

PHENIX Computing Center in Japan [CCJ]

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RIKEN CCJ Project

- Regional computing center in Japan for BNL-RHIC experiment especially for PHENIX collaboration.
- CCJ serves for RHIC physics activity in Japanese and Asian scientists.
- Analysis of large scale data and simulation.

- **RIKEN-CCJ** <http://ccjsun.riken.jp/ccj/>
- CPU performance : Pentium III/4 CPU
- Use CPU resource of RIKEN Super Combined Cluster System (RSCC)
- 104 (1.4~2.0GHz, CCJ) + 256 (3.06GHz, RSCC) CPUs
- Disk Storage : 80 TB raid & 10TB PC-local disks are operated
- HPSS (High Performance Storage System)
- Tape Storage: 1400 TB (= 6100 tapes : 5500 x 200GB + 600 x 500GB, thus expandable to ~3 PB)
- 4 tape/disk movers / Disk cache 8TB / 10 tape drives
- Total stored data went over the size of **1.2 PB**

- **PHENIX Experiment** <http://www.phenix.bnl.gov/>
- Collisions of polarized protons and heavy ions are delivered at BNL-RHIC.
- Understand the spin structure of the proton through polarized proton collisions. Search for quark gluon plasma, a state that existed at an early stage after the Big Bang.
- 500 collaborators from 14 countries, 69 institutions (as of Jul.2007).
- Experiment started in the year 2000 and will be continued to ~2012.
- Amount of DATA ~**500TB/year** in these years.



Data of High-energy nuclear physics experiment

8TB/day = 100MB/sec

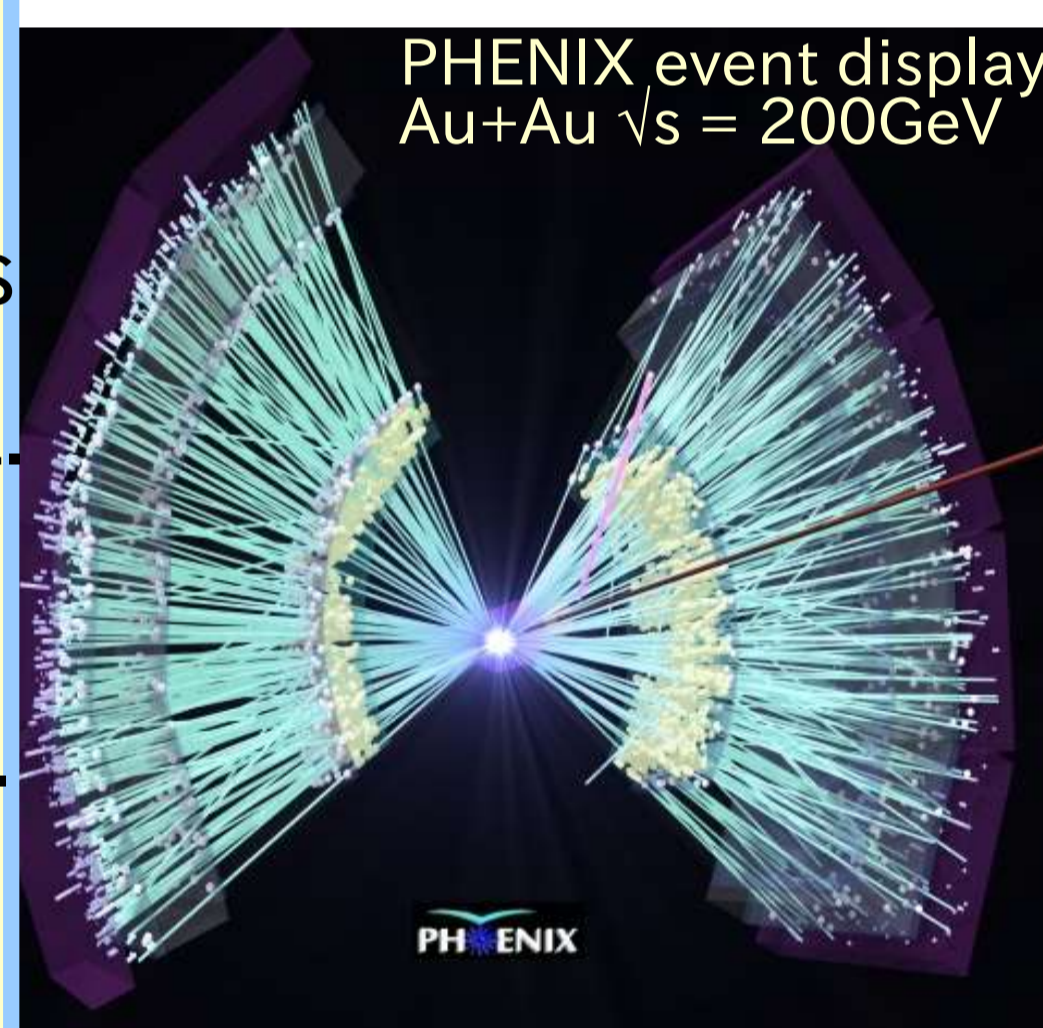
Internet

BROOKHAVEN
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Data transfer between RIKEN and BNL by the Internet

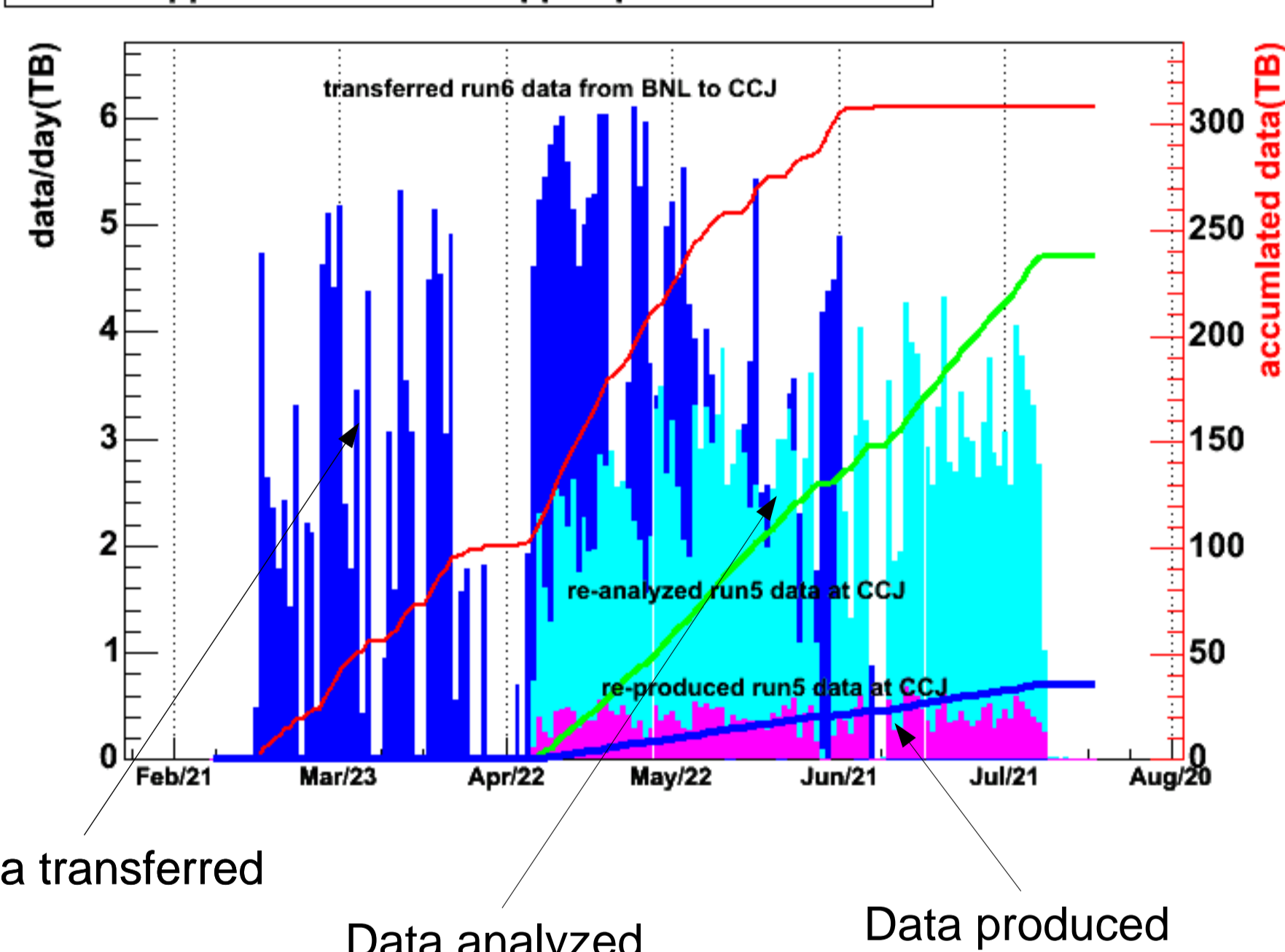
- In 2006 (PHENIX Run6), the experimental data were transferred using GridFTP, following the first large-scale network transfer in 2005 (260TB).
- Transfer is performed simultaneously with archiving to HPSS at BNL.
- **310 TB** of raw data were transferred in 110 days (typically 60MB/sec was achieved).
- Re-analysis of the 240TB of data taken in 2005 was performed in parallel by RSCC 200 CPUs and **35TB** of produced data (nDST) were also sent back to BNL. It took 90 days.
- Analysis of 2006 data was also completed and a result shown below ("Run6") was deduced.
- In 2008 Spring, 100 TB were transferred and analyzed. **360 MB/sec** was achieved in the test. 8 TB/day=100 MB/sec was achieved in a day.
- In 2009 Spring, next transfer (for ~300 TB) is planned.



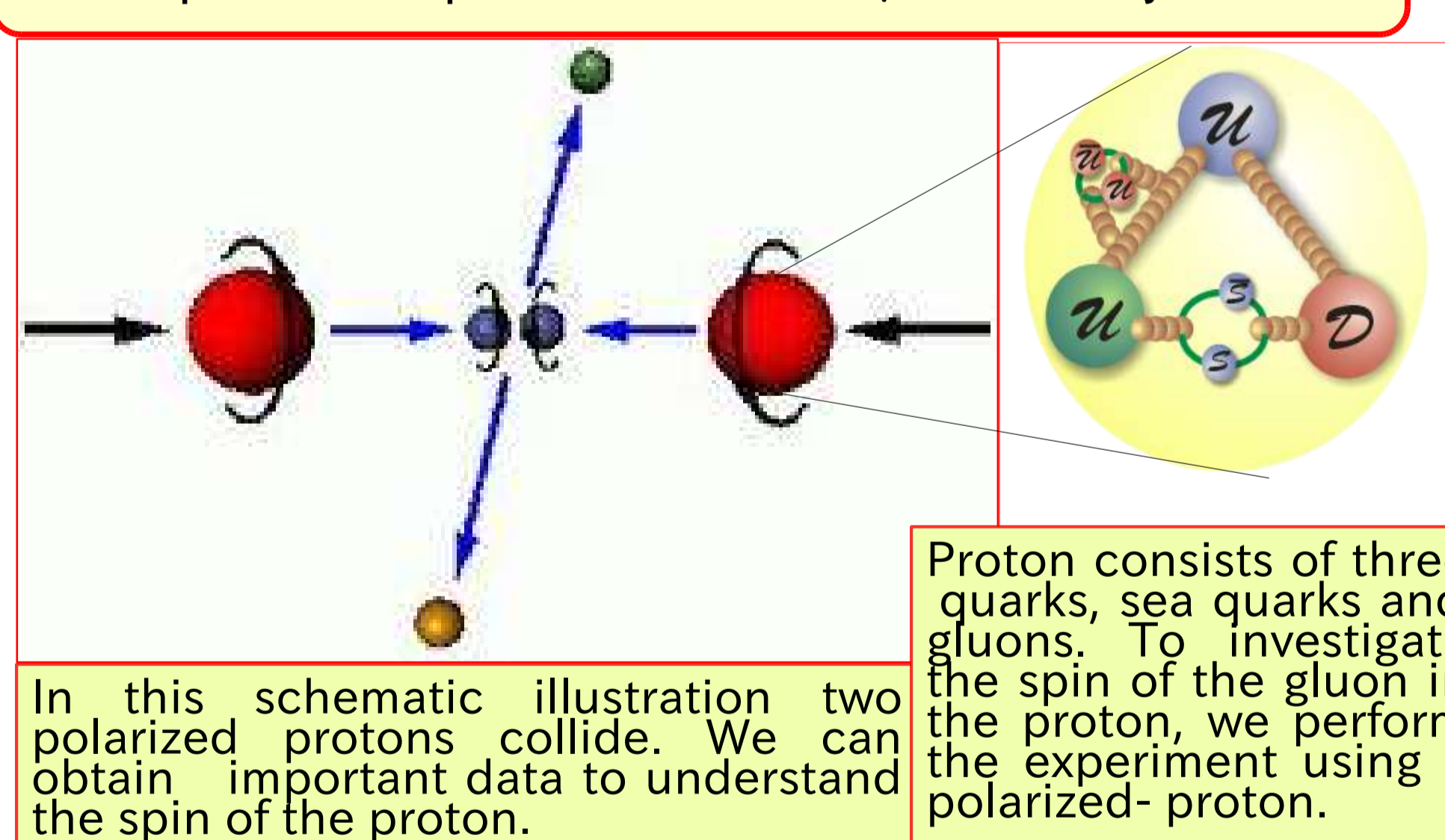
Relativistic Heavy Ion Collider
Brookhaven National Lab.



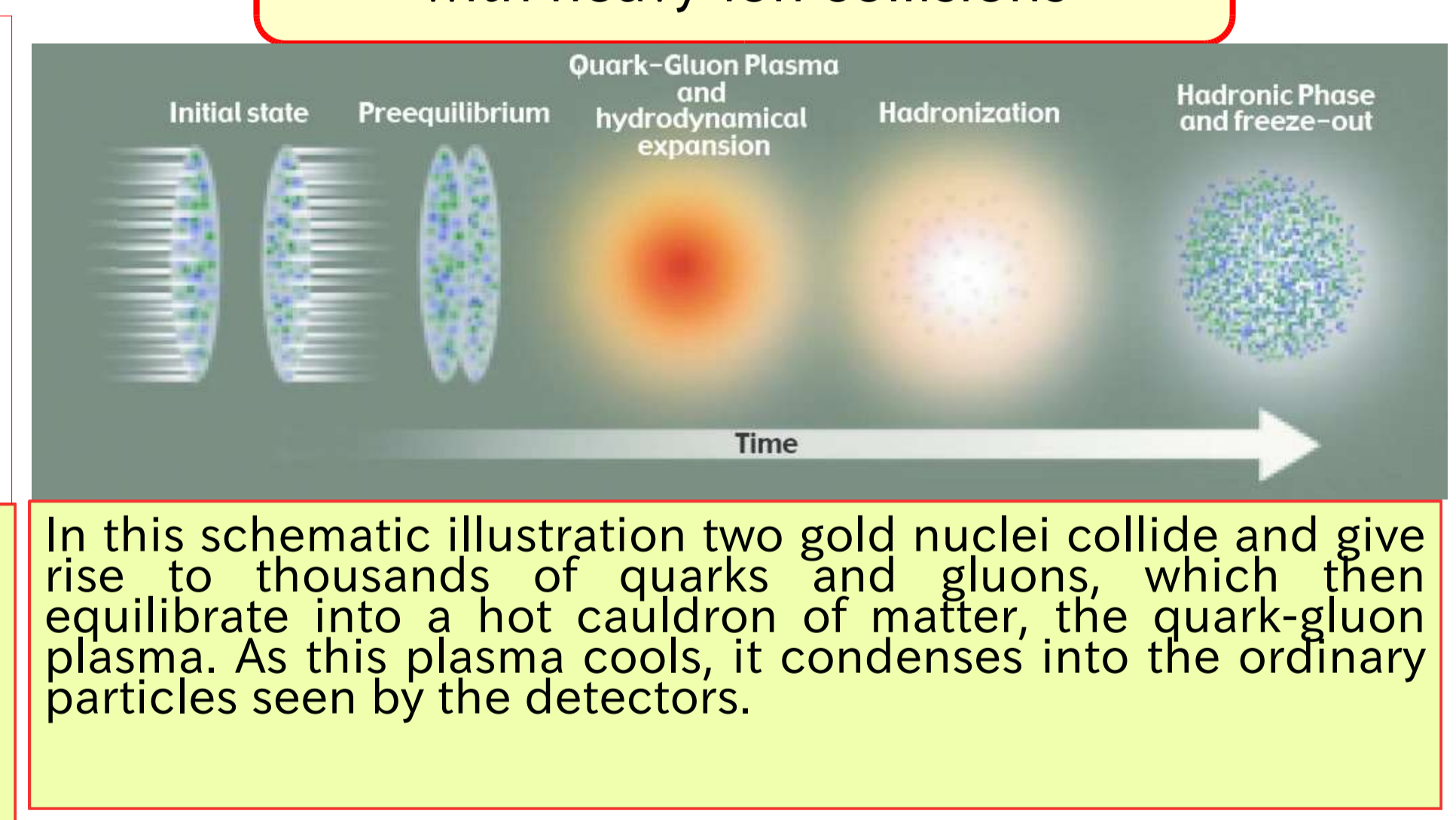
CCJ run6pp data transfer/run5 pp re-production in 2006



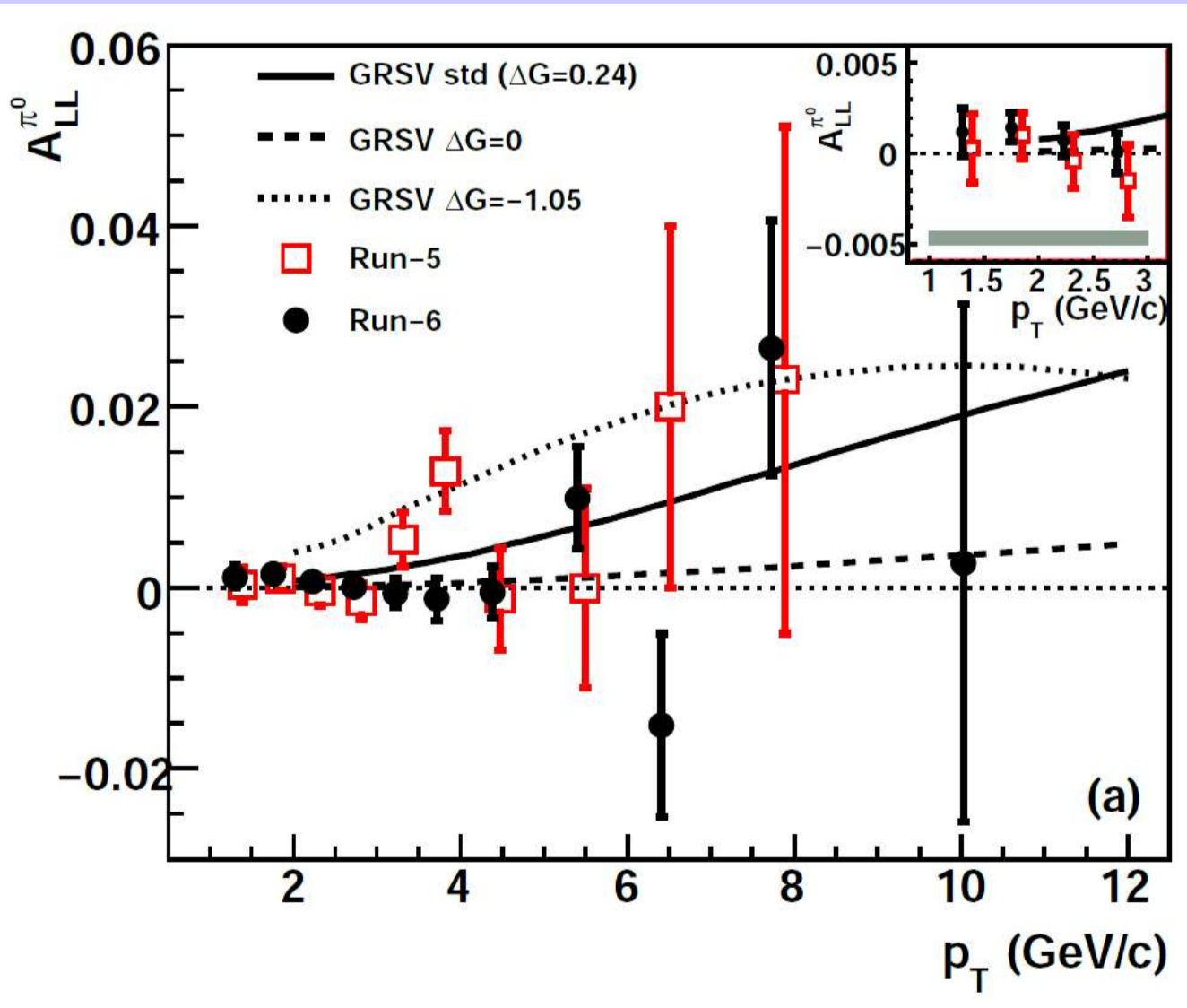
Study of the Proton Spin Structure with polarized-proton collisions, led by RIKEN



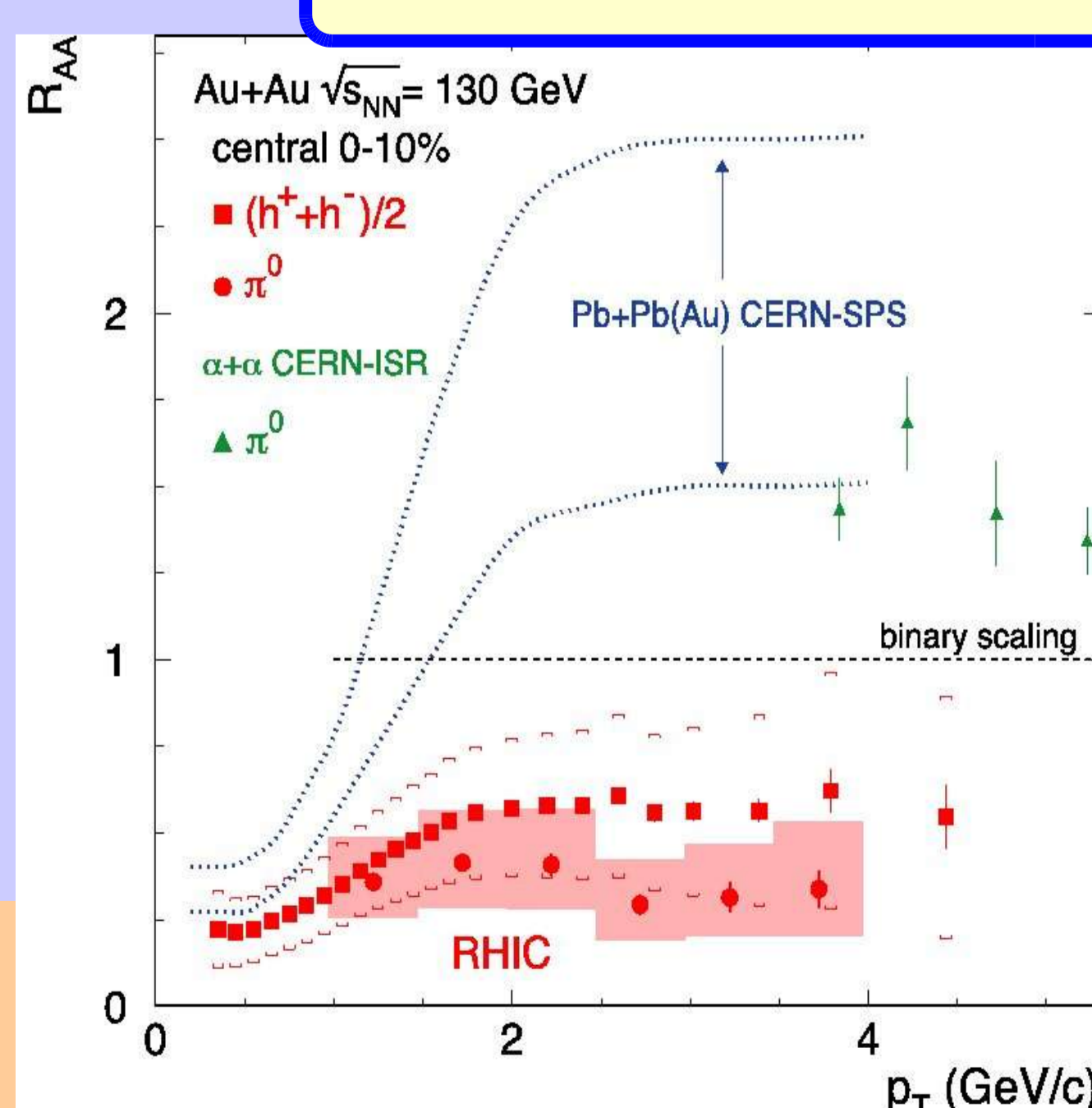
Study of the Quark-Gluon Plasma with heavy-ion collisions



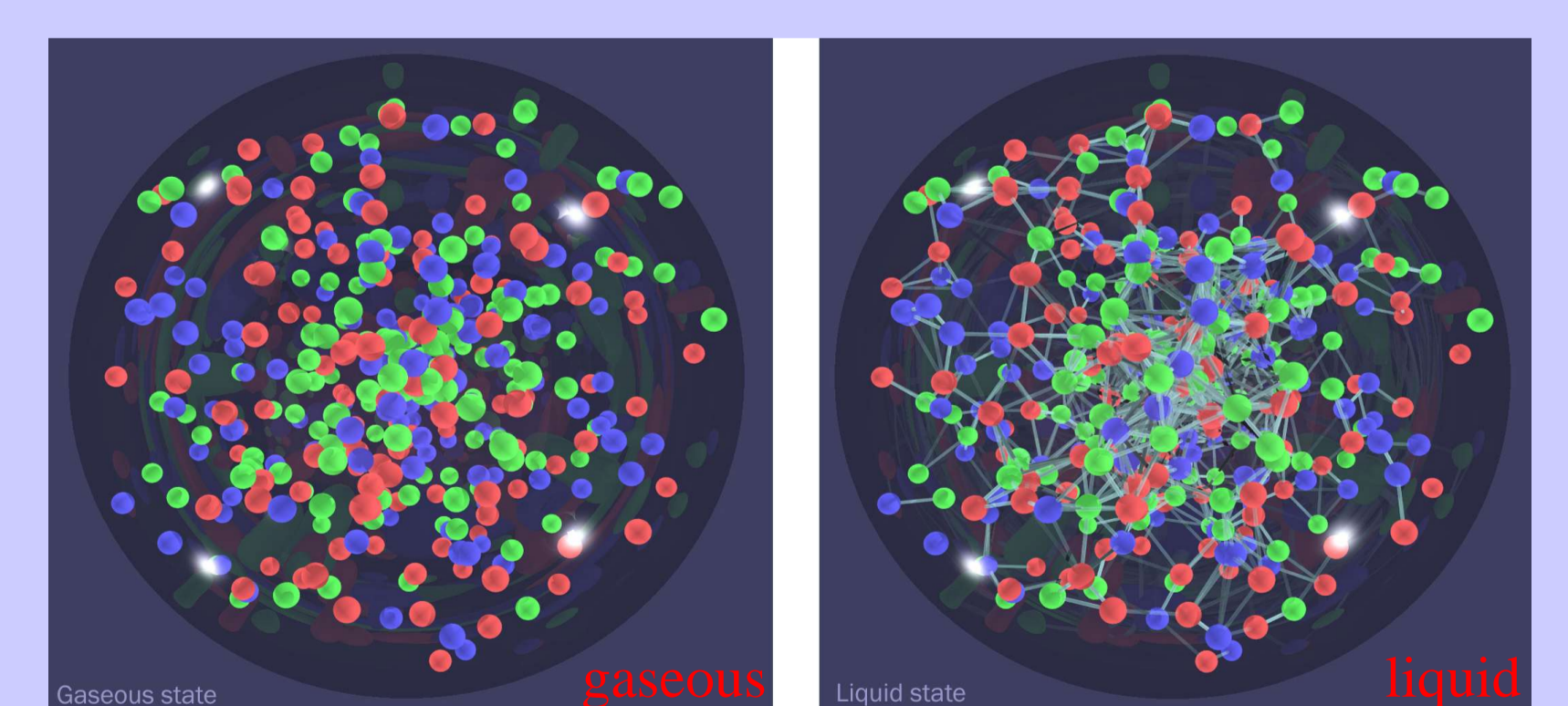
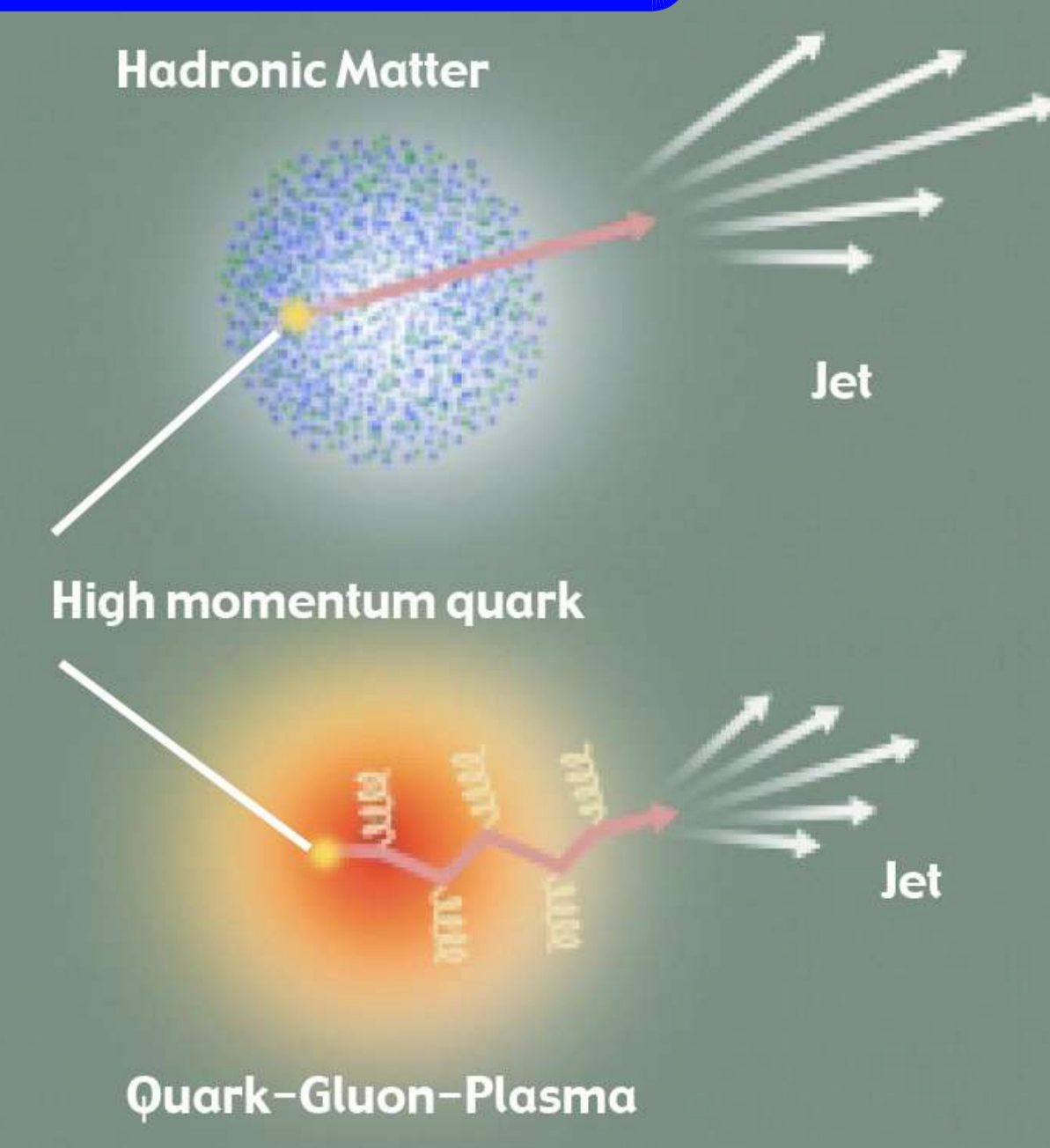
PHYSICS RESULTS



Measurement of the double helicity asymmetry in inclusive mid-rapidity neutral pion production for polarized proton-proton collisions. This is the first of a program to study the longitudinal spin structure of the proton, using strongly interacting probes, at collider energies. In perturbative QCD, A_{LL} is directly sensitive to the polarized gluon distribution function in the proton through gluon-gluon and gluon-quark sub-processes. The observed asymmetry is consistent with NO gluon polarization surprisingly, while standard pol.model is also consistent. Negative pol. model is excluded.



Plotted as a function of transverse momentum (p_T) is the ratio, R_{AA} , of the measured yield of charged and neutral pions in Au-Au collisions to the yield that would be expected based on an extrapolation of proton-proton collisions. The PHENIX results and measurements taken at lower energies at the CERN SPS are qualitatively different. At RHIC higher p_T seems to be depleted, which was predicted assuming an energy loss of partons in dense matter.



The behavior of the hot matter made by the nuclear collisions likes a fluid motion with very low viscosity. Namely, the hot matter seems as a liquid state. It is very unexpected findings because our naive expectation was the matter is gaseous state because it is very hot.

Discovery of the new state of matter