

Hadron Physics at J-Parc

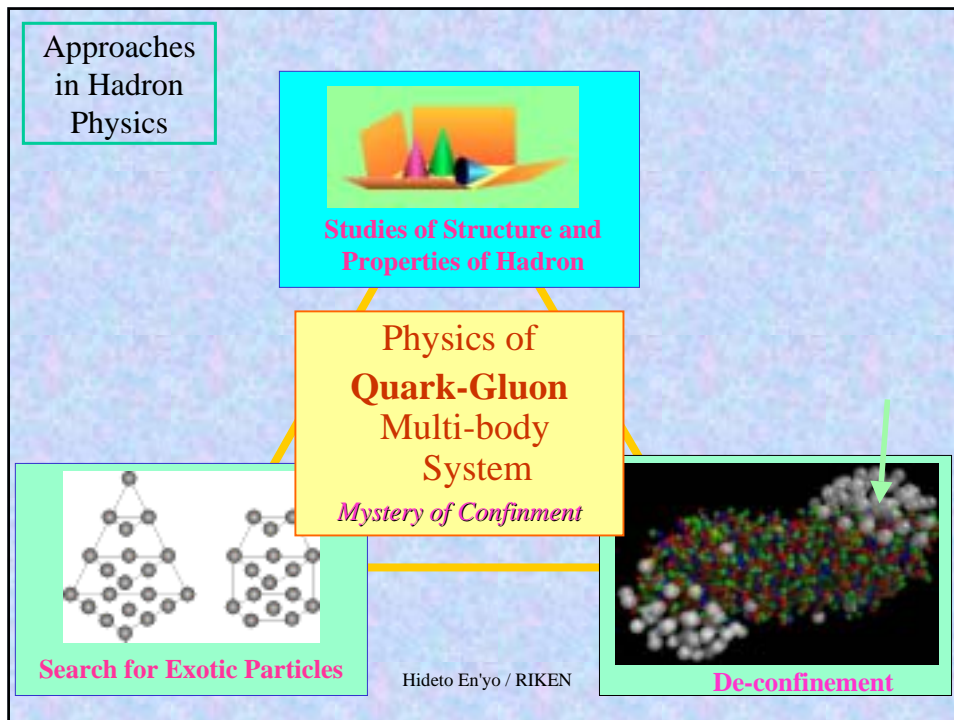
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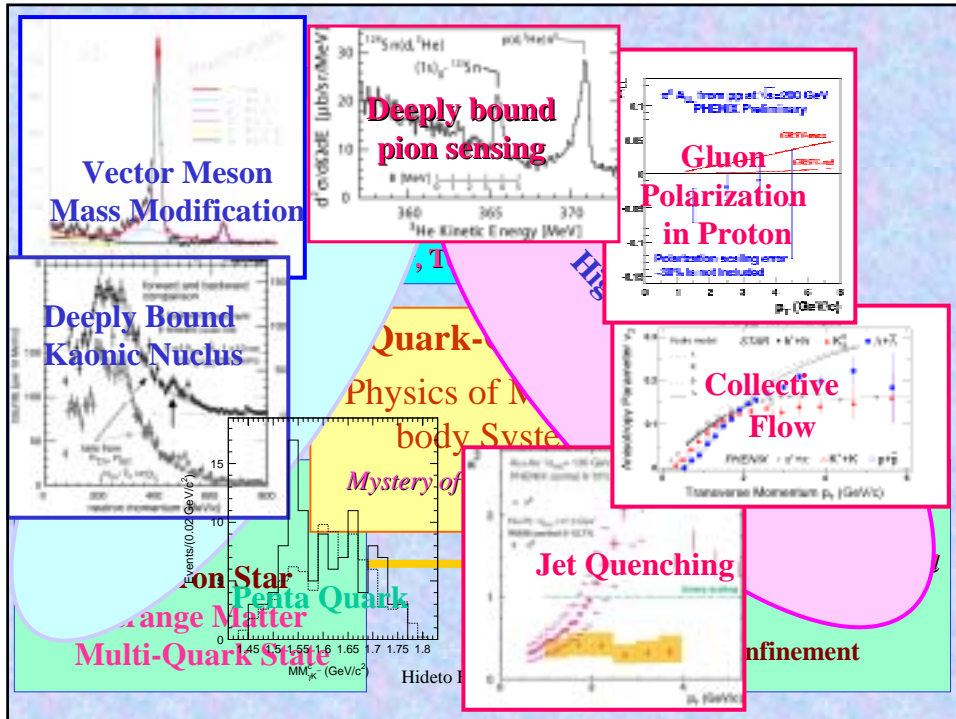
Introduction
Recent discoveries
Letter of Intent to J-Parc
Outlook

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Discovery Machine

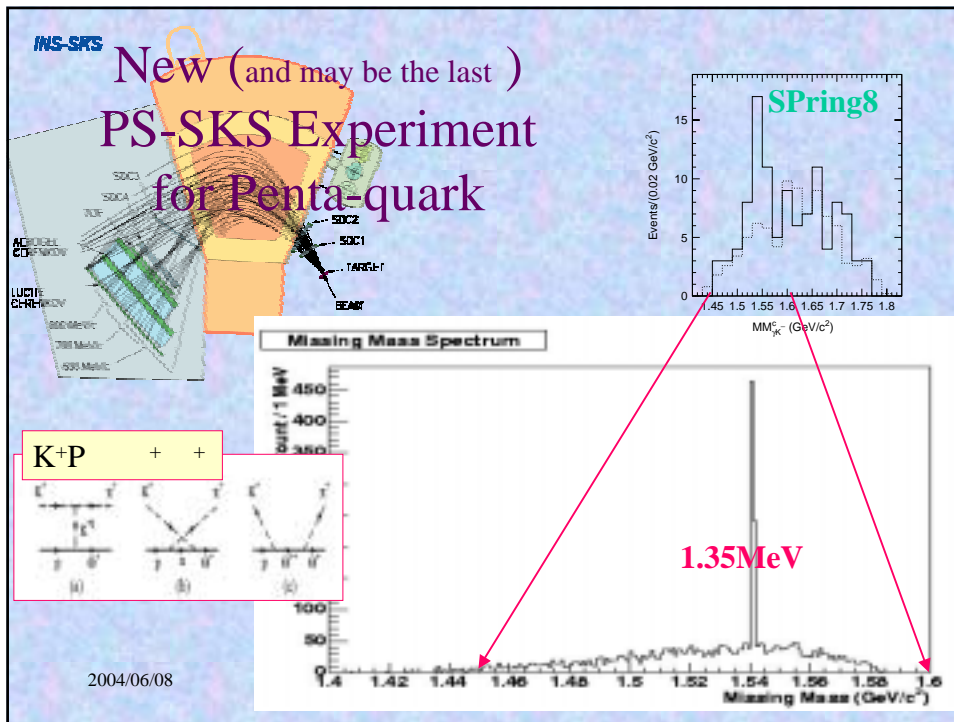
must be built at

Right Time
and
Right Energy

N. P. Samios

Year 2000 (Year of Miracle)

- ✓ *RHIC First Collision*
- ✓ *SPring-8 First Ex* *Now Blooming*
- ✓ *JHF approx* *Blooming in 2010?* *ng KEK-PS)*
- ✓ *RIBF c* *started*



LoI03: Hadron Spectroscopy

LoI01: Measurements of the spin rotation parameters A and R in the resonance region of N elastic scattering

LoI28: A hadron spectroscopy experiment with RF-separated high energy K beam at JHF

- Where do the gluonic degrees of freedom live?
- Are there “exotic” hadrons?
- Where are the gluons?
- Is the baryon number conserved?
- Can all hadrons be described by quarks?
- Polarized hadrons
- Etc.

**Rearrange must be considered
 Based on the pentaquark discovery**

The proposed measurements will aid in understanding the long-wavelength degrees of freedom of QCD and the nature of confinement.

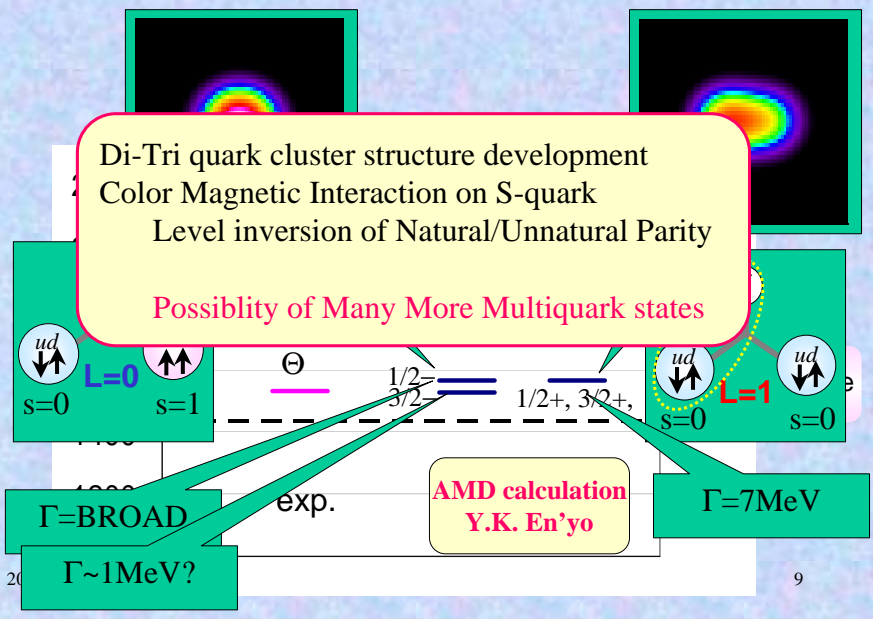
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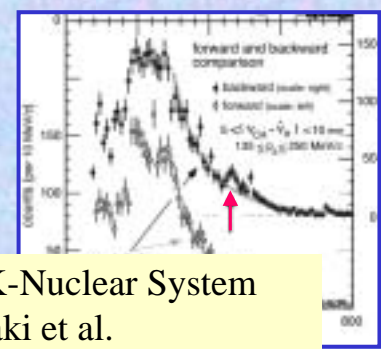
Issues on Pentaquark

Di-Tri quark cluster structure development
 Color Magnetic Interaction on S-quark
 Level inversion of Natural/Unnatural Parity
 Possibility of Many More Multiquark states

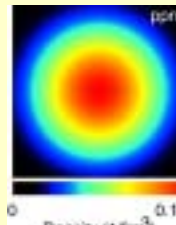
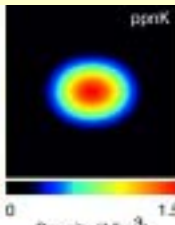
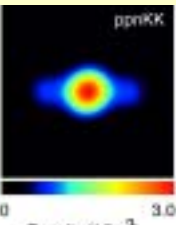


KEK-PS: Search for Deeply Bound Kaonic State

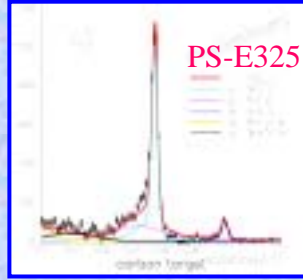
TOF Measurement for Deep-K Spectroscopy



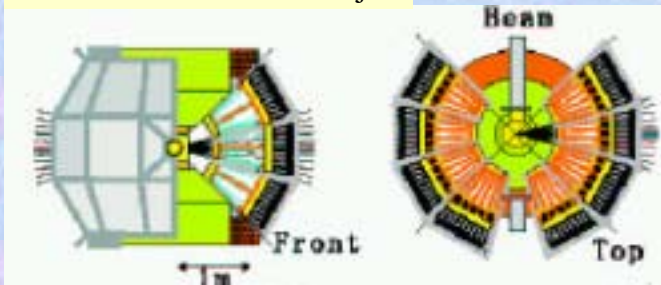
- **LoI10**: Study of Dense K-Nuclear System
 Nagae & Iwasaki et al.
 $(K^- + A \rightarrow N + {}_{\kappa}A^{-1})$ @ Day-1

Chiral Symmetry in Dense Matter



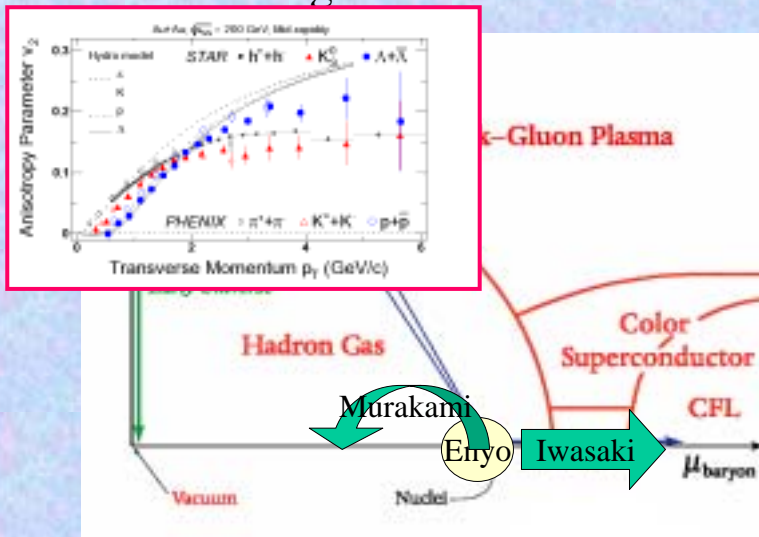
LoI-11: Electron Ball Project



- HBD
Hadron Blind Detector
- EM cal
- Silicon Tracking

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The Phase Diagram for Nuclear Matter

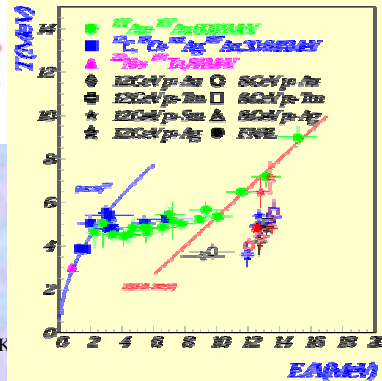
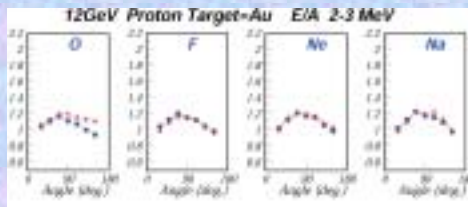
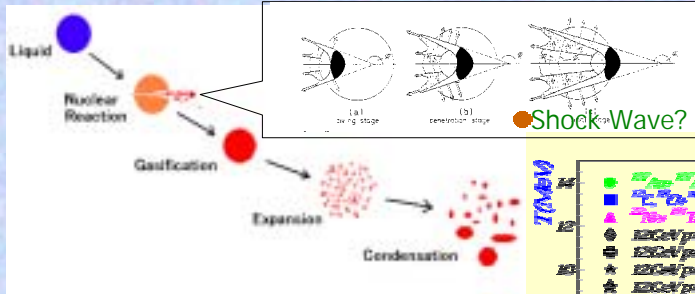


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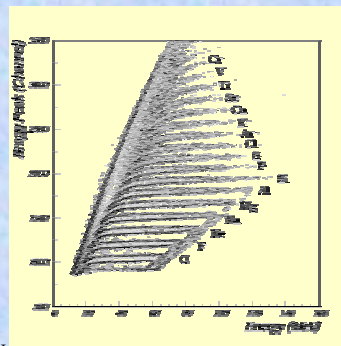
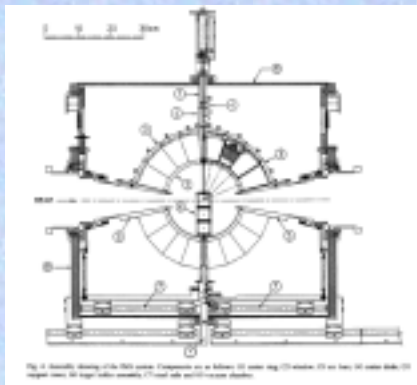
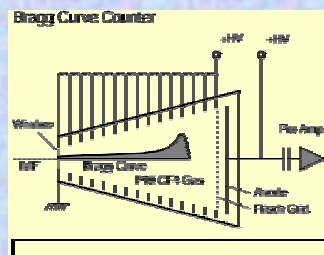
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**LoI18: Energy Dependence of Intermediate-Mass
Fragment Angular-Distribution:
Probing Nuclear Liquid-Gas Phase Transition**



◇ Variable Energy Hadron Beam
around 10 GeV/c.
New Generation Real 4 Detector.
Tagging Energy-loss of Primary Beam.



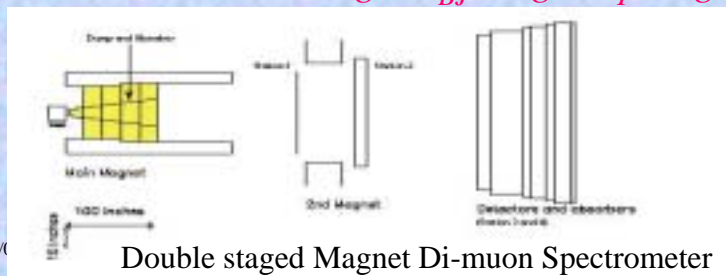
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pQCD at extream

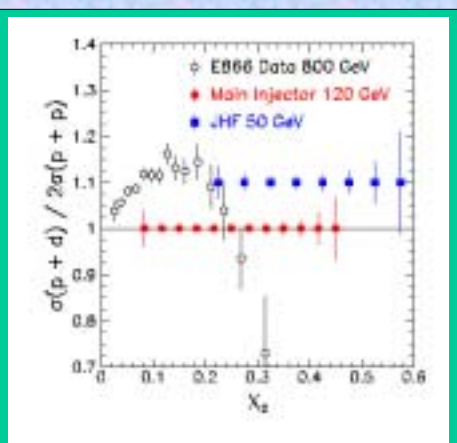
LoI15: Physics of High-Mass Dimuon Production at the 50-GeV Proton Synchrotron

LoI03: Analyzing power AN in 50 GeV very-high-P2T proton-proton elastic scattering

Nucleon structure at *High- X_{BJ} , High- X_T , High- X_F*



Physics with dimuon @ 50 GeV



- $\overline{d/u}$ at large x
- Anti quark PDF in A
- Quark energy loss in A
- PDF in large x
- Drell-Yan and J/ψ with polarized beam.

LoI14: Construction of High Momentum Beam line

- Secondary Beams:
 - Use a thin (2% = 15kW loss) target at SM1
 - Collect them at forward angles
 - Transfer them for ~120m
- Schematic Layout around SM1:



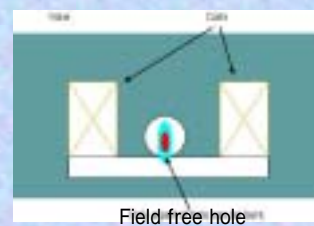
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Beam Line Configuration & Optics

- Primary Beams:
 - 10^{14} primary protons $\rightarrow 10^9$ - 10^{10} protons: **beam stealer**
 - 10^{14} primary protons $\rightarrow \sim 10^{12}$ protons: **electrostatic septum**. High heat and radiation deposit have to be taken into account(R&D)
 - 100 % of the primary beam, **conventional bending magnet** :
 - Weak primary beam (at the beginning of the accelerator operation, and heavy ion beam or polarized beam in the future)



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Cost & Schedule: Magnets from the World

- Total cost : \$5-8M??
- No construction budget. Seeking for reuse of second-hand magnets...
- Already from SLAC, Saclay, CERN, ...
- The high momentum beam line can be constructed even at the beginning of the NP hall operation from the viewpoint of the facility design.



Large dipole magnets at the Meson Pol beam line (FNAL)

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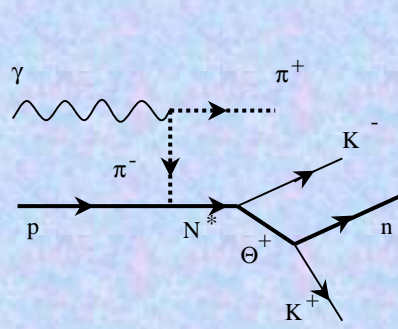
Summery

- Recent discoveries in hadronic physics are jus surprising
- MANY of these findings are studied extensively at Jparc
 - Multi-quark state / Hadron Spectroscopy
 - Dense Strange Matter
 - Chiral symmetry at dense matter
 - Nuclear Phase Diagram : Color-Super > liquid > gas > (QGP)
 - pQCD at extreme
- J-Parc, to be built at right time and at right energy
- General purpose High Momentum Beam Line, planning on going.

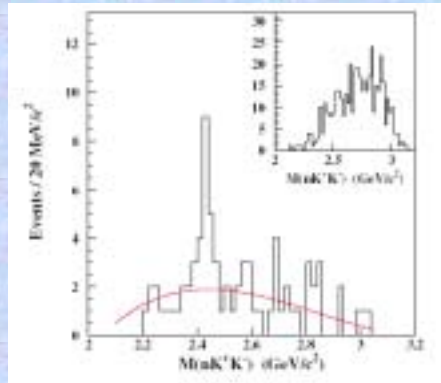
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N^* ; nK^+K^- invariant mass



CLAS @ J-Lab

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