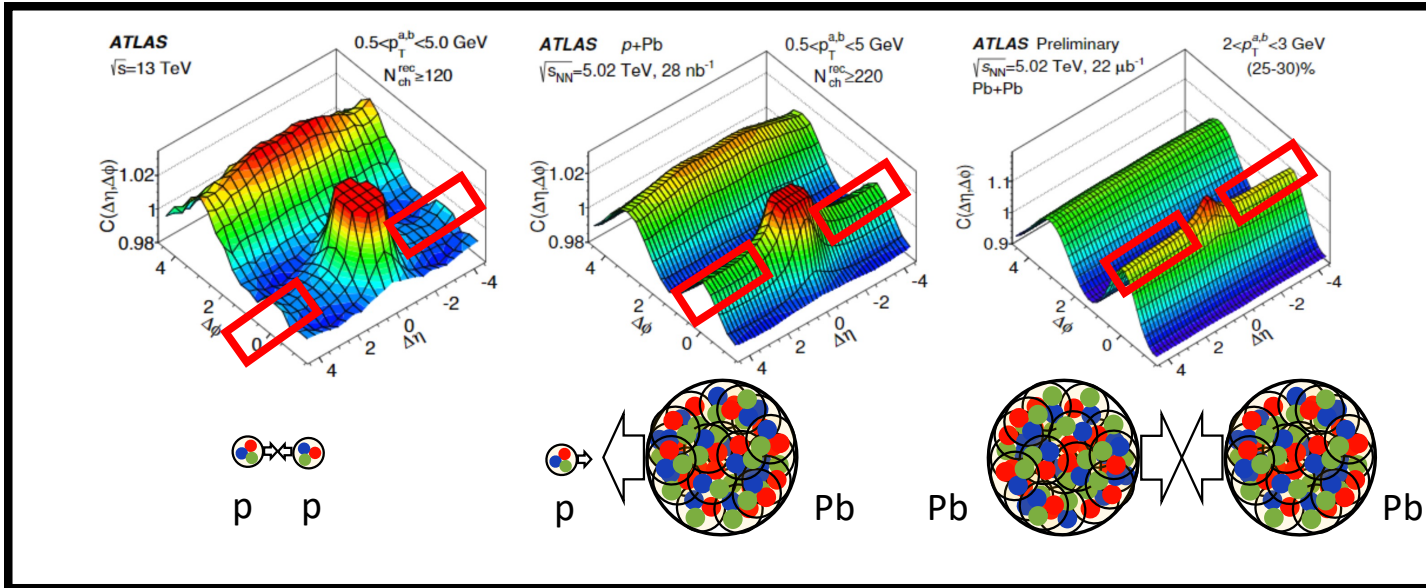
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	pp 8.8 TeV	few days	1.5 pb^{-1} (ALICE), 100 pb^{-1} (ATLAS, CMS, LHCb)



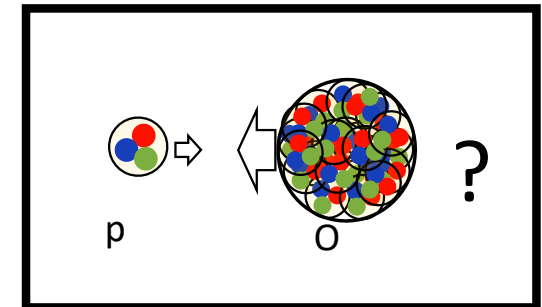
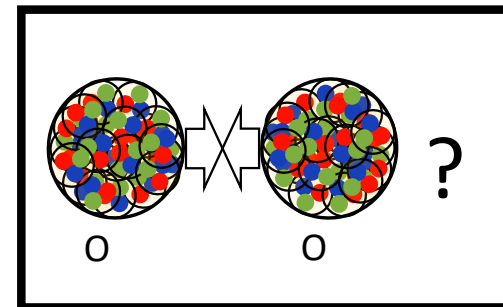
Multiplicity-MC simulation



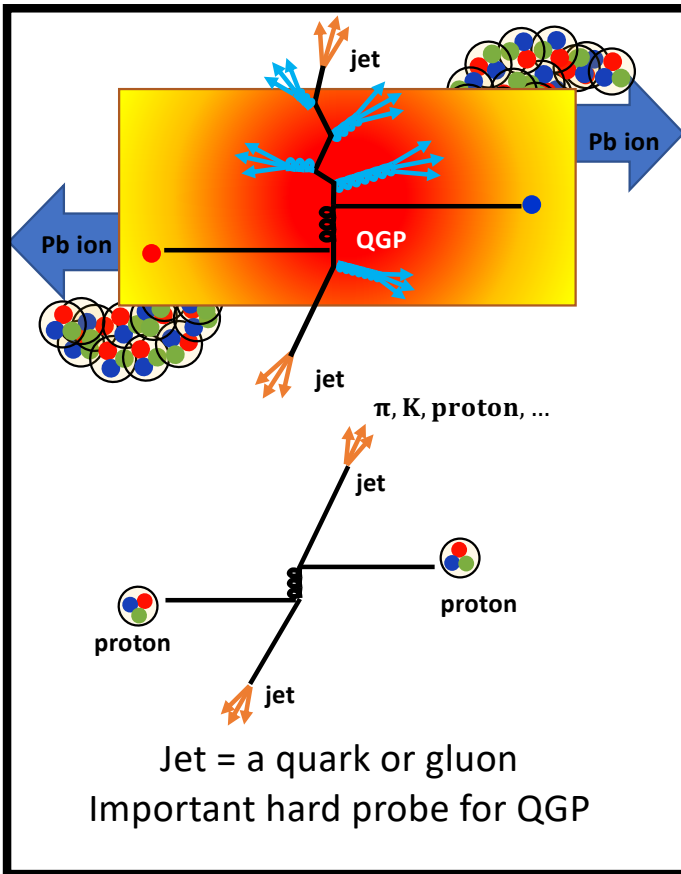
QGP search in small systems



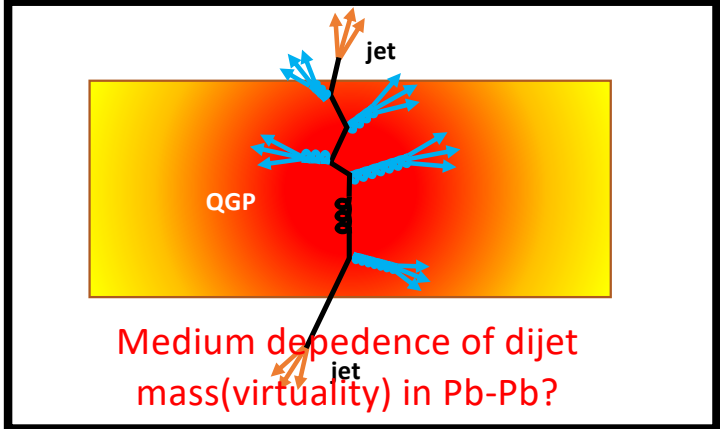
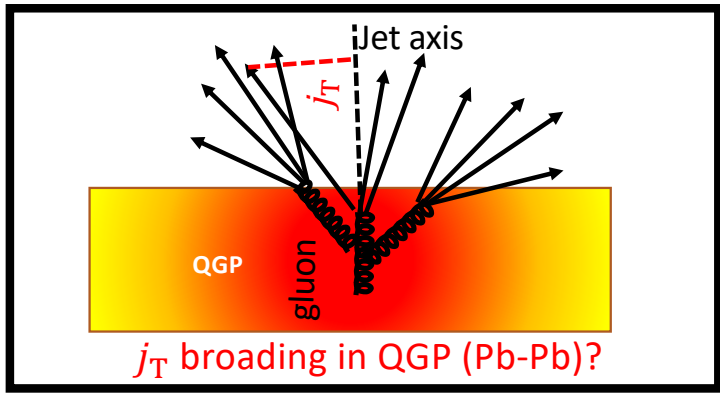
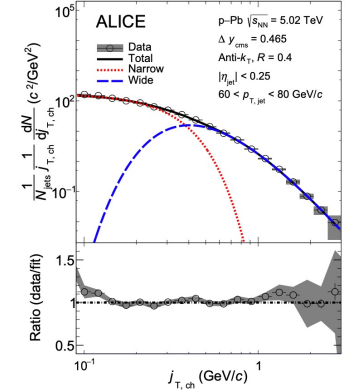
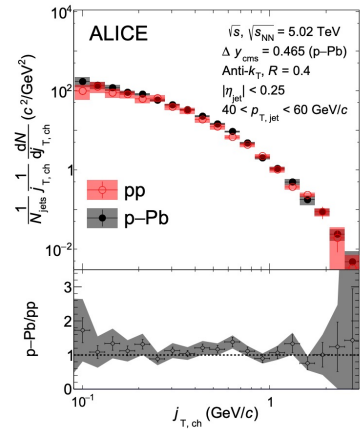
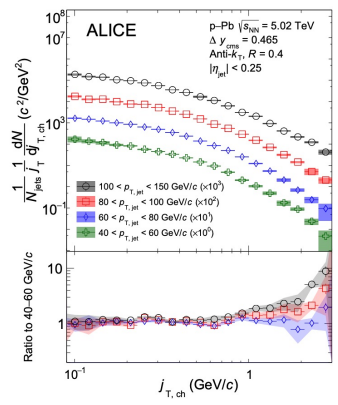
논문 게재 년도	충돌계	질량중심에너지 ($\sqrt{s_{NN}}$)
2021	양성자-납	5.02, 8.16 TeV
2022	양성자-양성자	14 TeV
2023	산소-산소, 양성자-산소	미정



Jet physics

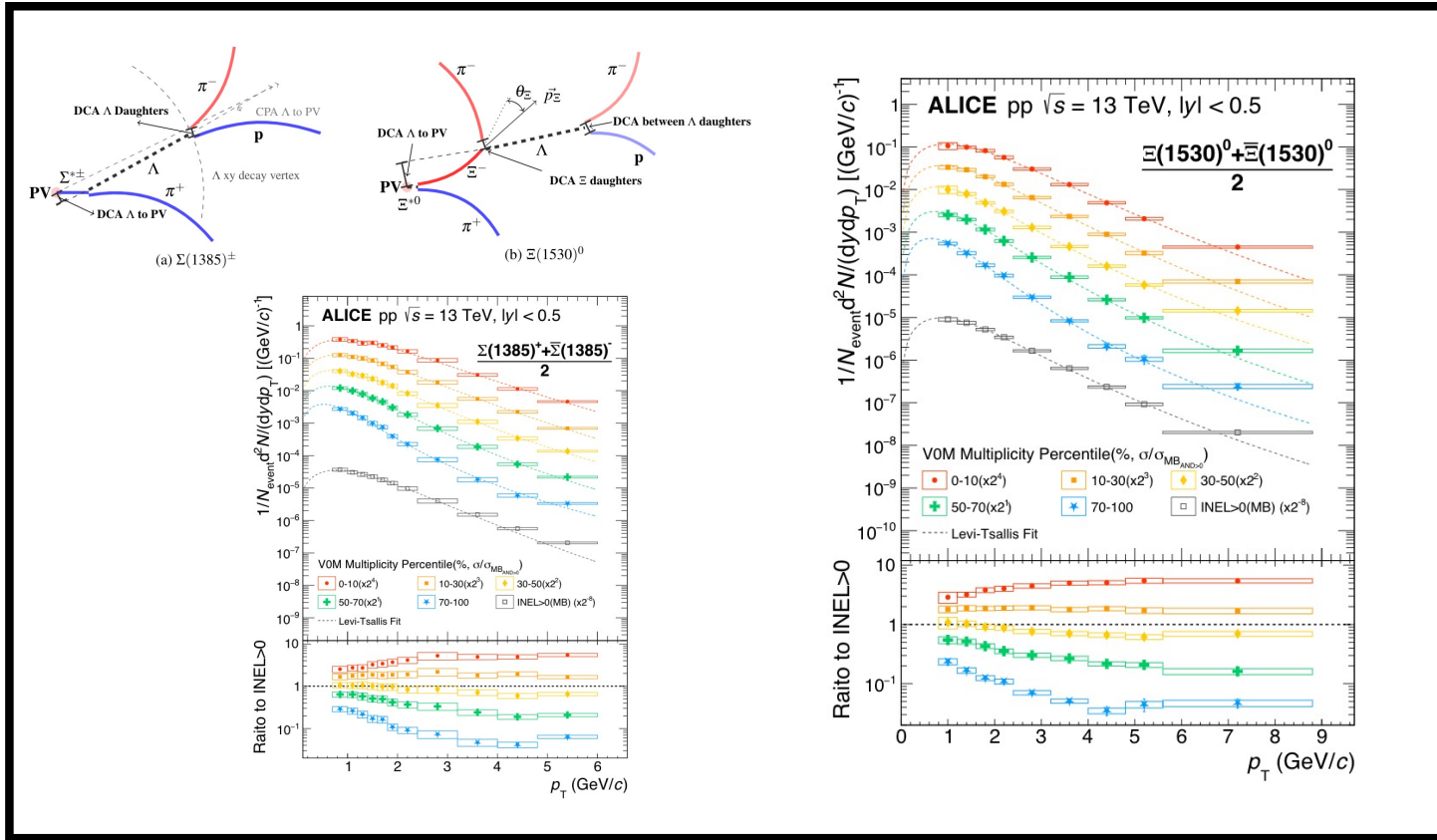
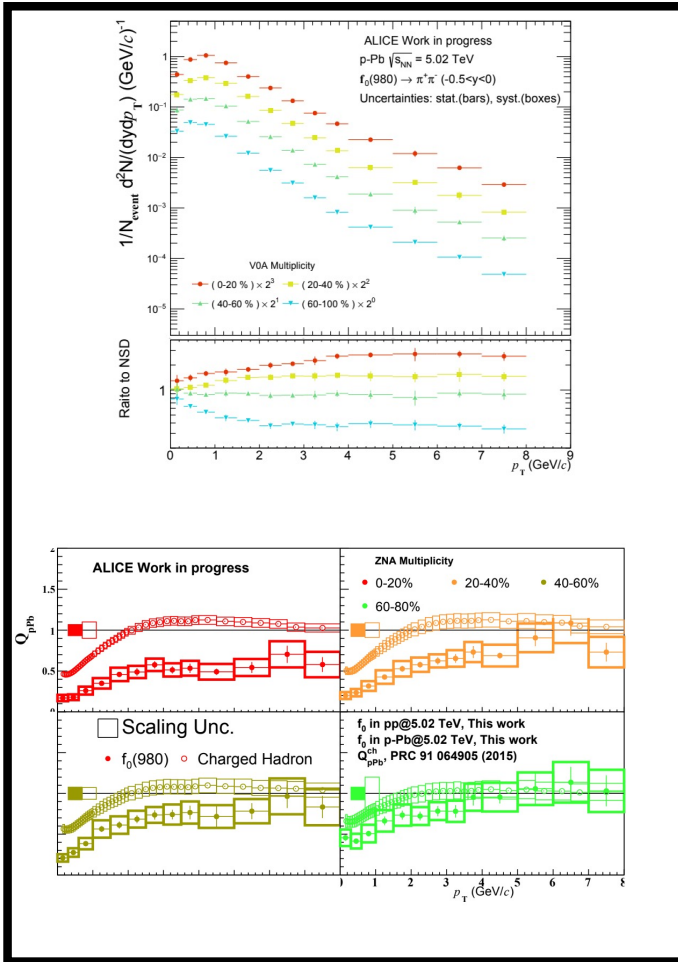


EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
 ALICE
Jet axis
 Jet fragmentation transverse momentum distributions
 in pp and p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV
 ALICE Collaboration
 arXiv:2011.00904v1 [nucl-ex] 11 Nov 2020



논문 게재 년도	충돌계	질량중심에너지 ($\sqrt{s_{NN}}$)	연구 주제
2022	납-납	5.02 TeV	j_T
2022	양성자-양성자, 납-납	5.02 TeV	다이제트 질량
2023	양성자-양성자, 납-납	5.02 TeV	다이제트 수직운동량
2023	양성자-양성자, 납-납	5.02 TeV	b-제트 생성량

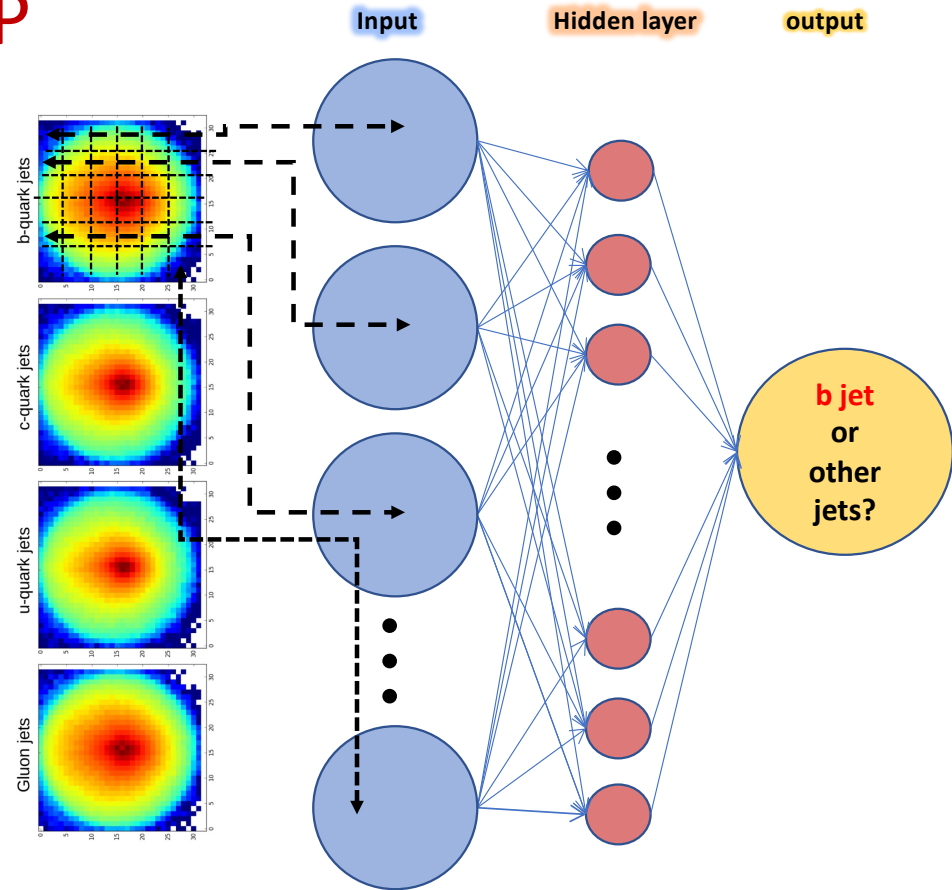
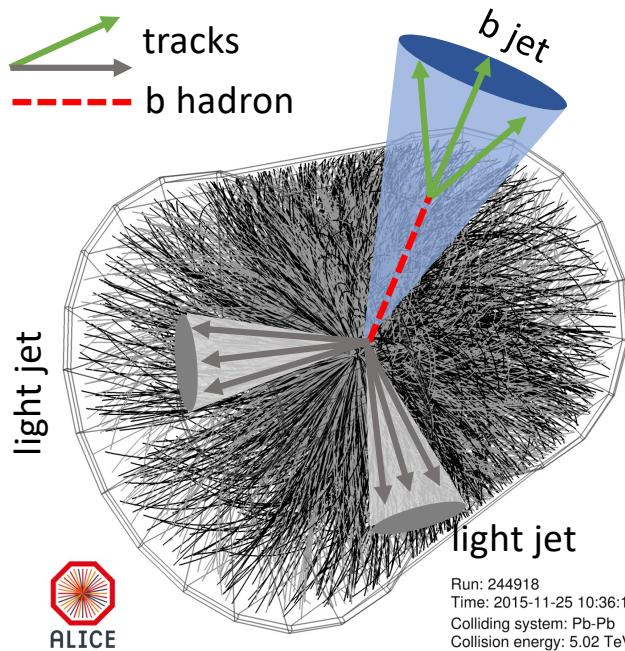
Light flavour hadrons



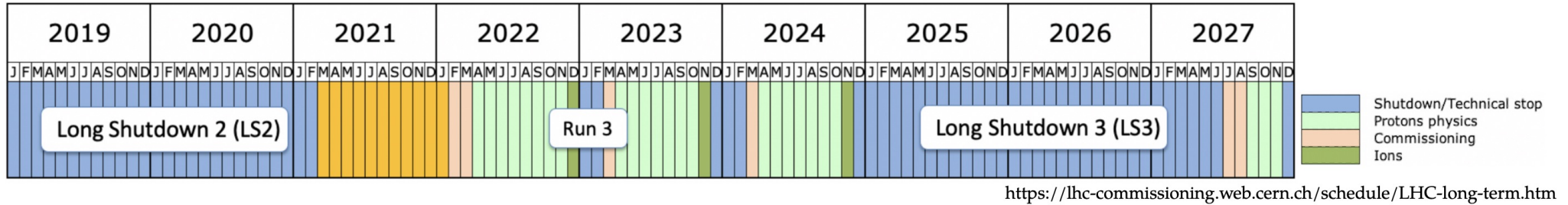
논문 게재 년도	충돌계	질량중심에너지 ($\sqrt{s_{NN}}$)	연구 주제
2021	양성자-양성자	13 TeV	$\Sigma(1385)^\pm, \Xi(1530)^0$
2022	양성자-양성자, 양성자-납	5.02 TeV	$f_0(980)$
2022	양성자-양성자, 납-납	5.02 TeV	$f_0(980)$

b jet and jet separation in QGP

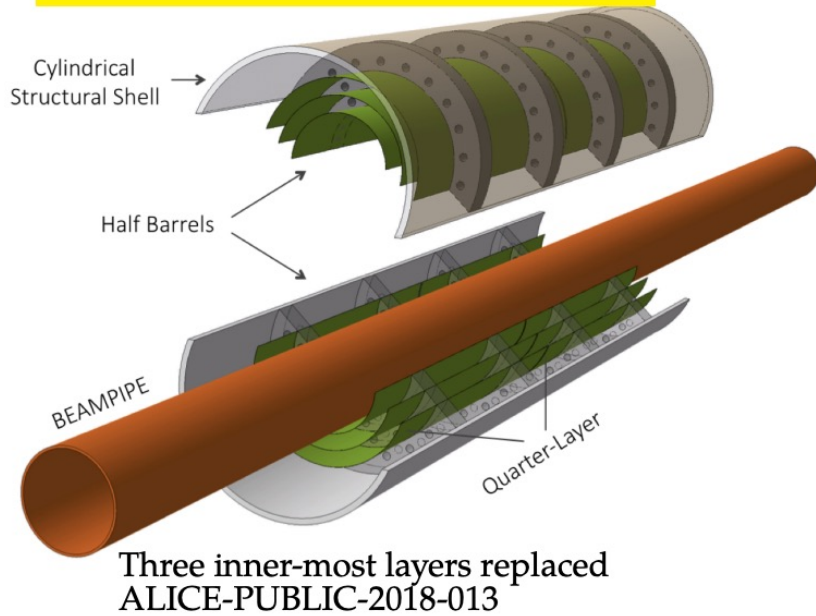
- b quark : excellent probes for the study of QGP
- Produced before the QGP
- Single source of production (hard scattering)
- pQCD calculable
- Can be tagged due to the long lifetime



Longer term (LHC Run 4)

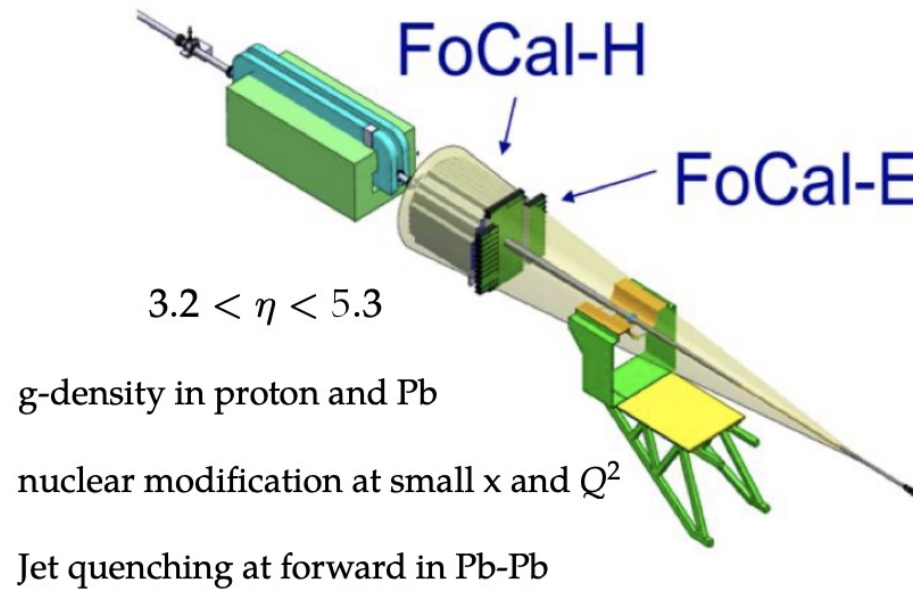


Ultra-light Inner Tracking System 3

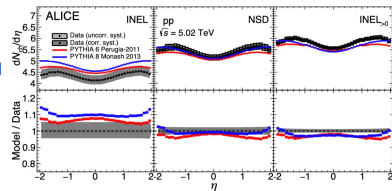


Forward Calorimeter

LoI CERN-LHCC-2020-009



Summary



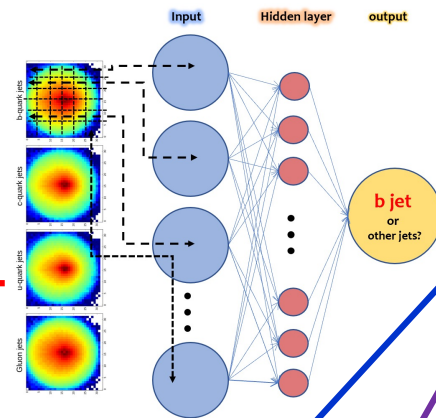
Publishing the ongoing subjects

논문 게재 년도	충돌계	질량중심에너지 ($\sqrt{s_{NN}}$)
2022	납-납 (Pb-Pb)	5.5 TeV
2022-2023	양성자-양성자 (pp)	5.5 TeV
2023	산소-산소 (OO) 그리고 양성자-산소 (pO)	미정
2024	양성자-양성자 (pp) 그리고 양성자-납 (p-Pb)	8.8 TeV

논문 게재 년도	충돌계	질량중심에너지 ($\sqrt{s_{NN}}$)
2021	양성자-납	5.02, 8.16 TeV
2022	양성자-양성자	14 TeV
2023	산소-산소, 양성자-산소	미정

논문 게재 년도	충돌계	질량중심에너지 ($\sqrt{s_{NN}}$)	연구 주제
2021	양성자-양성자	13 TeV	$\Sigma(1385)^\pm, \Xi(1530)^0$
2022	양성자-양성자, 양성자-납	5.02 TeV	$f_0(980)$
2022	양성자-양성자, 납-납	5.02 TeV	$f_0(980)$

AI research for the b-jet study



QGP search in small systems

Jet physics

Year	Systems, $\sqrt{s_{NN}}$	Time	L_{int}
2022	Pb-Pb 5.5 TeV	3 weeks	2.3 nb^{-1}
	pp 5.5 TeV	1 week	3 pb^{-1} (ALICE), 300 pb^{-1} (ATLAS, CMS), 25 pb^{-1} (LHCb)
2023	Pb-Pb 5.5 TeV	5 weeks	3.9 nb^{-1}
	O-O, p-O	1 week	$500 \mu\text{b}^{-1}$ and $200 \mu\text{b}^{-1}$
2024	p-Pb 8.8 TeV	3 weeks	0.6 pb^{-1} (ATLAS, CMS), 0.3 pb^{-1} (ALICE, LHCb)
	pp 8.8 TeV	few days	1.5 pb^{-1} (ALICE), 100 pb^{-1} (ATLAS, CMS, LHCb)

ALICE reference paper

ALICE Run4 upgrade



Backup