

クォーク・核物質研究部門報告

Quark-Nuclear Matters

- ・ 格子QCD 研究
- ・ 宇宙元素合成研究
- ・ QGP/臨界点研究

【拠点・施設】

ALICE/LHC, STAR/RHIC
J-PARC, RIKEN/RIBF, GSI/FAIR
計算科学研究センター
宇宙史研究センター

クォーク・核物質研究部門 部門長：江角晋一(p)

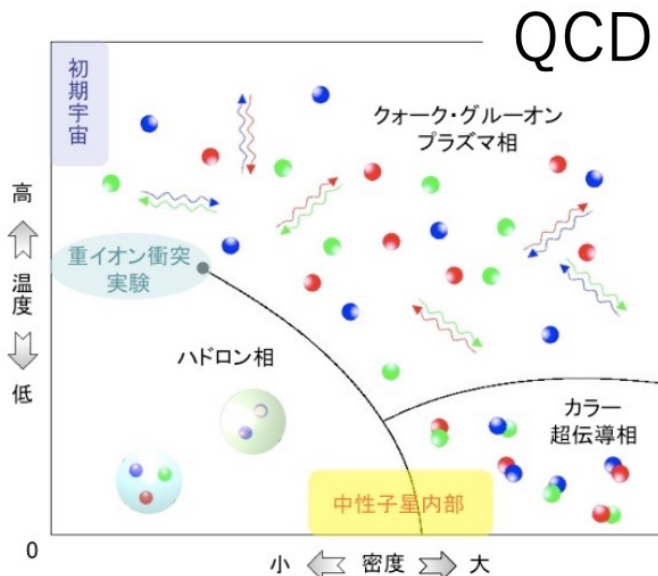
構成教員：小澤 顕(p)、中條達也(l)、Norbert Novitzky(a海外unit副PI)、新井田貴文(a)、野中俊宏(a)、轟木貴人(a)、三明康郎(p特命)、金谷和至(p特命)、山口貴之(apCA:埼玉大)、小沢恭一郎(apCA:KEK)、佐甲博之(pCA:原研)、Thomas Peitzmann(p海外unitPI: Utrecht大)、Marco van Leeuwen(p海外unitPI: Utrecht大)

連携教員：藏増嘉伸(p)、谷口裕介(ap)、笹公和(ap)、森口哲朗(a)、杉立徹(p客員:広大)、濱垣秀樹(p客員:長崎総合科学大)、秋葉康之(p客員:理研)、若杉昌徳(p客員:京大)、永宮正治(p:理研)、郡司卓(ap:東大)、志垣賢太(p:広大)、齋藤武彦(p客員:理研)、山口由高(ap客員:理研)、**稲葉基**(ap客員)

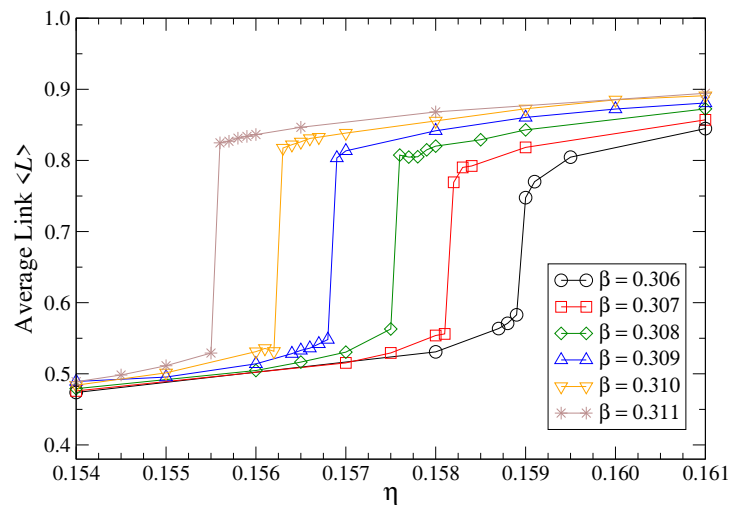
研究員：坂井真吾、Ashutosh Kumar Pandey、鈴木伸司、**Abderrahmane Ghimouz** : 筑波技大)

離職された方 _____

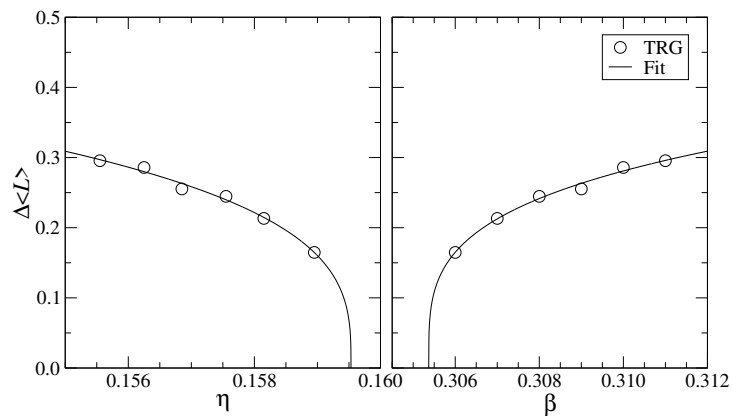
格子QCD計算によるQCD相転移・相構造の研究



一次相転移



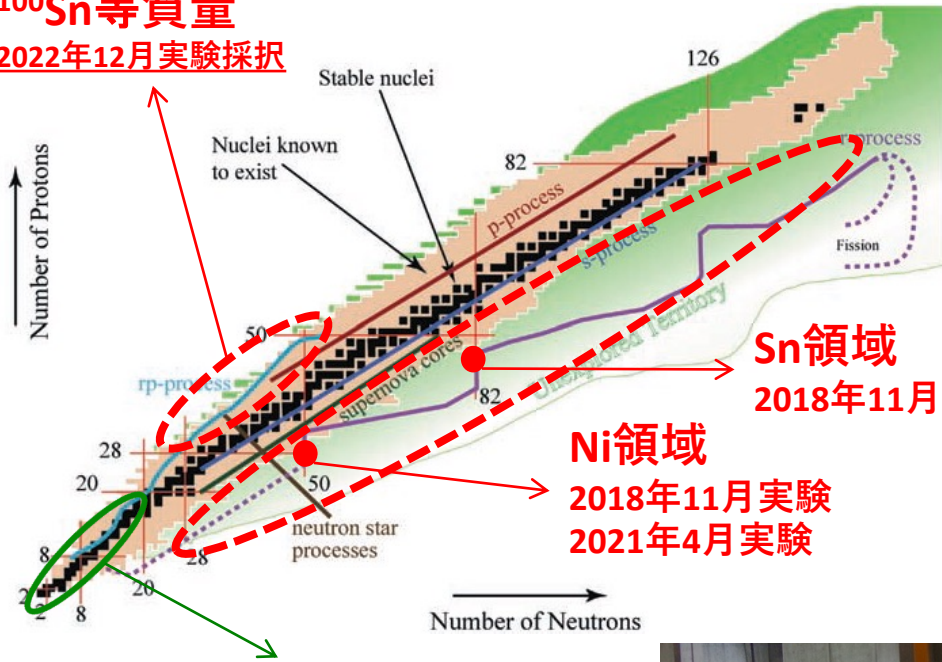
臨界終点の決定



宇宙元素合成の研究

^{100}Sn 等質量

2022年12月実験採択



Sn領域
2018年11月実験

Ni領域
2018年11月実験
2021年4月実験

核半径測定： ^{17}Ne , ^{17}F
核モーメント測定： ^{30}P

稀少RIリング@ RIBF (理研)

21世紀に解決すべき科学上の11大問題
「重元素はいかにして造られたのか？」

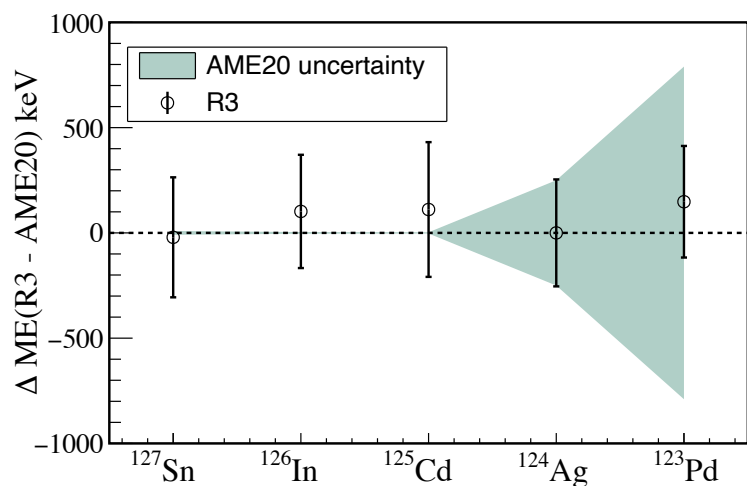
重元素の生成過程を探る
重元素合成仮説(Rプロセス)
不安定核の質量測定が必須

- 日本初の不安定用蓄積リング
- 筑波大中心で約10年かけて製作
- 2015年、3月完成
- 2018年、11月質量測定実験 (Ni、Sn領域)
- 2021年、4月 Ni領域の2度目の実験
- 2022年、12月 ^{100}Sn 領域の実験採択



- 2018年11月に行ったSn領域の実験の結果を **PRL128, 15702 (2022)** に出版した。

Nucleus	ME_{AME20} [keV]	ME_{R3} [keV]	σ_{total} [keV]	σ_{m_0} [keV]	σ_{stat} [keV]	σ_{sys} [keV]
^{126}In	-77809(4)	-77707	269	254	65	62
^{125}Cd	-73348.1(29)	-73237	320	252	192	40
^{123}Pd	-60430(790)	-60282	265	248	86	40



^{123}Pd の質量誤差を改善した。

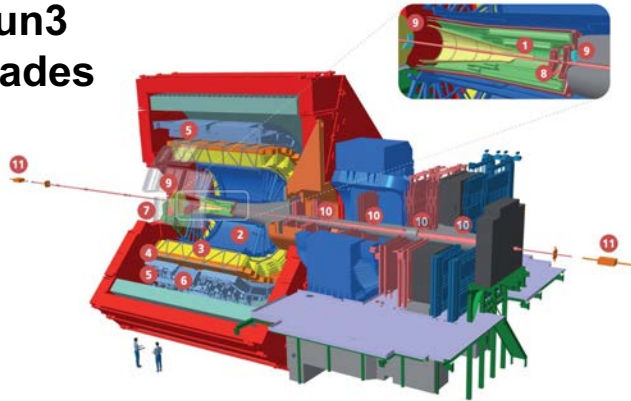
- 2021年度の稀少RIリングの実験では、キッカー磁石不調（放電、コンデンサー故障など）があった。
- キッカー磁石のアップグレード（放電箇所補修、コンデンサー交換など）が進行中。



- 2023年秋にマシンスタディを予定

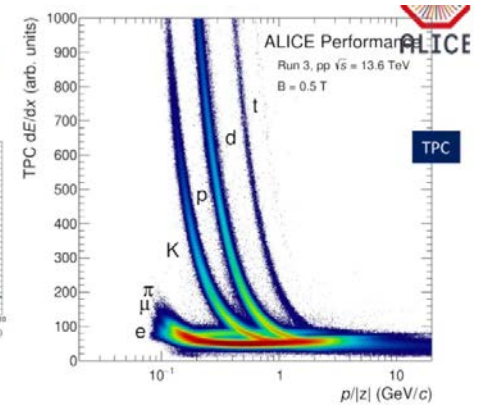
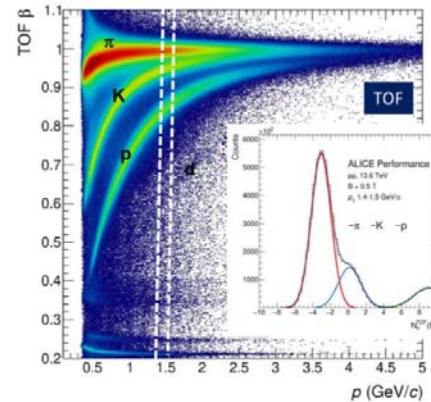
Quark Gluon Plasma/QCD相構造研究

ALICE Run3 with upgrades



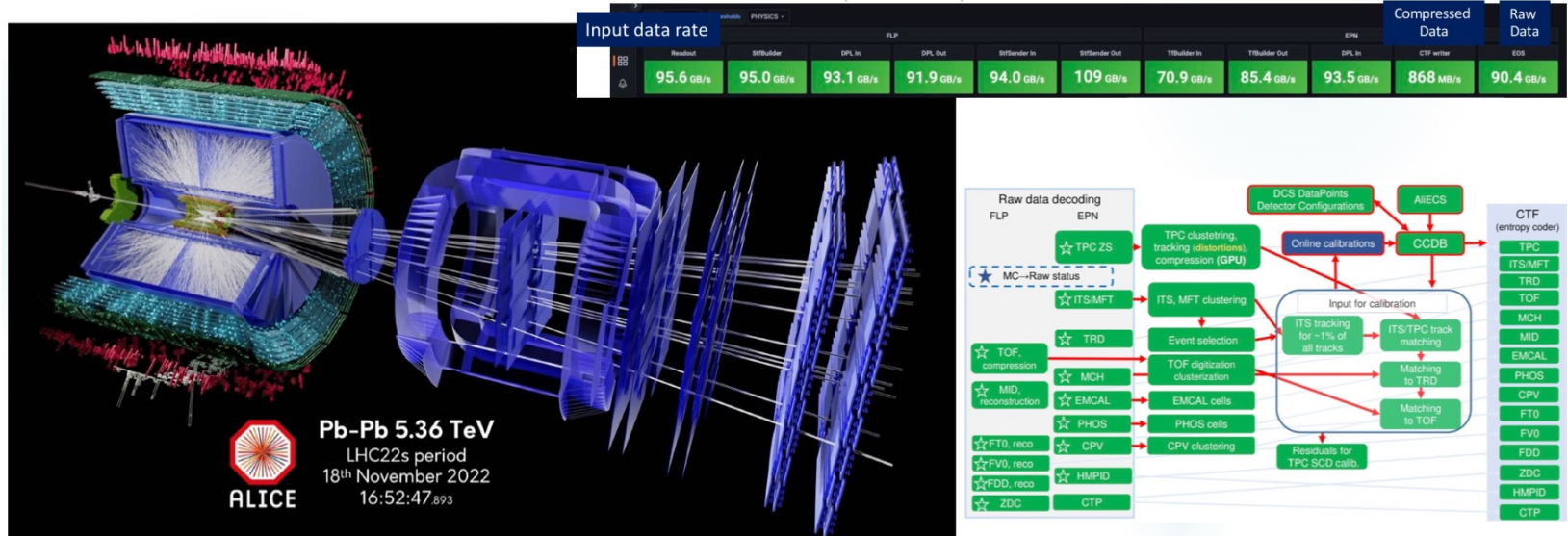
Run3 PbPb test run

- All ALICE 15 detectors in the data taking
- Online calibrations and reconstruction (including most central events)
- TPC IDC FLP workflow running all time
- 3.68 PB of data recorded (CTF and Raw TF)

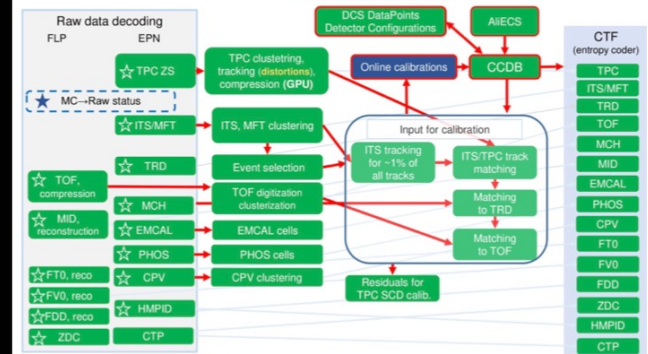


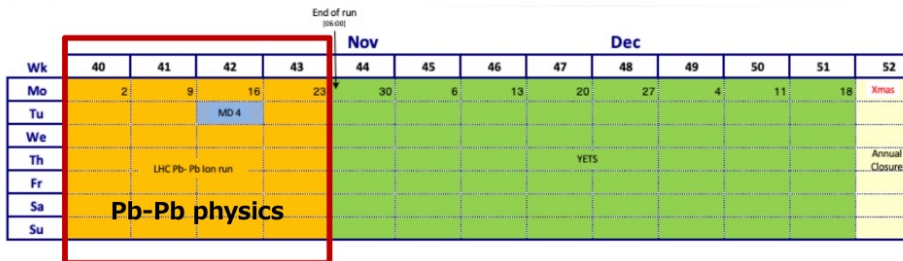
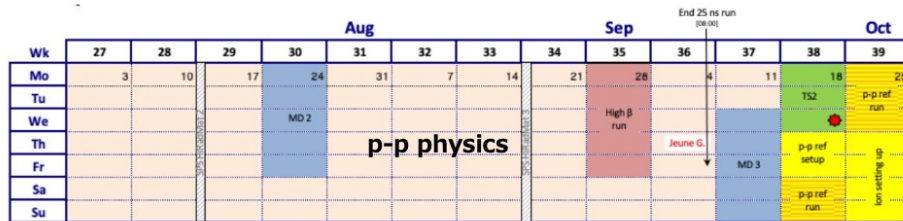
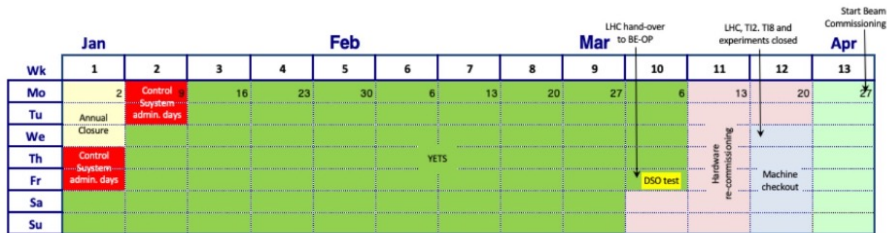
LHC conditions

- Proton cycle: 6.8 Z TeV (5.36 TeV) 😊
- $\beta^* = 10$ m in IP2 😞
- Slip-stacking tests \rightarrow 2 fills
- Crystal collimation tests

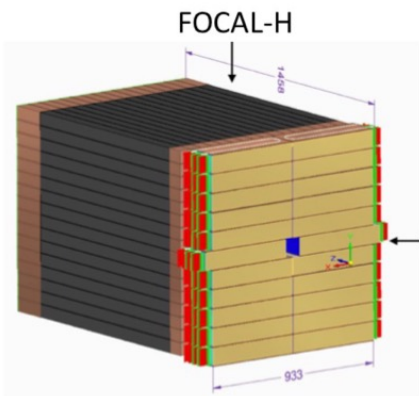
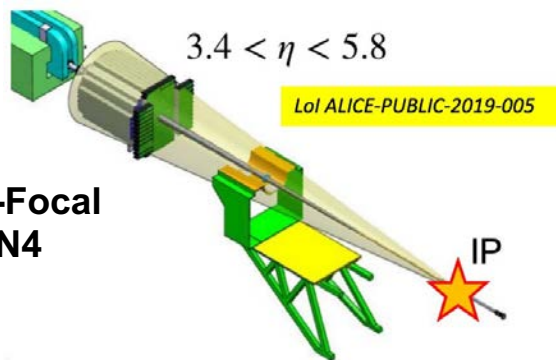


Pb-Pb 5.36 TeV
LHC22s period
18th November 2022
16:52:47.893

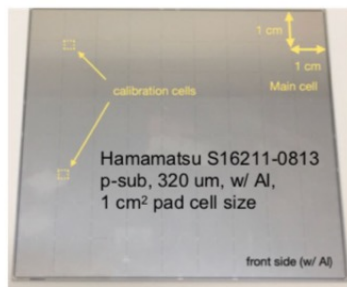




ALICE-Focal for RUN4

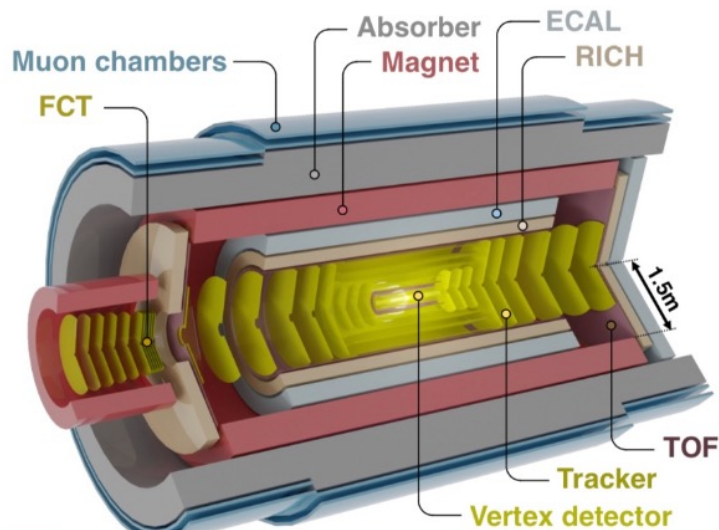


Si-pad sensor

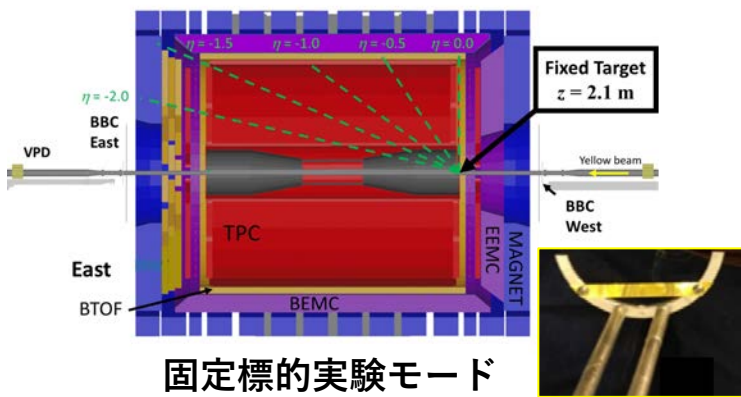
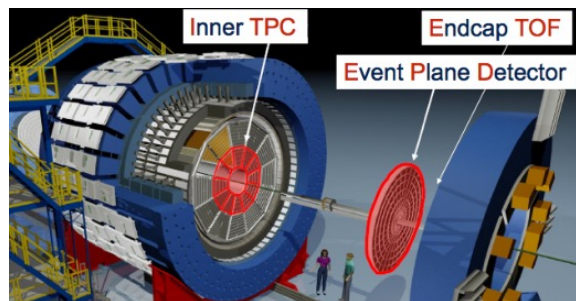
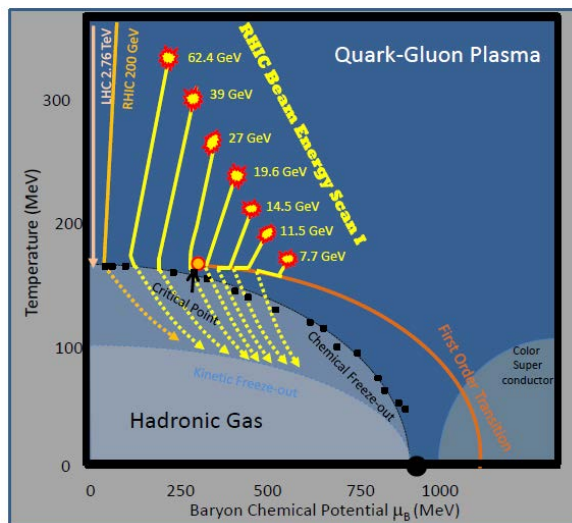


FOCAL-H

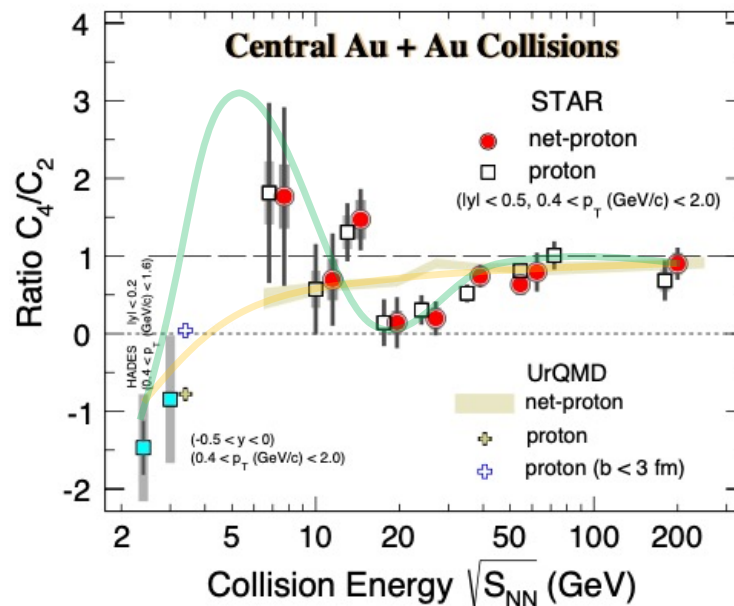
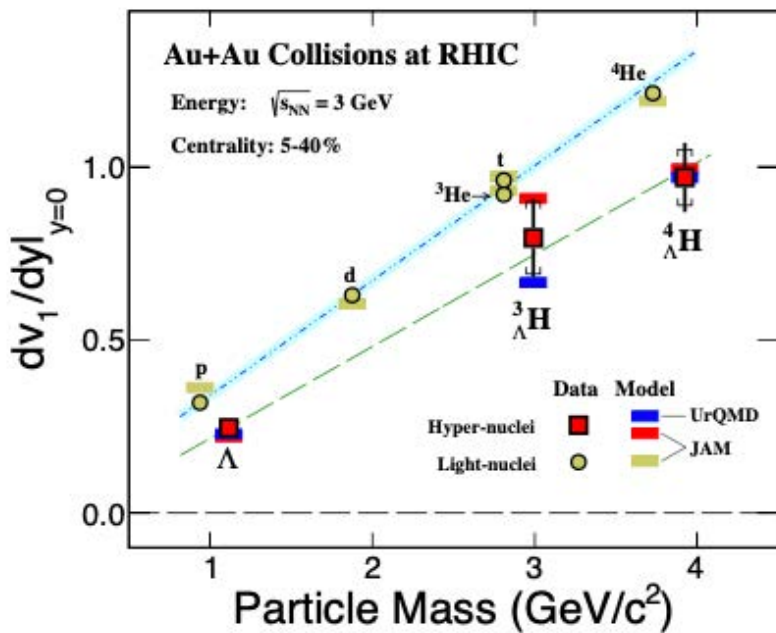
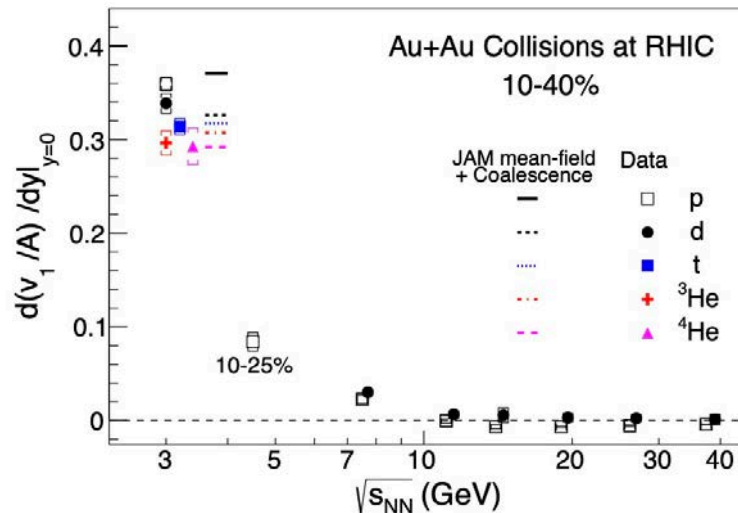
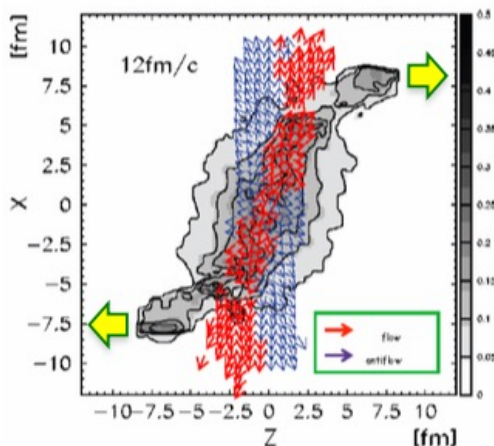
ALICE3 proposal for RUN5-

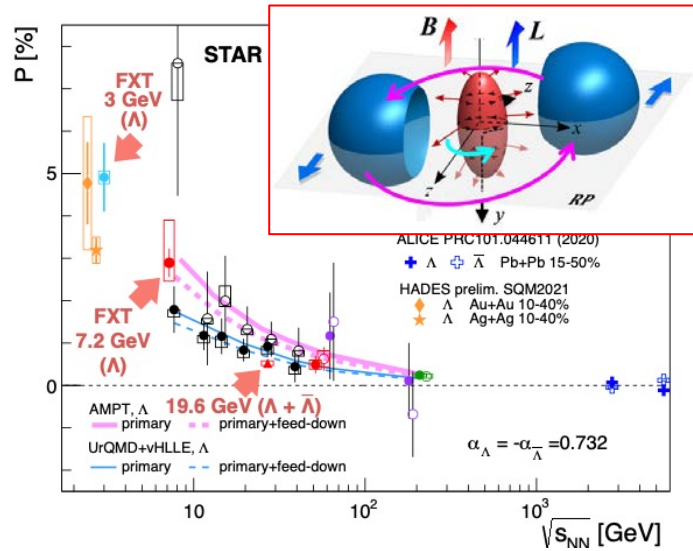
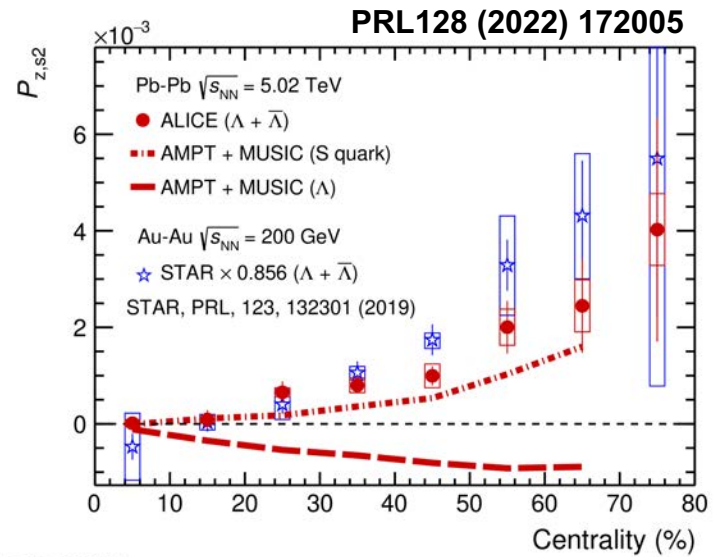
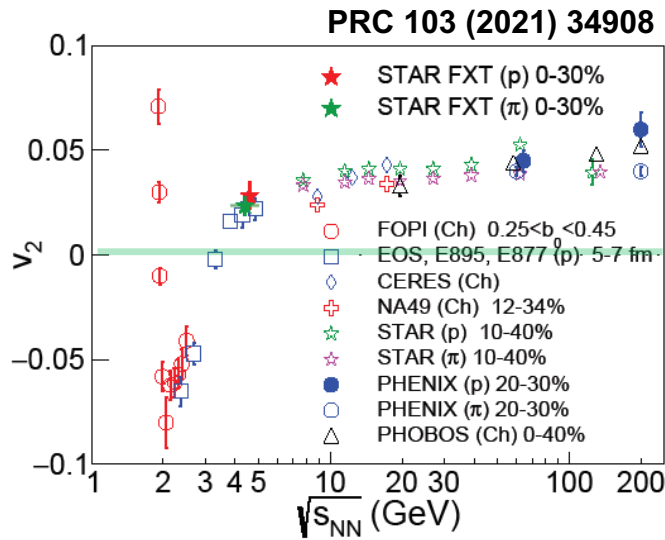


Beam Energy Scan at RHIC-STAR

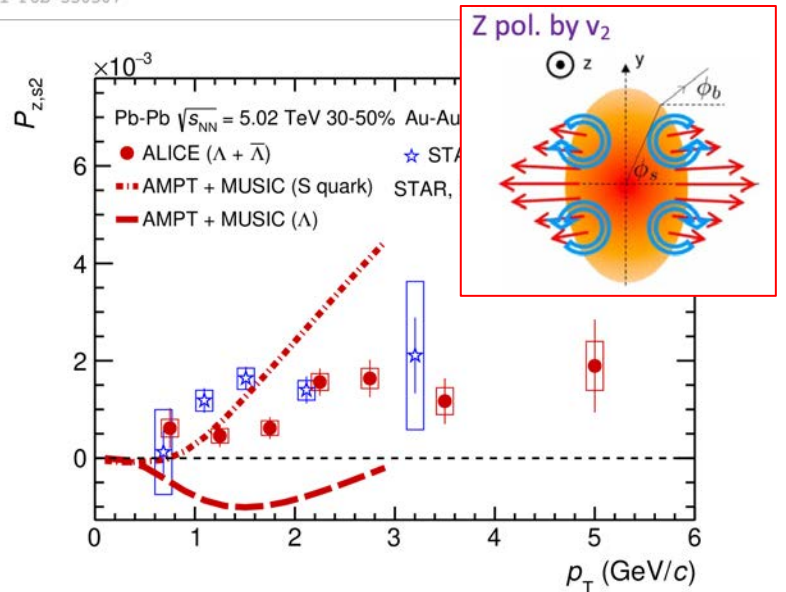


2018	Start	Stop	Good	Target	Status
27 GeV	May 10 th	June 17 th	555 M	700 M	Final
3.0 FXT	May 30 th	June 4 th	258 M	100 M	Final
7.2 FXT	June 11 th	June 12 th	155 M	none	Final
2019	Start	Stop	Good	Target	Status
19.6 GeV	Feb 25 th	April 3 rd	478 M	400 M	Preliminary
14.6 GeV	April 4 th	June 3 rd	324 M	310 M	Post-prod QA
3.9 FXT	June 18 th	June 18 th	52.7 M	50 M	Produced
3.2 FXT	June 28 th	July 2 nd	200.6 M	200 M	Post-prod QA
7.7 FXT	July 8 th	July 9 th	50.6 M	50 M	Produced
200 GeV	July 11 th	July 12 th	138 M	140 M	Produced
2020	Start	Stop	Good	Target	Status
11.5 GeV	Dec 10 th	Feb 24 th	235 M	230 M	Summer
7.7 FXT	Jan 28 th	Jan 29 th	112.5 M	100 M	Produced
4.5 FXT	Jan 29 th	Feb 1 st	108 M	100 M	Produced
6.2 FXT	Feb 1 st	Feb 2 nd	118 M	100 M	Produced
5.2 FXT	Feb 2 nd	Feb 3 rd	103 M	100 M	Produced
3.9 FXT	Feb 4 th	Feb 5 th	117 M	100 M	Produced
3.5 FXT	Feb 13 th	Feb 14 th	115.6 M	100 M	Produced
9.2 GeV	Feb 24 th	Sep 1 st	161.8 M	160 M	Summer
7.2 FXT	Sep 12 th	Sep 14 th	317 M	None	Fall
2021	Start	Stop	Good	Target	Status
7.7 GeV	Jan 31 st	May 1 st	100.9 M	100 M	May
3.0 FXT	May 1 st	June 28 th	2103 M	2.0 B	Fall
9.2 FXT	May 6 th	May 6 th	53.9 M	50 M	Fall
11.5 FXT	May 7 th	May 7 th	51.7 M	50 M	Fall
13.7 FXT	May 8 th	May 8 th	50.7 M	50 M	Fall
17.3 GeV	May 25 th	June 7 th	256.1 M	250 M	Fall
7.2 FXT	June 3 rd	July 3 rd	88.6 M	None	Fall





ALI-PUB-530307



ALI-PUB-530311

さらに高密度領域へ 臨界点の向こう側へ

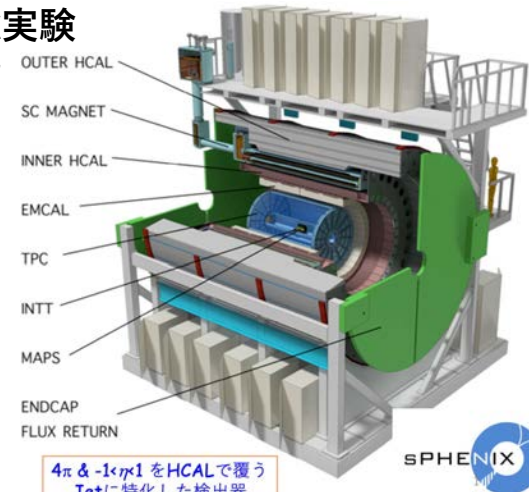


原研・東海村 J-PARC重イオン



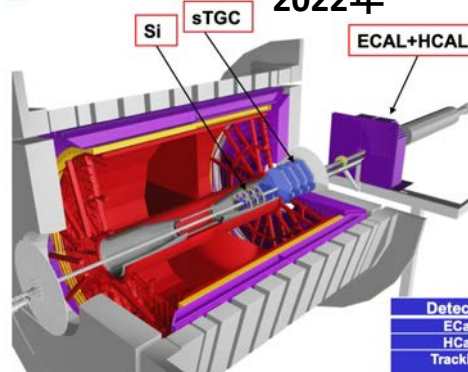
sPHENIX実験

2023年~



RHIC → eICへ

STAR実験 前方アップグレード 2022年~



- At $2.5 < \eta < 4$
- Jets
 - PID ($\pi^0, \gamma, e, \Lambda$)
 - charged particle momentum resolution 20-30% at $0.2 < p_T < 2$ GeV/c
 - event-plane reconstruction and trigger capability

Detector	pp and pA	AA
ECal	~10%/√E	~20%/√E
HCal	~50%/√E+10%	---
Tracking	charge separation photon suppression	$0.2 < p_T < 2$ GeV/c with 20-30% $1/p_T$

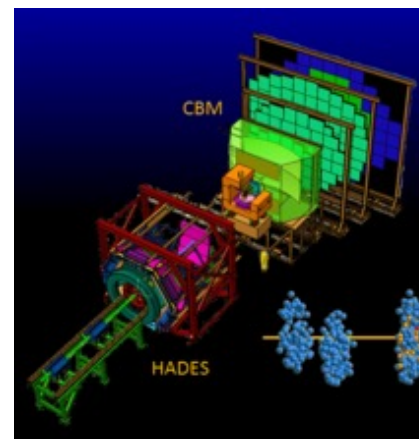


ドイツ

GSI/FAIR-CBM

中国

HIAF/HIRFL-CSR



クォーク・核物質研究部門の
TCHoU-Workshopとして

前方物理に関する国際会議
2023年3月13-15日（筑波大）



高バリオン密度に関する国際会議
2023年4月29-30日（筑波大）



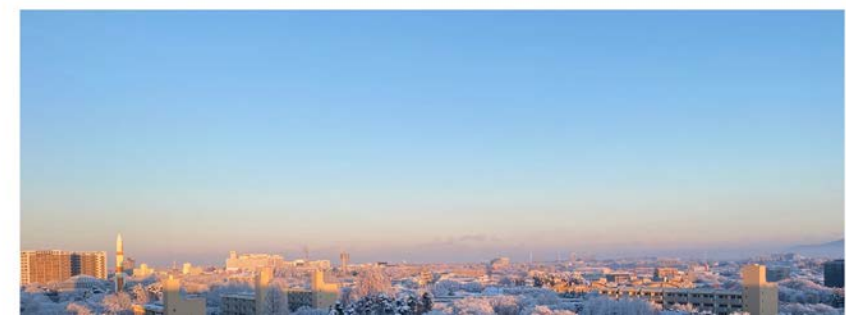
2nd International Workshop on Forward Physics and Forward Calorimeter Upgrade in ALICE

13-15 Mar 2023
Tsukuba
Japan timezone

<https://indico.cern.ch/event/1235107/>

- Overview
- Timetable
- Contribution List
- Registration
- Participant List
- Accommodation
- Visa

2nd International Workshop on Forward Physics and Forward Calorimeter Upgrade in ALICE



Workshop on Highly Baryonic Matter at RHIC-BES and Future Facilities --- beyond the Critical Point towards Neutron Stars ---

April 29-30 (Sat-Sun) 2023, Room-1D201/1D204, Area-1, Ur

Workshop on Highly Baryonic Matter at RHIC-BES and Future Facilities --- beyond the Critical Point towards Neutron Stars --- (WHBM 2023)

29-30 April 2023
Central Area 1, Tsukuba Campus, University of Tsukuba
Asia/Tokyo timezone

<https://conference-indico.kek.jp/event/205/>