

Workshop Summary

January 8, 2010, KEK

Toshi-Aki Shibata, Tokyo Institute of Technology

KEK theory center workshop on

‘High-energy hadron physics with hadron beams’

January 6 - 8, 2010

21 talks in 3 days

**[10 experimental
11 theoretical**

If we recall the objective ...

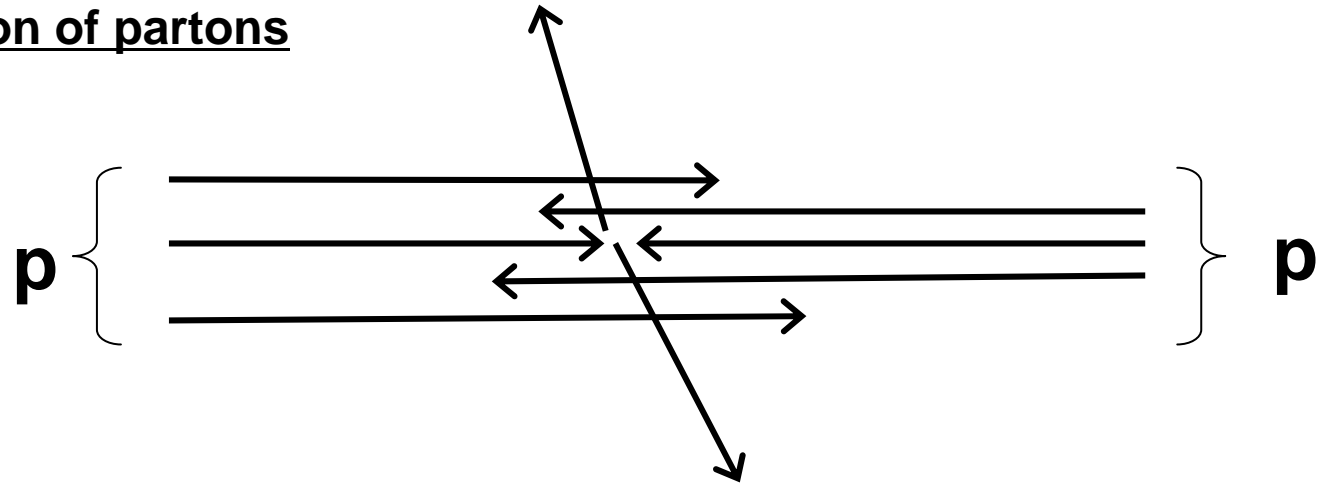
This workshop is intended to discuss topics on high-energy hadron physics with the high-momentum hadron beams at J-PARC and related facilities such as Fermilab, GSI-FAIR, and CERN-COMPASS.

The J-PARC is an accelerator complex with a 30 (50) GeV main ring for high-intensity proton beam (<http://j-parc.jp/index-e.html>). The Phase-1 construction has already been completed, and the beam operation has started.

The workshop topics include
hadron properties in nuclear medium,
partonic structures of nucleon and nuclei,
QCD and hard processes with hadron beams,
other physics opportunities with polarized and unpolarized hadron beams.

The goal of the workshop is to discuss exciting hadron physics programs which can be pursued at J-PARC and other hadron facility.

Transverse motion of partons



Partons, large angle scattering was observed

Collinear reactions, scaling and scaling violation (Q^2 evolution)
Perturbative QCD

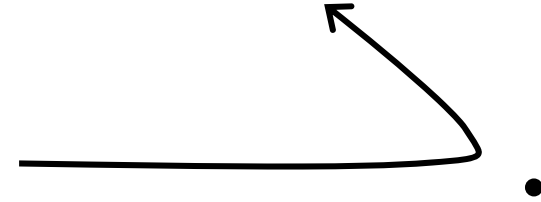
Transverse momentum k_T is introduced

Spin-orbit coupling, orbital angular momentum
Transverse momentum dependent parton distributions
→ Non-perturbative aspects of QCD

Lattice QCD, QCD models

Color confinement

**Scattering by a point-like particle
(Rutherford scattering)**



Deviation from it is described with Form Factors

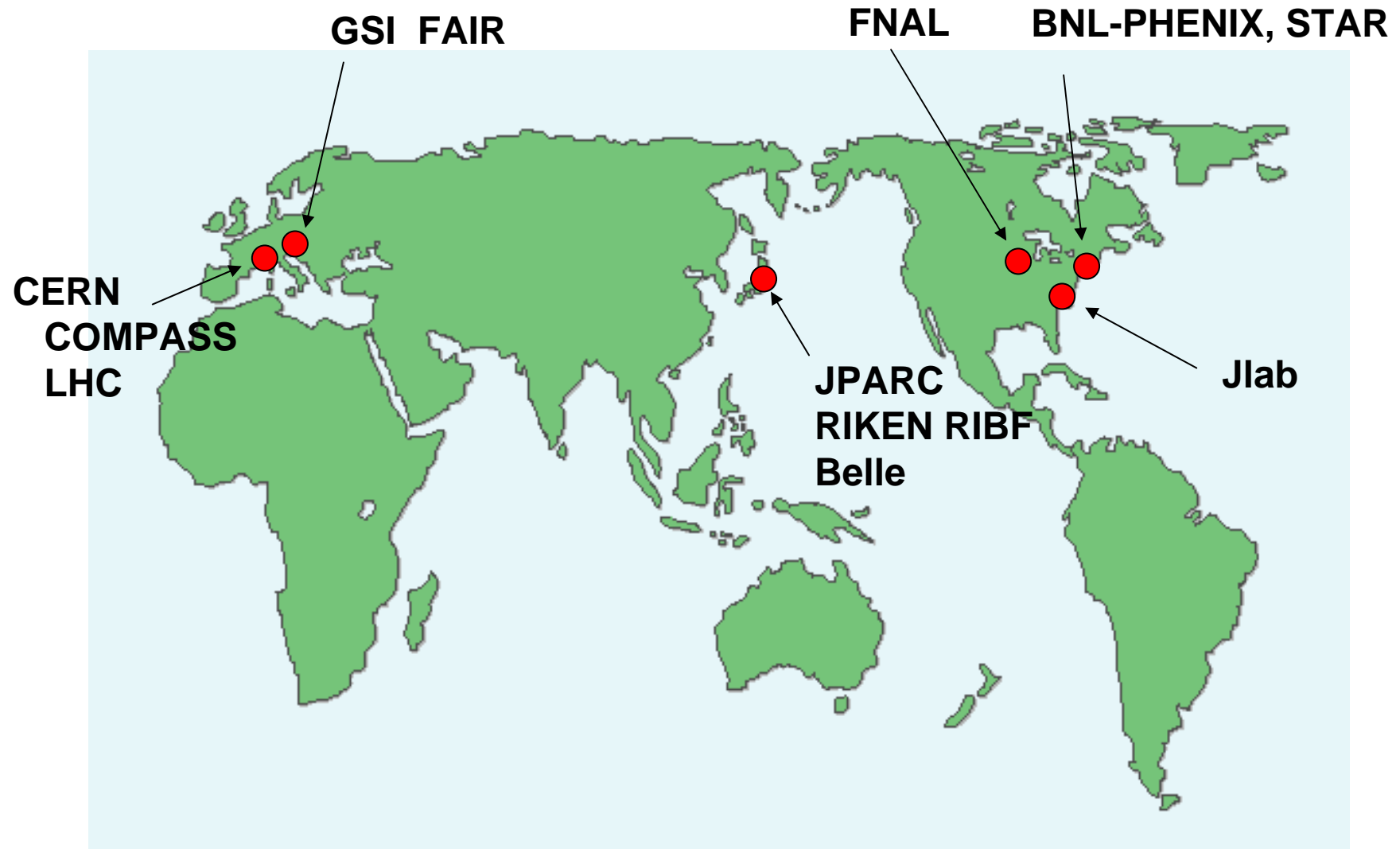
Electric and magnetic properties of hadrons

**In a similar way, the deviation from (development beyond)
collinear reaction picture is now bringing us new aspects of
quark-gluon structure of hadrons**

Link between perturbative and non-perturbative QCD

- January 6 Shin'ya Sawada (KEK) **Hadron facility of J-PARC**
 Jianwei Qiu (BNL) Cross sections and spin asymmetries in hadronic collisions
 Daniel Boer (Univ Groningen) T-odd effects in hadronic collisions
 Jen-Chieh Peng (Univ Illinois) **Hadron structure with dilepton productions**
 Norihiro Doshita (Yamagata University) [Oleg Denisov (INFN, Torino)]
Future Drell-Yan program of the COMPASS Collaboration
 Yuji Goto (Riken) **Polarized Drell-Yan experiments at J-PARC and RHIC**
 Christian Weiss (JLab) Antiquark flavor asymmetries -- origin and probes
- January 7 Toshi-Aki Shibata (Tokyo Tech) [Gerhard Mallot (CERN)]
Spin measurements in lepton scattering
 Yuji Goto (Riken) [Ernst Sichtermann (LBL)] **RHIC-Spin physics**
 Masashi Wakamatsu (Osaka Univ) The role of orbital angular momentum in the proton spin
 David Richards (JLab) Lattice QCD calculations of hadron structure
 Yuji Koike (Niigata Univ) Single transverse spin asymmetry in QCD
 Paolo Lenisa (Univ Ferrara) **Structure functions and spin physics at FAIR**
 Michael Leitch (Los Alamos) **What we have learned from d+Au collisions at RHIC**
 Francois Arleo (LAPTH, Annecy) Phenomenological aspects of parton energy loss in cold media
- January 8 Su Hounng Lee (Yonsei Univ) Meson mass in nuclear medium
 Ryugo Hayano (Tokyo Univ) **Experimental study of hadron properties in the nuclear medium**
 Wolfgang Bentz (Tokai Univ) [Ian Cloet (Univ. Washington)]
 Parton distributions in nuclear systems
 [Nuclear modifications of structure functions]
 Mark Strikman (Penn State Univ) Probing generalized parton distributions and color
 transparency in hard exclusive processes at hadron facilities
 Eliezer Piasetzky (Tel Aviv Univ) **Study of short range correlation in nuclei with hard exclusive
 reactions**
 Ryoichi Seki (California State Univ) J/Psi-N interaction and J/Psi-nuclei

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2010 and beyond

J-PARC Proposal of Drell-Yan experiment, 50 GeV proton beam
Proposal for polarized proton beam
Hadron mass modification in nuclear medium,
Color transparency, Short range correlation

BNL RHIC: Antiquark helicity distributions via W production
Physics with upgraded detectors
Future Drell-Yan experiment

d+A program, Energy loss of partons in cold nuclear matter

FNAL SeaQuest(E906) Drell-Yan experiment, p+p,d, A 2010-

CERN COMPASS: Drell-Yan experiment with pion beam and
polarized targets, ...

LHC: Anti-quark distributions via W production

Jlab Present 6 GeV program + Upgrade to 12 GeV

GSI FAIR: Antiproton – proton collider, Drell-Yan process
Polarizing antiproton beam, Color transparency

RIKEN RIBF

Comments

- **Combination of lepton / photon with hadron probes is effective. Drell-Yan process is a good example.**
- **Different hadron reaction channels, but with common motivations and techniques
Collaborative developments / interactions of physicists will be the key.**
- **We did not hear about spectroscopy or reactions of particles beyond Standard Model, SUSY partners, but it might be a new region of hadron physics.**

What are the expected roles of J-PARC for hadron physics?

What are the necessary conditions for that?

for

- **Quark-gluon structure of the nucleon**
Spin structure, antiquark (sea quark) flavor asymmetry, ...
- **Hadron mass and width in nuclear medium**
- **Color transparency and nucleon short range correlation**
- **Parton energy loss in nuclear matter**
- **Link between perturbative and non-perturbative QCD**
- **Test of Lattice QCD calculations**
- **Others, ...**

We thank the organizers for preparing this workshop

Kazunori Itakura (KEK)

Shunzo Kumano (KEK)

Jen-Chieh Peng (Univ Illinois)

Shin'ya Sawada (KEK)

**and the secretaries and all those who worked for the
workshop.**