Exotic Phases of Matter
Quark-Gluon Plasma

Masakiyo Kitazawa
(YITP, Kyoto)

Nichi-Doku Joint Lecture, 2025/4/18, HUOK, Kyoto University

My Journey to Germany

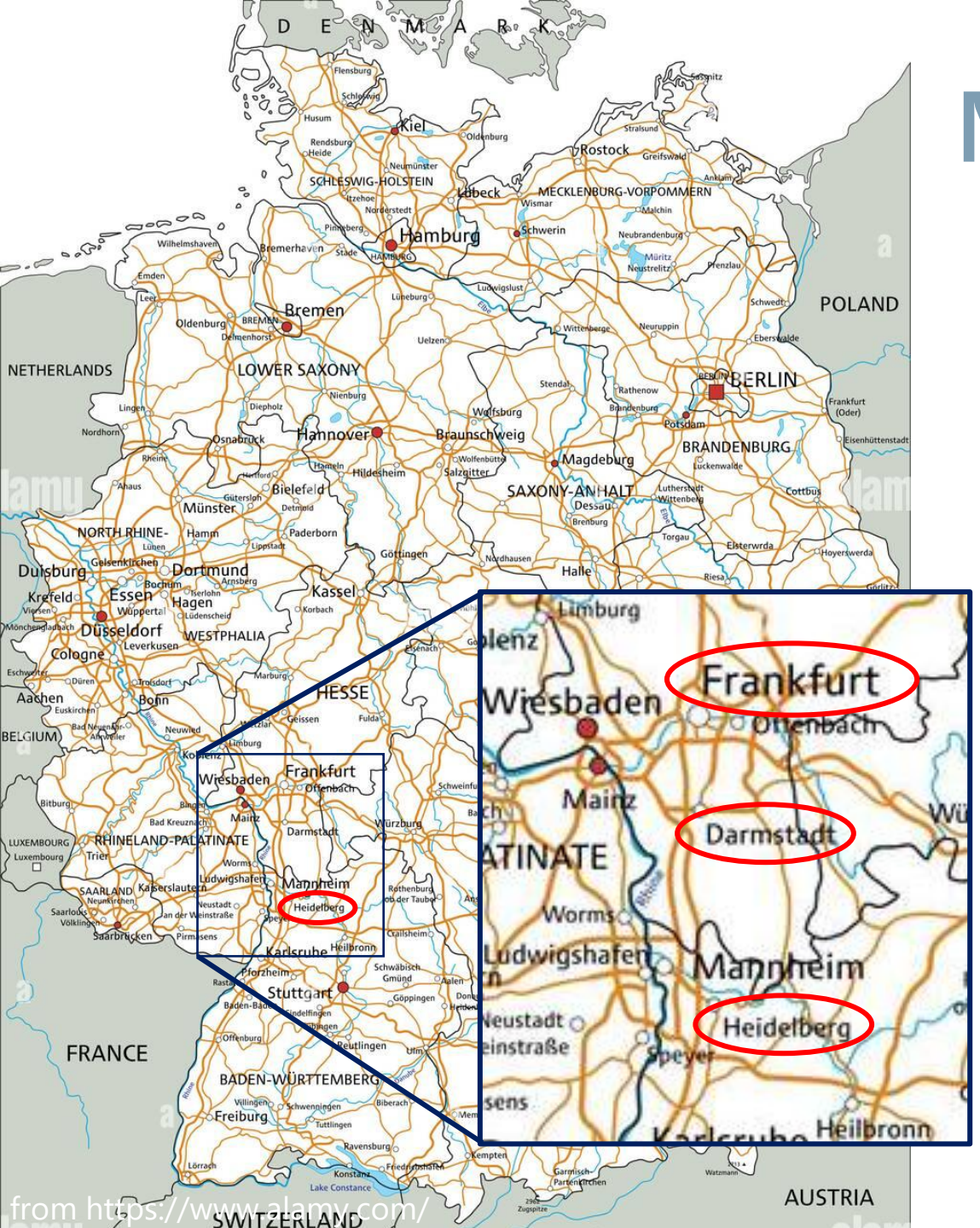
in April 8-16, 2025

April. 8-12 Frankfurt

— International Conference
— "Quark Matter 2025"

April 12-15 Darmstadt

— International Workshop at GSI
— "Physics of High net-baryon Densities"



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Apr

Heidelberg U. in 2005

Quark Matter 2025

Topics

- Quark-gluon plasma
- Relativistic heavy-ion collisions
- …

6-12 April 2025 about **1000 participants**

GSI in Darmstadt

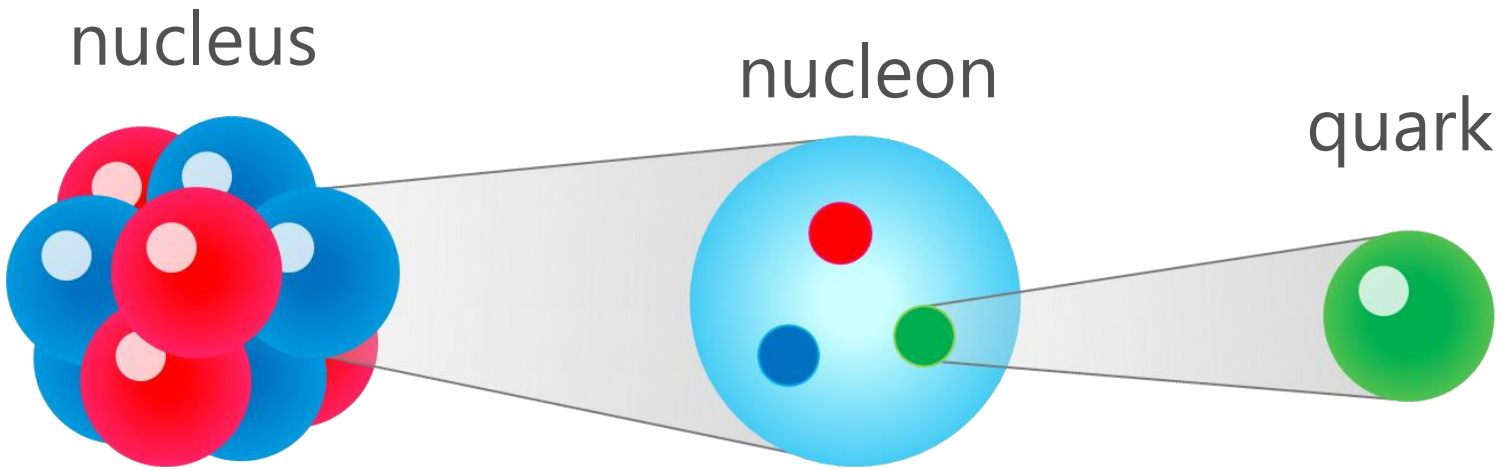
Workshop “Physics of High net-baryon Densities”
12-14 April 2025, GSI

FAIR Phase 0 Research Program

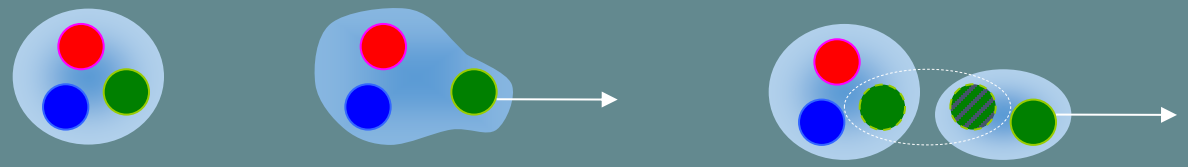
FAIR:
New accelerator / experimental halls under construction

CBM:
Compressed Baryonic Matter

Building Blocks of Matter

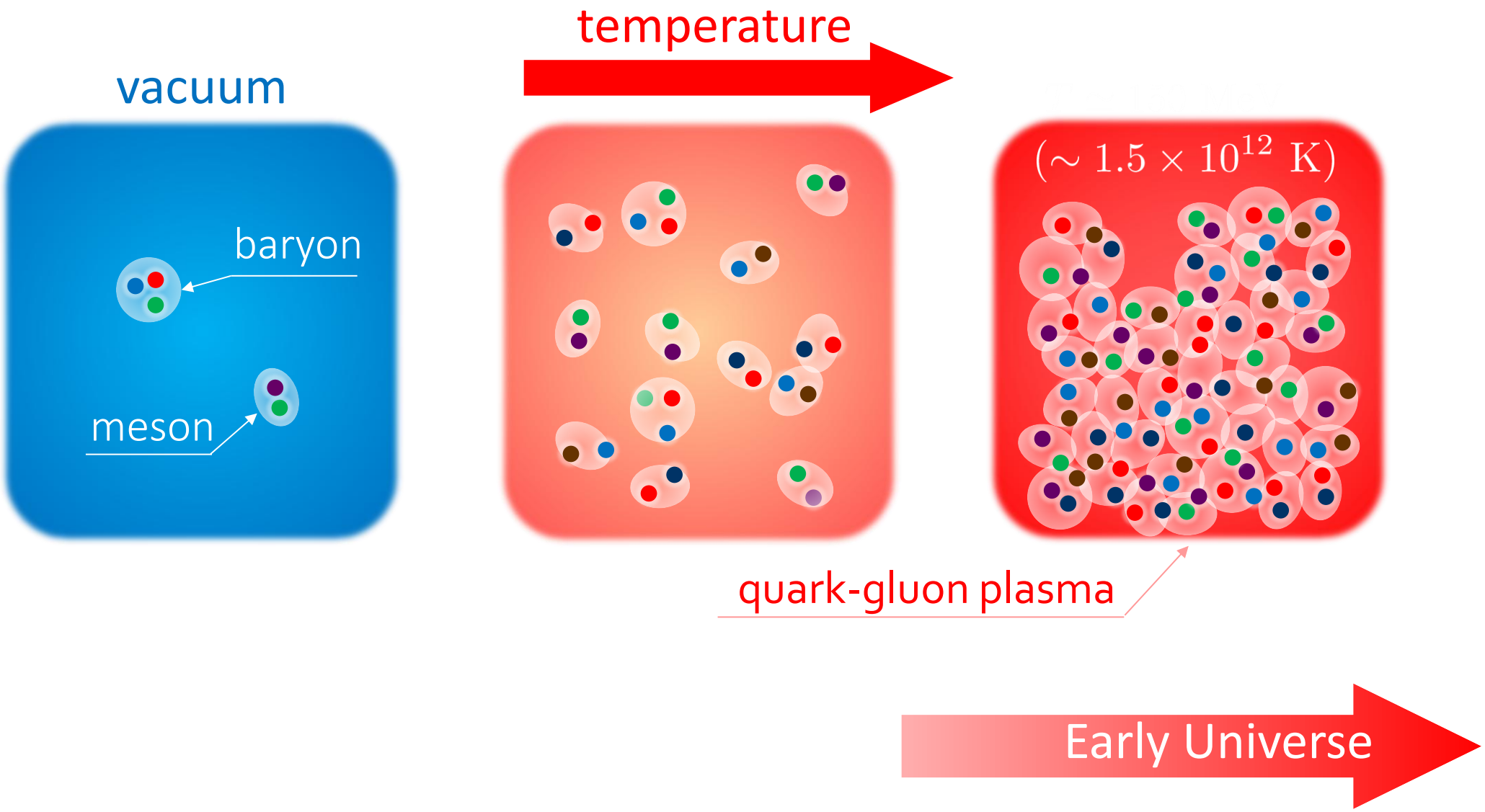


If one wants to pick up a quark from a nucleon…

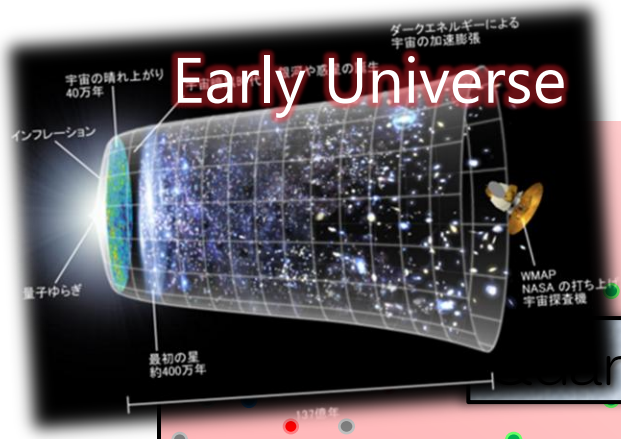


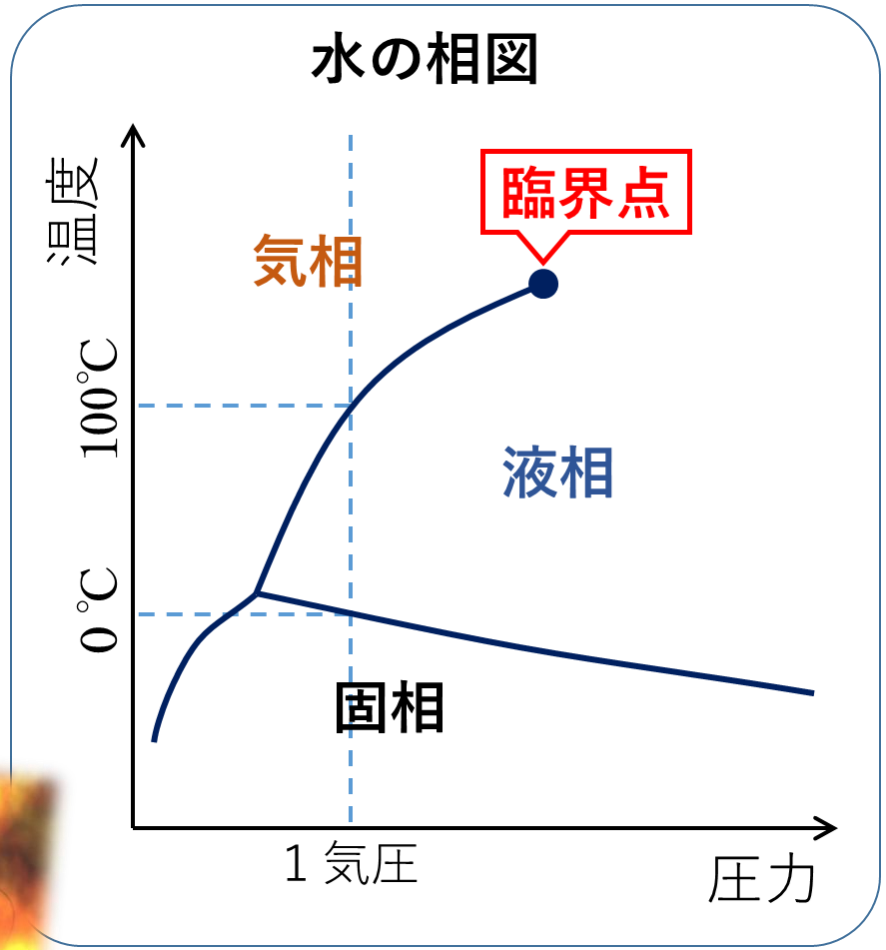
A meson is formed via $\bar{q}q$ pair production.

Quark-Gluon Plasma

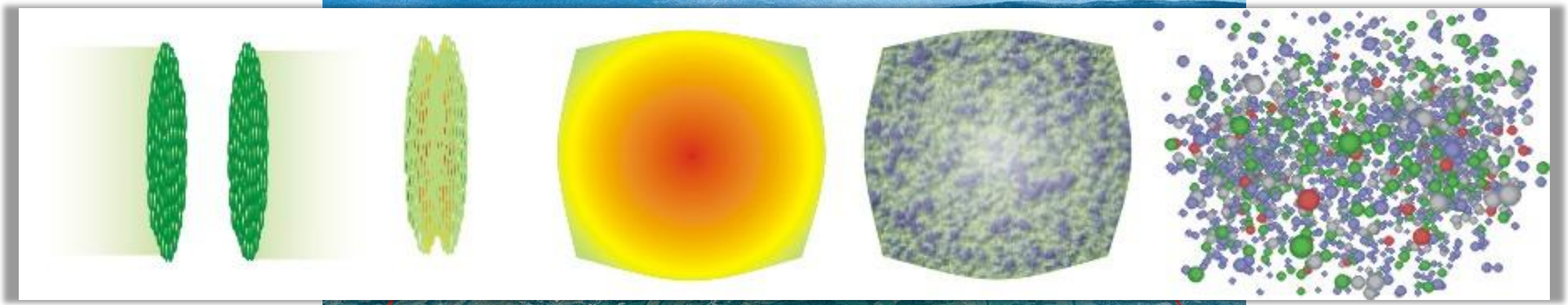


QCD Phase Diagram

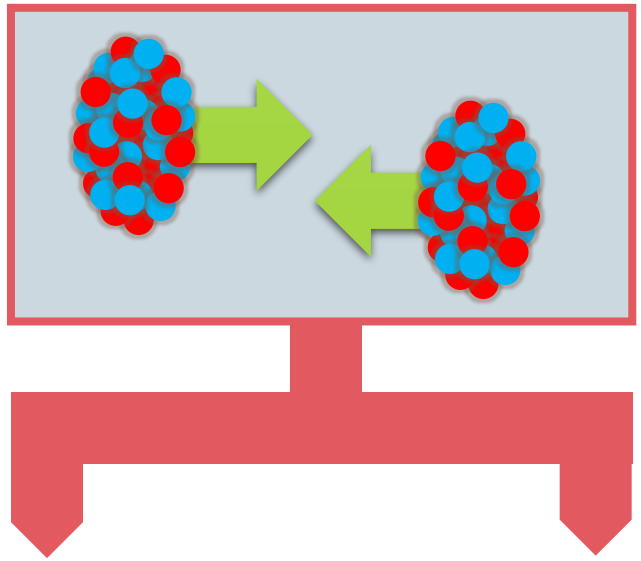




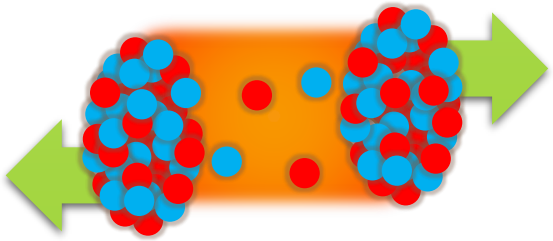
Relativisitc Heavy-Ion Collisions



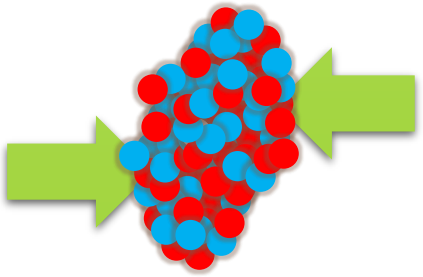
Beam-Energy Scan



High E

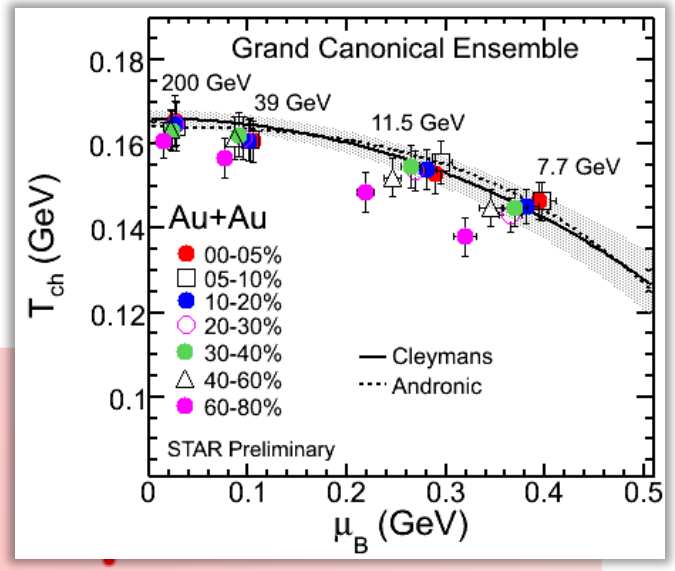


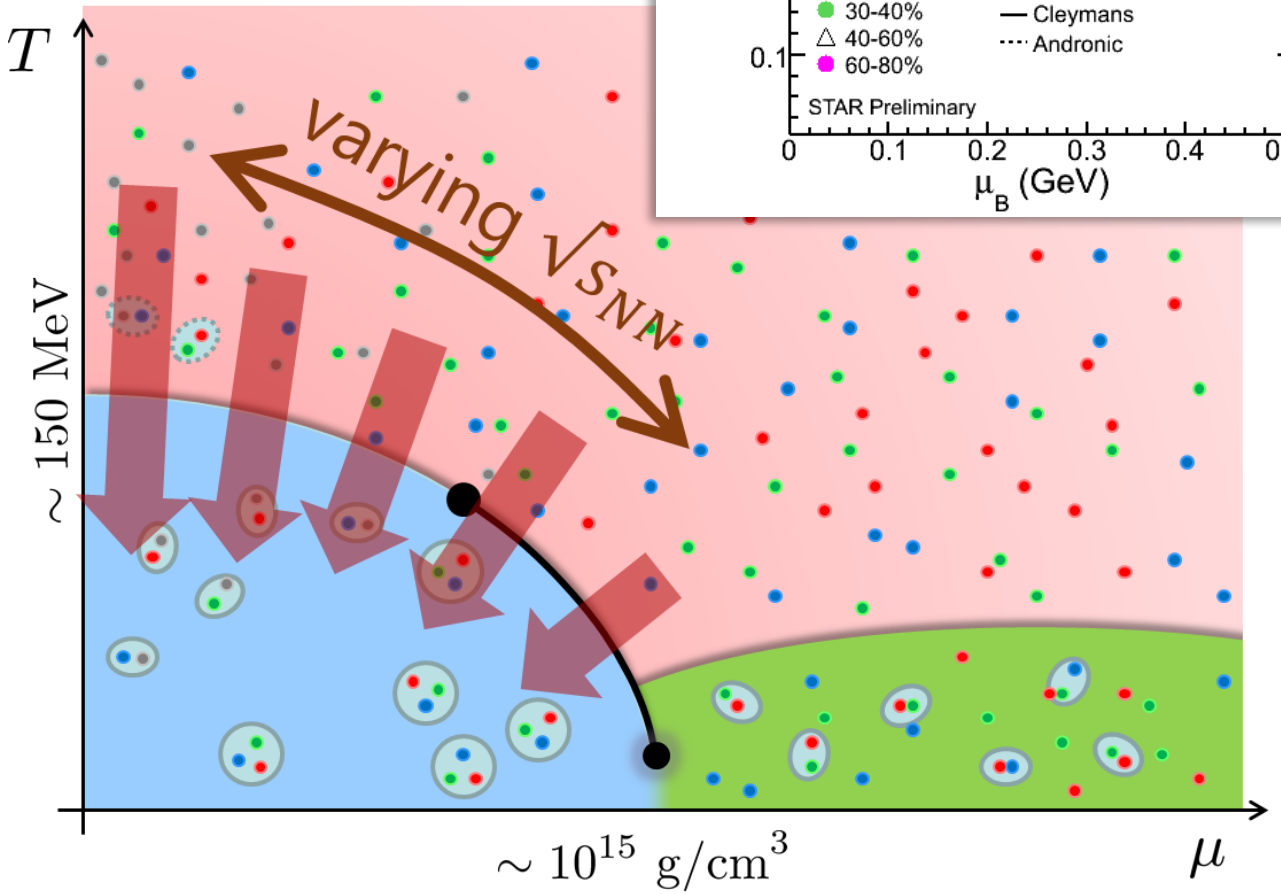
Low E



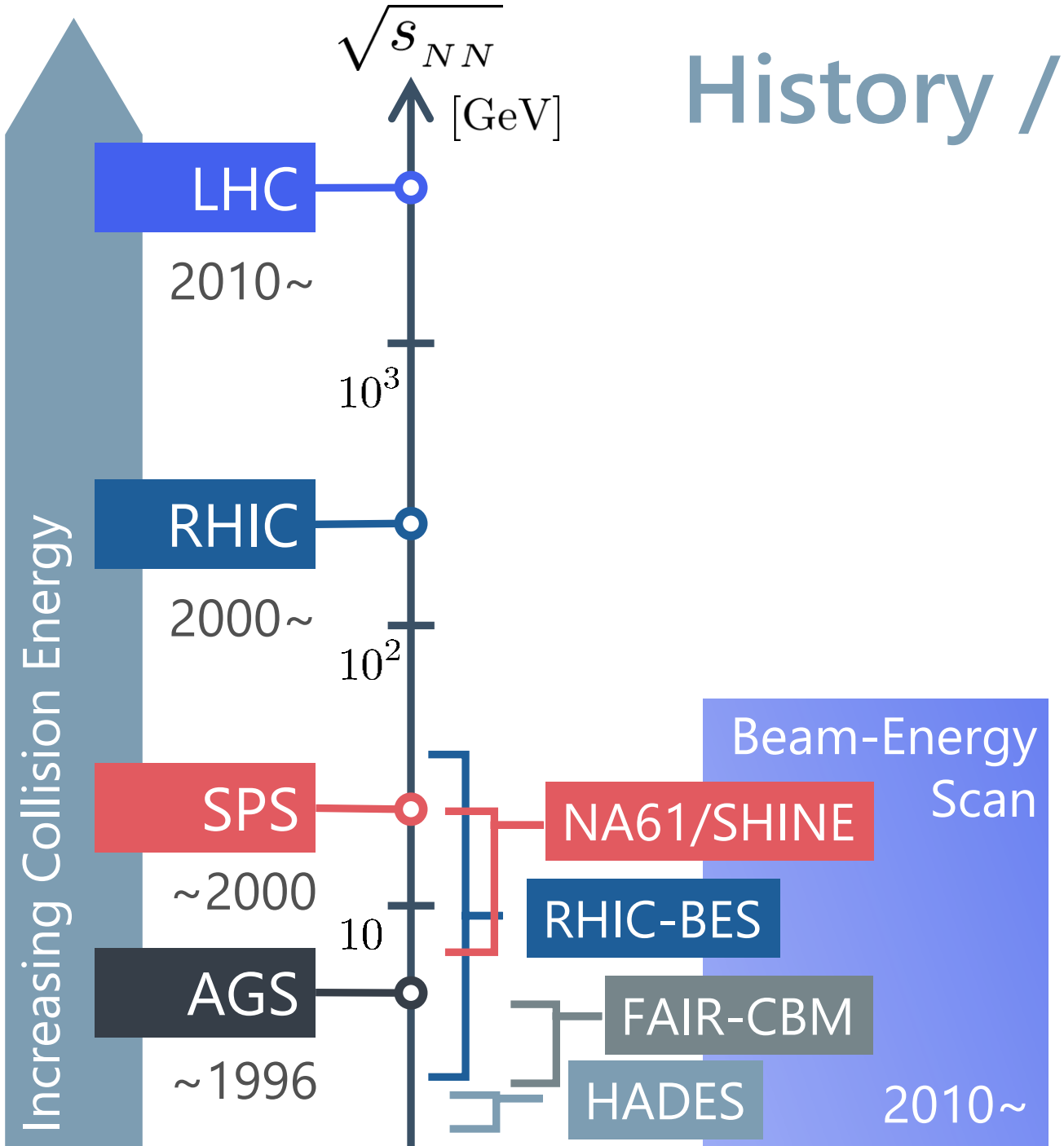
Baryon stopping

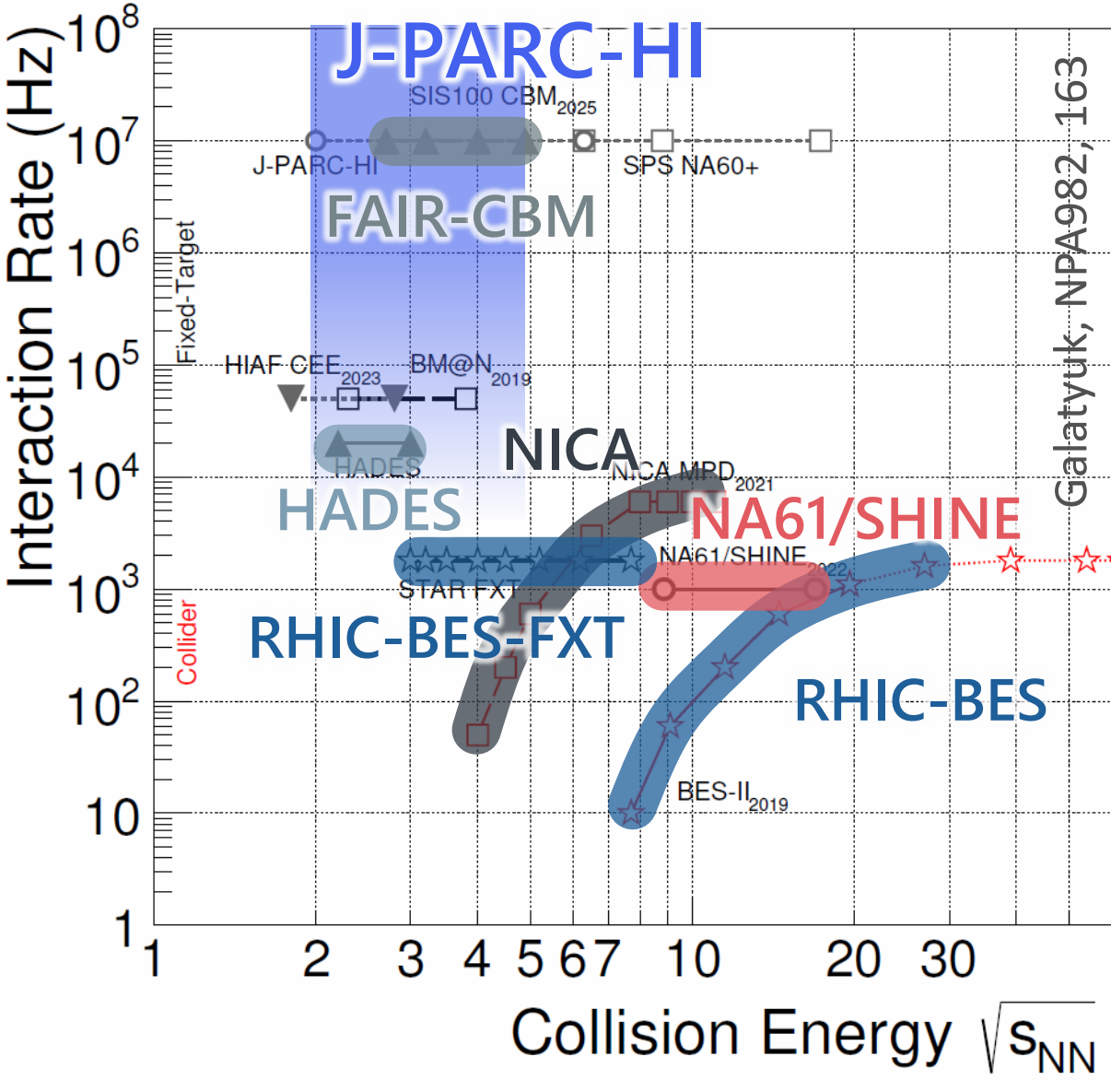
STAR, 2012





History / Current Status of HIC

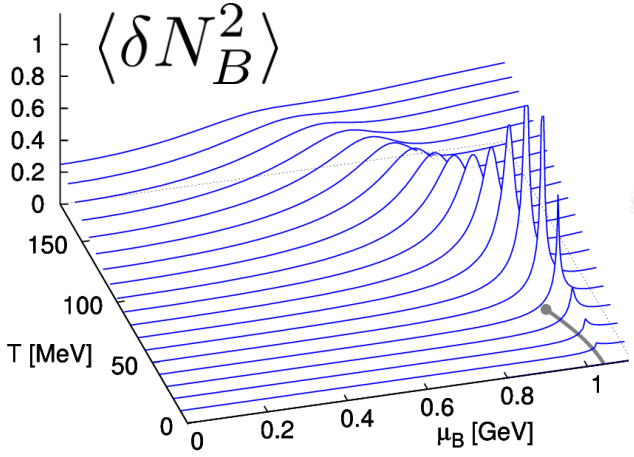




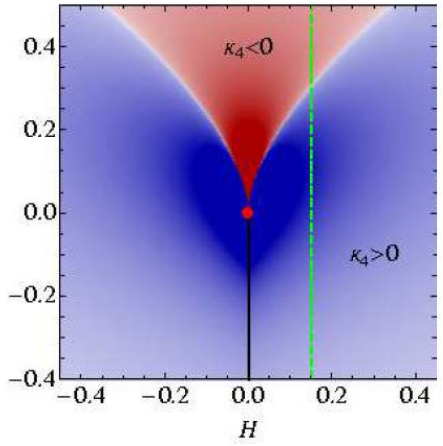
Search for QCD Critical Point

Conserved charge fluctuations

— Higher-order cumulants
— Signal of QCD CP



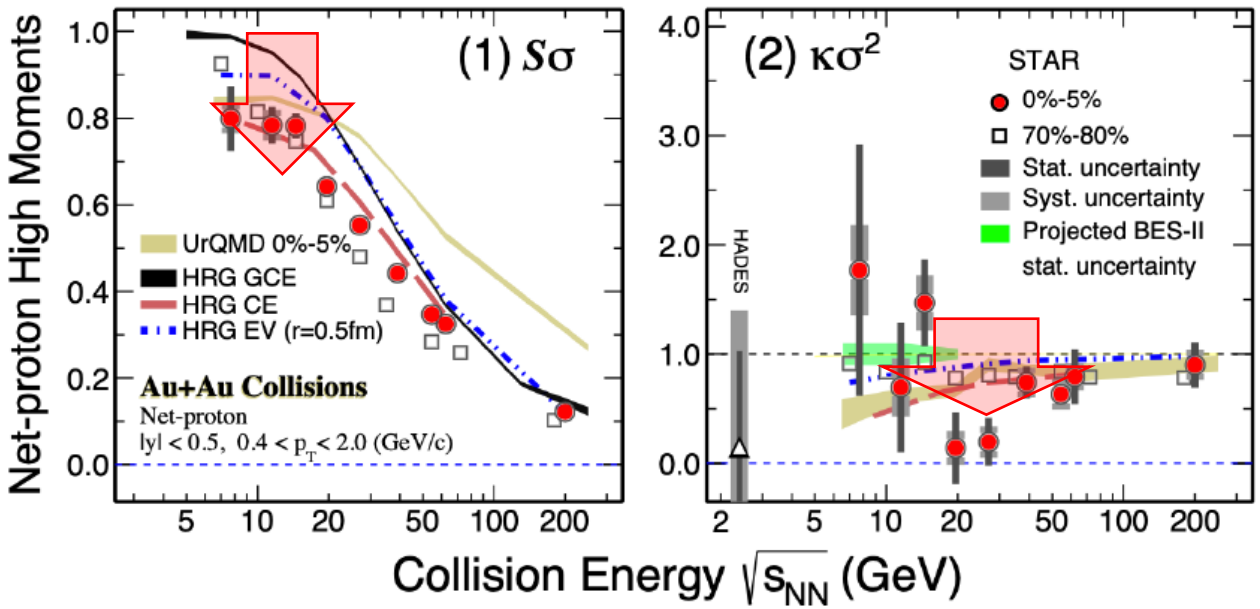
Asakawa, Ejiri, MK (2009)



Stephanov (2011)

Experimental Result

STAR (2022)



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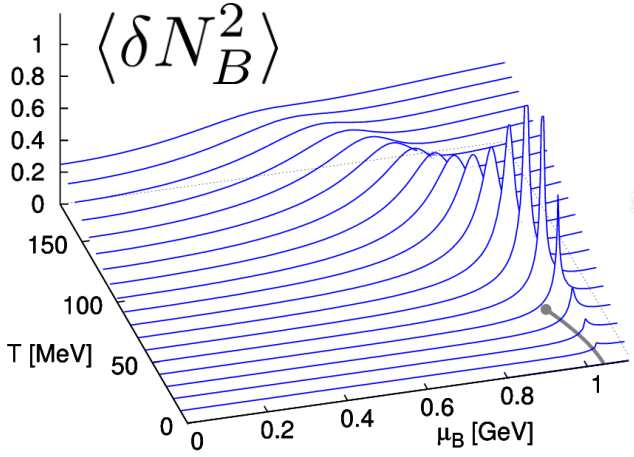

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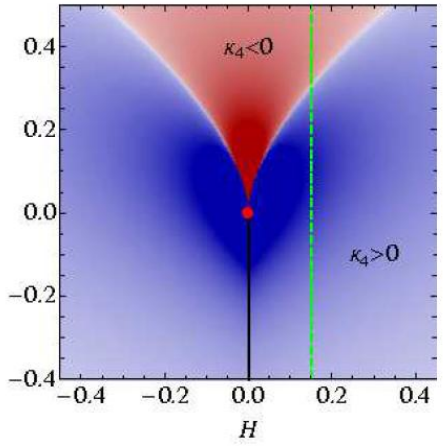

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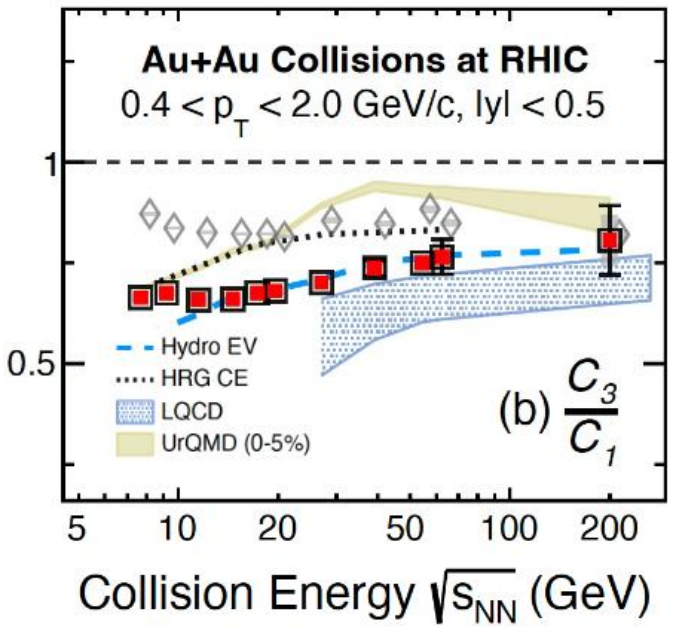
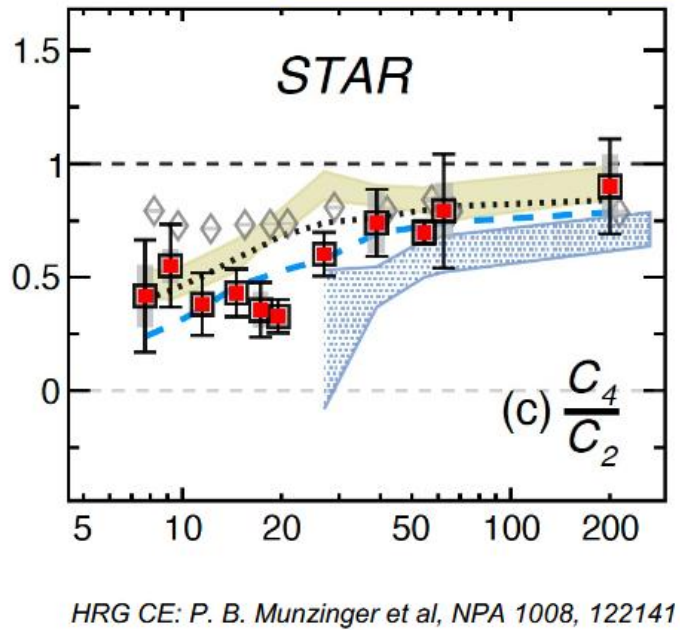
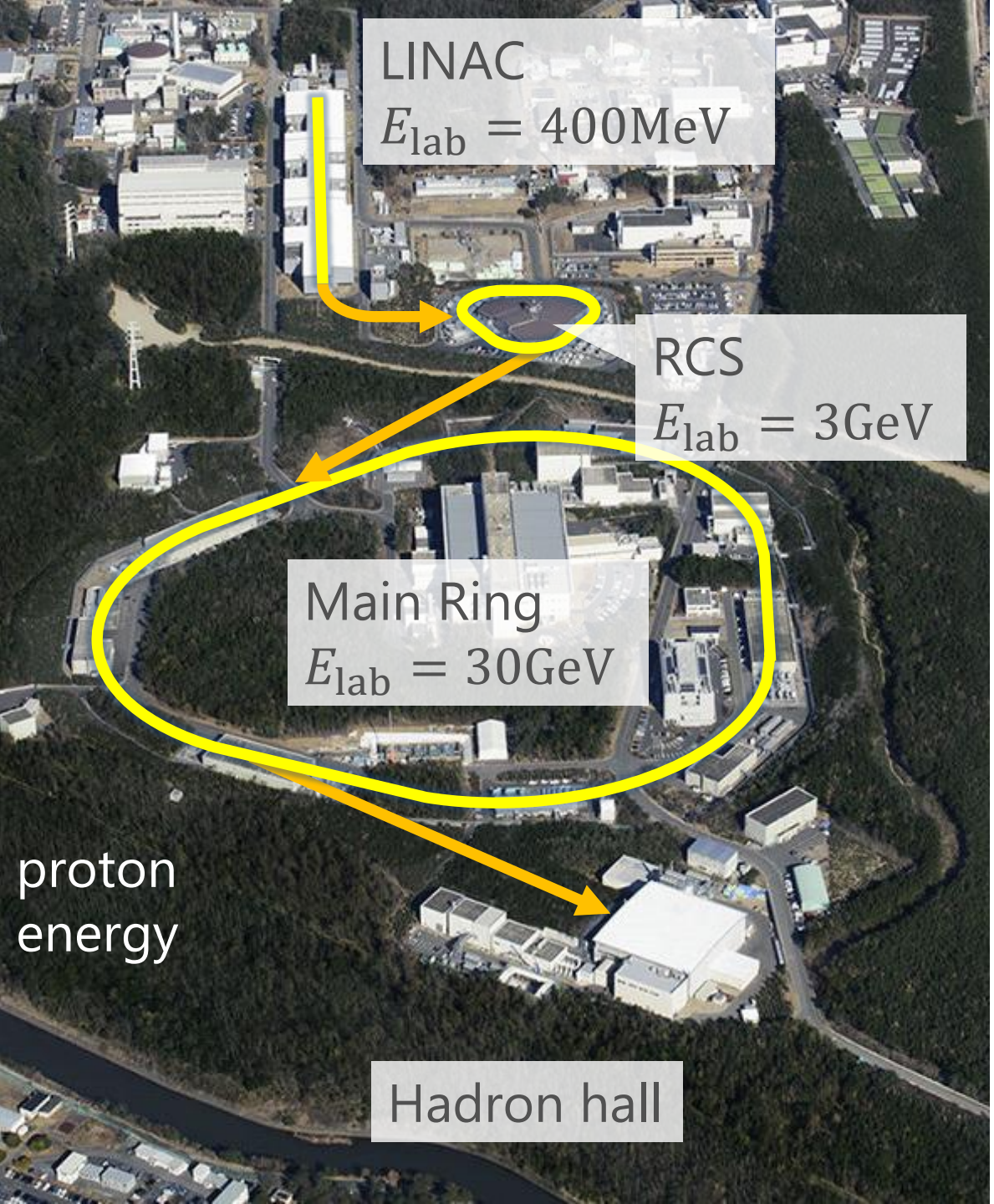
STAR **(QM2025)**





HRG CE: P. B. Munzinger et al, NPA 1008, 122141 (



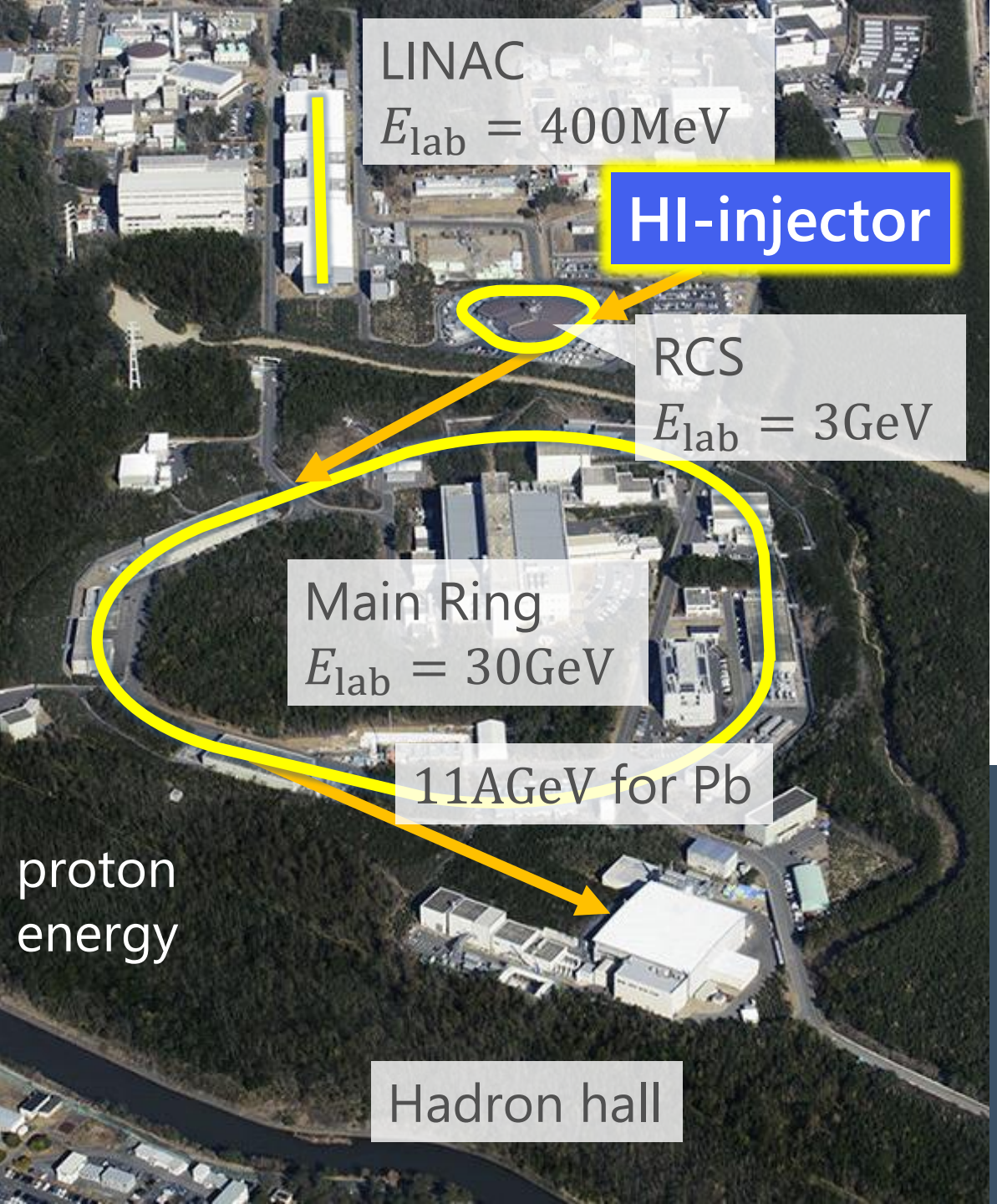
J-PARC

Accelerators

- LINAC
- RCS
- Main Ring(MR)
- High intensity $I = 1\mathrm{MW}$

Purposes

- Hadron/Nuclear physics
- Neutrino physics
- Material/Life science



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J-PARC-HI

J-PARC Heavy Ion Program

High intensity

×

Intermediate energy

Summary

—Exploring QCD phase diagram in heavy-ion collisions is a hot topics in nuclear physics.
—Many new interesting experimental results in last few years.
—Future experiments will pursue the research further.
—Germany and Japan will play key roles in the future!!