Nuclear Physics with double strangeness (S=-2)
KEK-E373 => AGS-E964 ...... > J-PARC

Λ Observation of a $^6_Λ^Λ$He (KEK-E373)
Success of Emulsion detector with micro-meter accuracy

**NAGARA event**

$^6_Λ^Λ$He double-hypernucleus
Unique interpretation!

$\Xi^- + ^{12}_C \rightarrow ^6_Λ^Λ$He + $^4$He + t
$^6_Λ^Λ$He $\rightarrow ^5_Λ^Λ$He + p + π-

H. Takahashi et al.,
P. R. L. 87, 212502(2001)

**Lambpha**

$m(^6_Λ^Λ$He) = 5951.82±0.54MeV

Δ$B_N$ = 7.25±0.19, 15.29±0.17 MeV

(assumed $B_\Xi^- = 0.13$ MeV)

$m(H) \geq 2223.7$ MeV/c²

(90% C.L.)

http://www.phys.ed.gifu-u.ac.jp/Topics/NAGARA-e.htm

**Demachi-yanagi event**

two body case at point A

$e^- + ^{14}_N \rightarrow ^{6}Be + t$ or $^3Be^* + t$

$\Delta B_N : -1.14 \pm 0.19$ or $+1.86 \pm 0.19$ MeV

B$^N_N : 15.29 \pm 0.17$(ground) MeV

*three body case at point A

1) $e^- + ^{14}_N \rightarrow ^{6}Be + p + n$

$\Delta B_N : +1.47 \pm 0.17$ MeV

RHIC/AGS
Ann. Users’ meeting
May.11,2004.
K. NAKAZAWA
Gifu / Japan

High Energy News
Vol.20 No.5 (2002)
KEK

KEK
From KEK-E373 output to AGS-E964

KEK-E373 (Preliminary results)
* ~$10^3$ $\Xi^-$ stopping events in nuclear emulsion.
* Observation of several double-$\Lambda$ hypernuclei $\Rightarrow$ NAGARA event (without any ambiguities).

AGS-E964 (statistics x 10)
* ~$10^4$ $\Xi^-$ stopping events in nuclear emulsion.
* ~$10$ double-$\Lambda$ hypernuclei (without any ambiguities). $\Rightarrow$ making a nuclear chart with $S=-2$.
* A-dependence of $\Delta B_{\Lambda \Lambda}$ in several nuclides.
* X-ray measurement from $\Xi^-$-atom, for the first time. $\Rightarrow$ information of $\Xi$-N interaction.
* funded $2.5M$ by JPN. Gov., already. (2003~2007)
Nuclear Chart with Strangeness

- Strange matter / N-star
- Double-hypernuclei
- \( \Lambda, \Sigma \) hypernuclei
- Proton
- Neutron

C=1
C=2

S=-\infty
S=-2
S=-1
S=0

3000/7000

RHIC/AGS
Ann. Users’ meeting
May. 11, 2004.
K. NAKAZAWA
Gifu / Japan
Title: Systematic Study of Double Strangeness System with an Emulsion-Counter Hybrid Method.

Beam: K\(^-\) (1.7GeV/c), 
2 \times 10^5 K^-/spill (4.1sec) 
with K^-/\pi^- > 9 at D6-line

Detectors: Nuclear Emulsion, 
Double-sided Si strip Detector, 
Ge-Detector (Hyperball), 
KURAMA magnet

Time requested:
100 hours for detector tune 
100 hours for beam tune 
1100 hours for beam exposure

We requested Beam time on FY2006
Setup around the target (E964)

Volume of nuclear emulsion
70 liters (E373) => 210 liters

Track scanning method
Automated + Interactive (E373) => Fully Automated (speed x 4)

Emulsion Mover
- Controlled with PC
- Move emulsion during spills
- Keep track density to 1 × 10⁶/cm²

DSSD(Double-Sided)
Precise prediction of Ξ⁻ tracks on the first emulsion plate.
=> Reduction in background tracks which are picked up in the first plate.

Quite low background
X-ray data are only analyzed for clear Ξ⁻ stopping events which are identified by nuclear emulsion.
Development of Automatic Scanning

KEK-E373
- stage drive: step-by-step
- image capture: 30Hz
⇒ 1.5~2.0 sec / one view

Images are shown:
1. Surface detection
   ⇒ Grid measurement for position calib.
2. Track scanning

Current system
Surface & Grid: 22 sec.
Track_scan: 15 sec.

AGS-E964 (BNL)
- stage drive: Non-Stop
- image capture: 100Hz
⇒ ~0.2 sec / one view
(designed value)

Non-stop driving: speed ~1mm/sec

Developing system
Surface & Grid: 9 sec.
Track_Scan: 6 sec.
**E964 experiment**

*Nuclear Physics with double strangeness (S=-2)*

KEK-E373 => AGS-E964 ......> J-PARC

AGS-E964 (statistics X10 of the past experiments)

*) International collaboration (USA/China/India/JPN/Korea/Myanmar/UK)

*) $10^4 \Xi^-$ stopping events in nuclear emulsion.

*) ~10 double-$\Lambda$ hypernuclei (without any ambiguities).

=> making nuclear chart with S=-2.

A-dependence of $\Delta B_{\Lambda\Lambda}$ in several nuclides.

*) X-ray measurement from $\Xi^-$-atom, for the first time.

=> information of $\Xi$-N interaction.

*) funded $2.5M$ by JPN. Gov., already. (2003~2007)

However, the rearrangement of the beamlines are being planned for future fixed target programs and decommissioning of D-line is discussed.

**To J-PARC (50GeV proton accelerator : JHF)**

Initial PLAN : 2007 for the first beam.

PLOSSLEM : Buried cultural property was excavated.

Goshawk (endangered species) was found.

Start shall be delayed.


*) E964 leads the community of hypernuclear physics to significant activities at J-PARC.
Near Future Condition of Hadron Beams

2005 (?)

KEK-PS
Θ+ experiment with SKS [ΔE<1.5MeV] (K. Imai)
ShUTDOWN for J-PARC

Desert of H.B. for M.E. Phys?

AGS is the Unique possible tool for M.E. Phys. with H.B.?

2009 (?)

J-PARC 1st Beam

AGS is the Unique possible tool for M.E. Phys. with H.B.?