31st July to 2nd August 2016

Welcome to MIN16 - Meson in Nucleus 2016 -

Ryugo S. Hayano
The University of Tokyo

The Nobel Prize in Physics 1949
Hideki Yukawa

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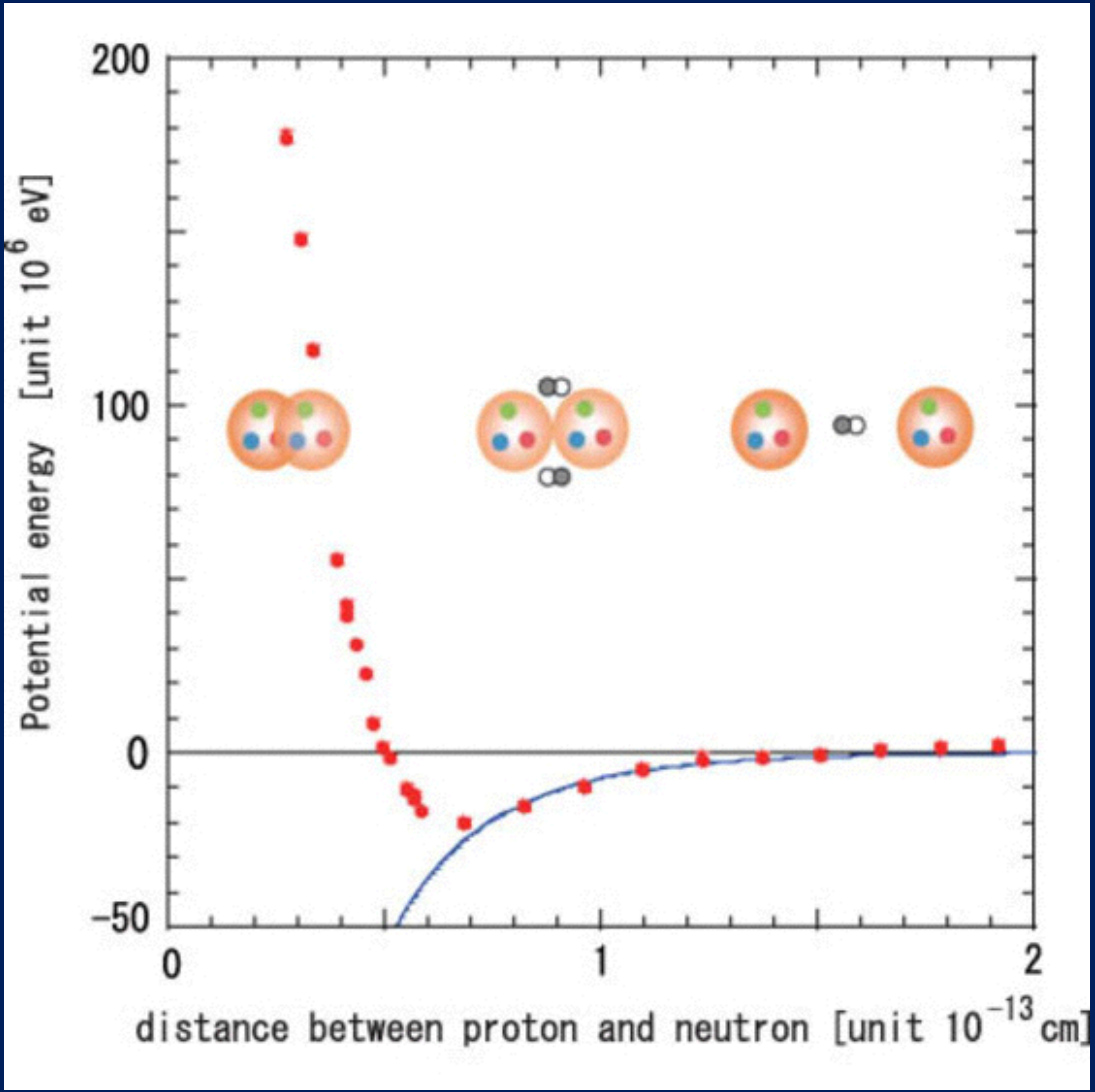
The Nobel Prize in Physics 1949

Hideki Yukawa
Prize share: 1/1

The Nobel Prize in Physics 1949 was awarded to Hideki Yukawa *"for his prediction of the existence of mesons on the basis of theoretical work on nuclear forces"*.

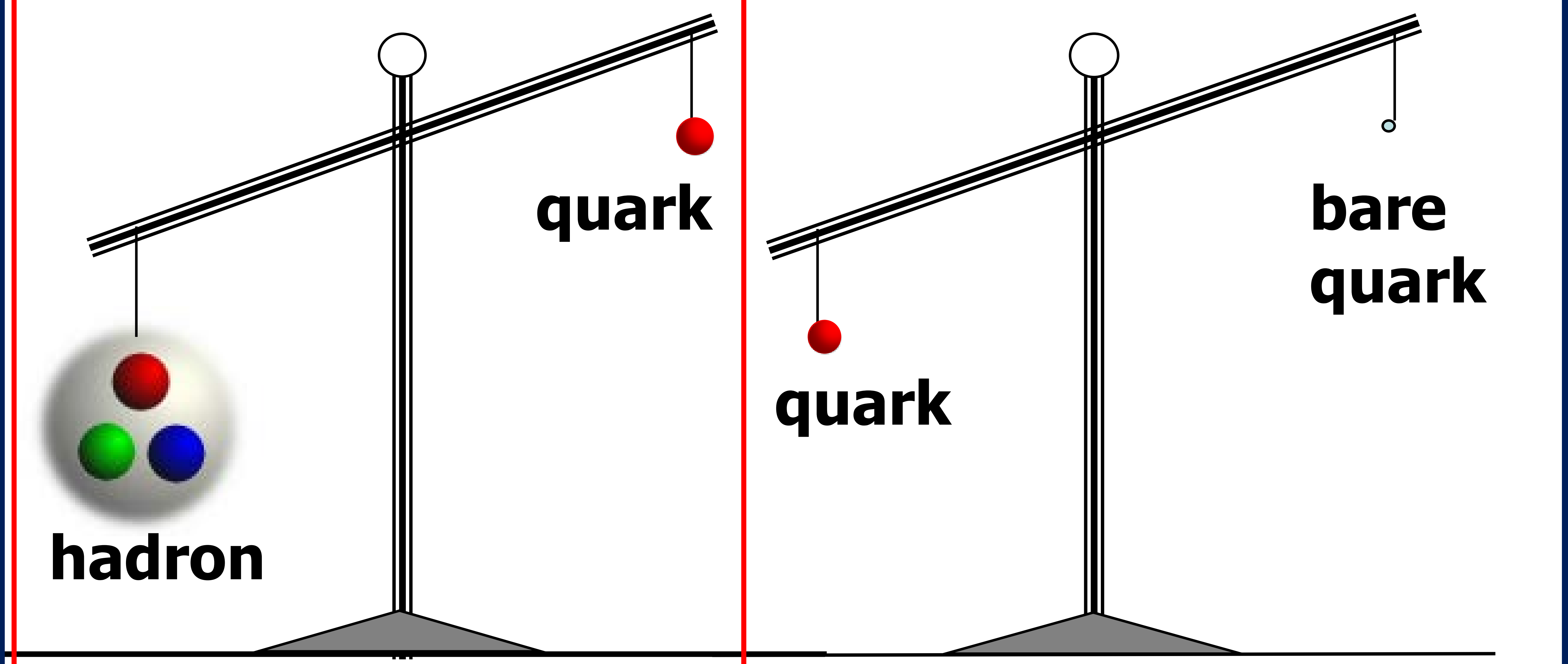


Ishii N., Aoki, S. & Hatsuda, T. Nuclear force from lattice QCD. PRL 99, 022001 (2007)

MIN2016 Topics

- Fundamental theories of QCD
- Mesonic atoms
- Mesonic nuclei
- Hadron formation in nuclear medium
- Hadron-hadron interaction
- New facilities

All related to a fundamental question:



$$m_q \simeq 3 \text{ MeV}$$
$$m_N \simeq 1000 \text{ MeV}$$

"Chiral" condensate

Nambu (1960)

$$m_0 = 0$$
$$m_q \simeq 3 \text{ MeV}$$

"Higgs" condensate

Englert-Brout, Higgs (1964)

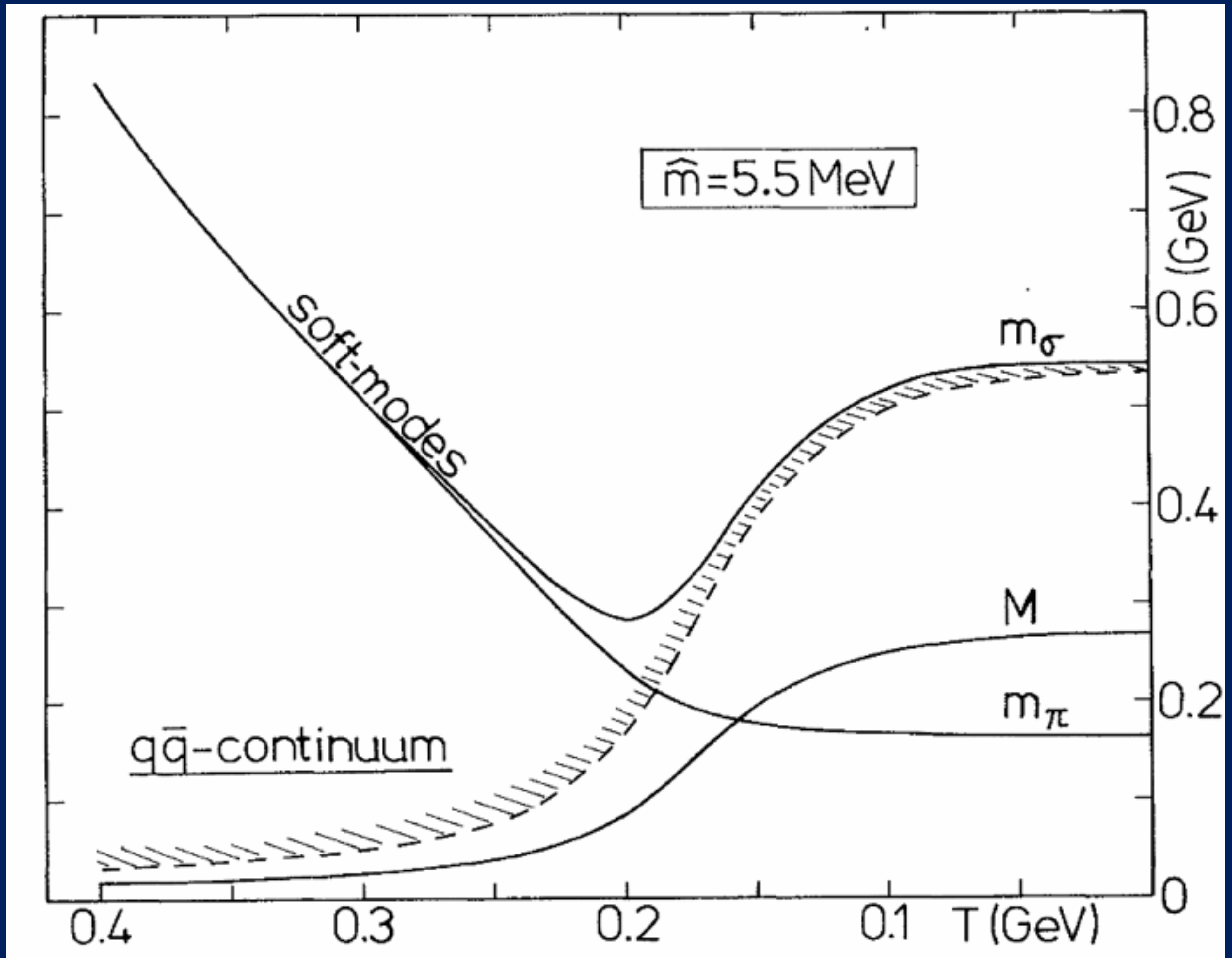
Hatsuda, HIN2013

we have been asking

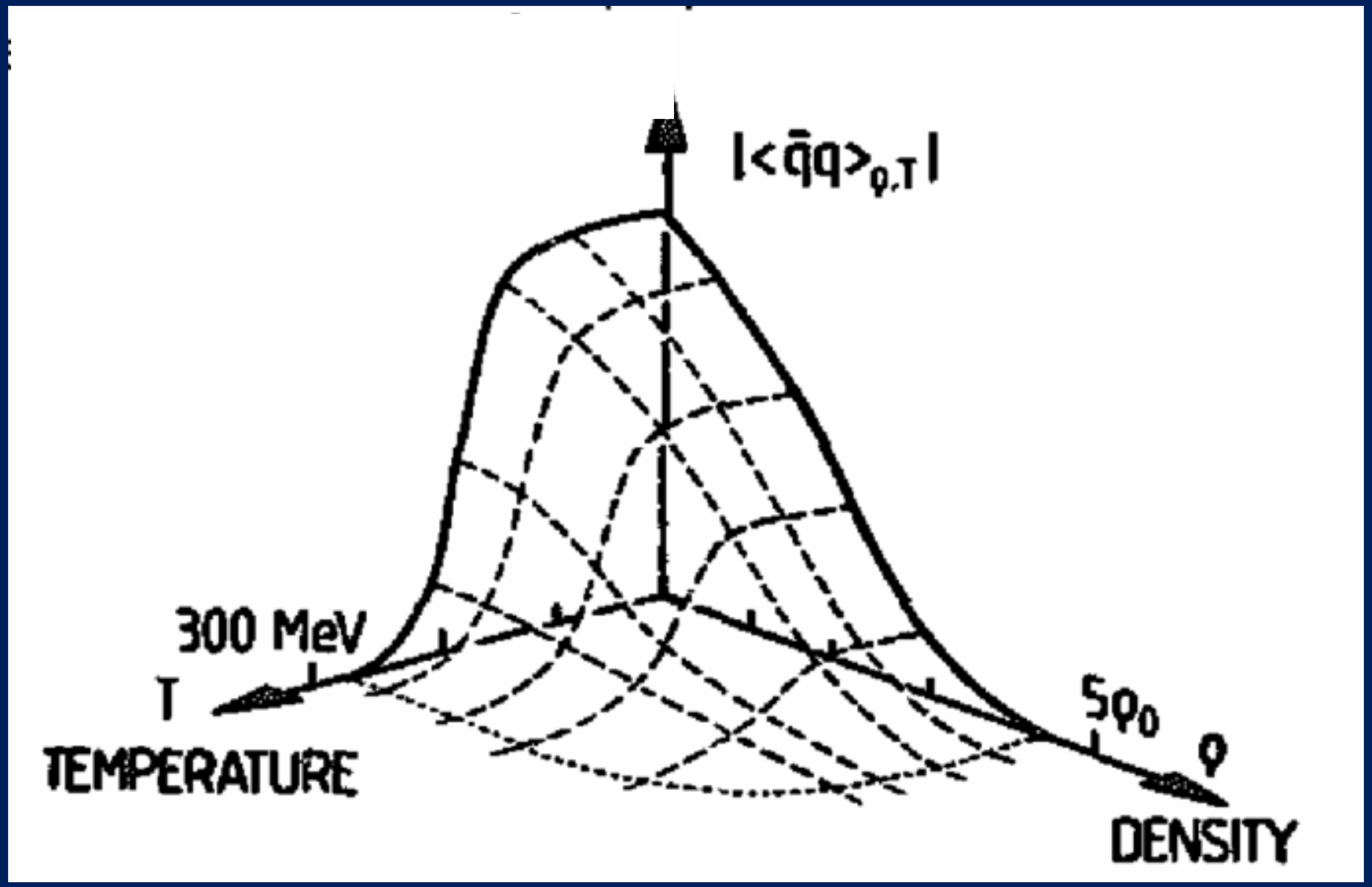
a similar set of questions

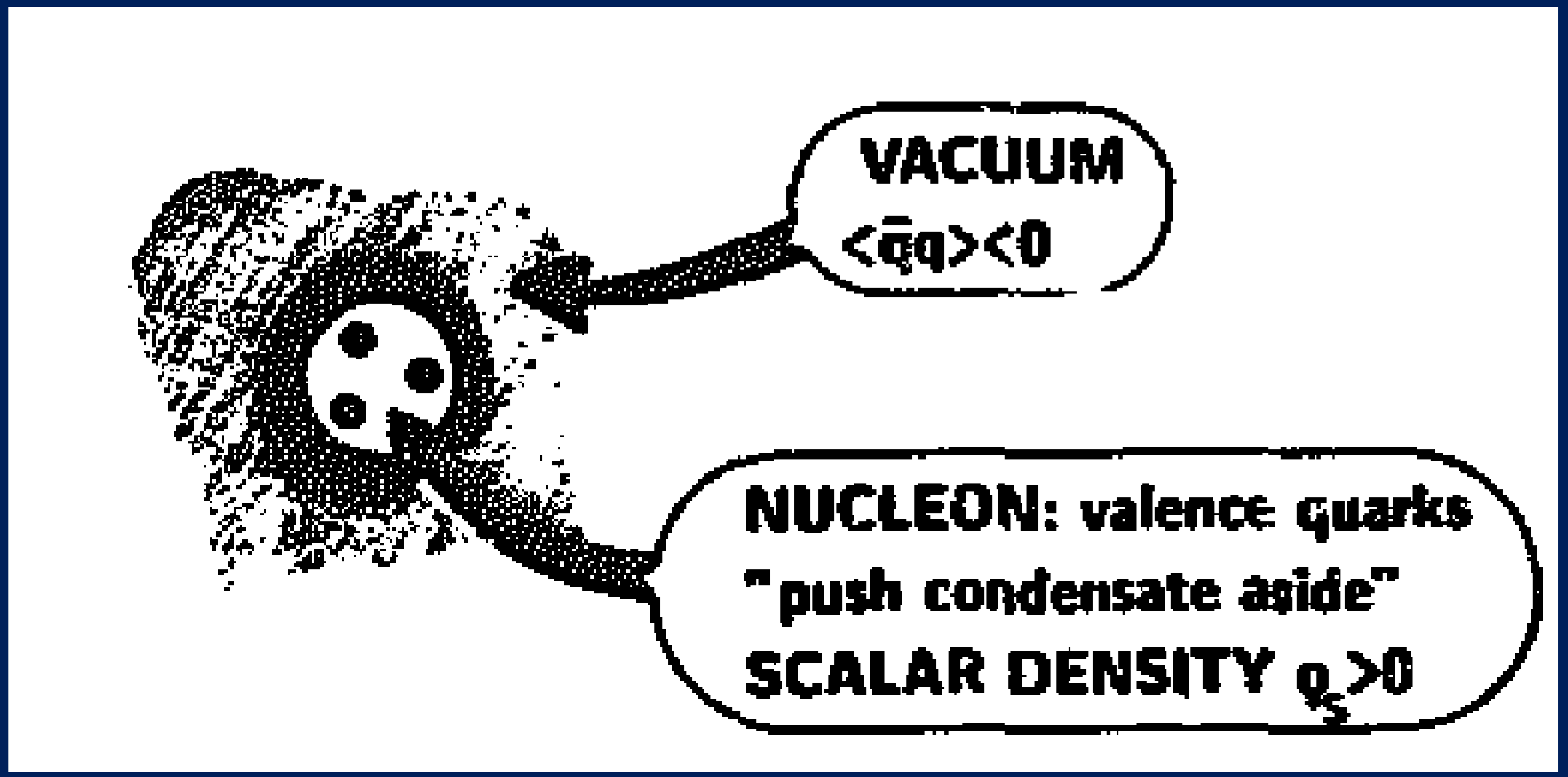
over and over

for quite some time



T Hatsuda; T Kunihiro, PRL 55 (1985) 158

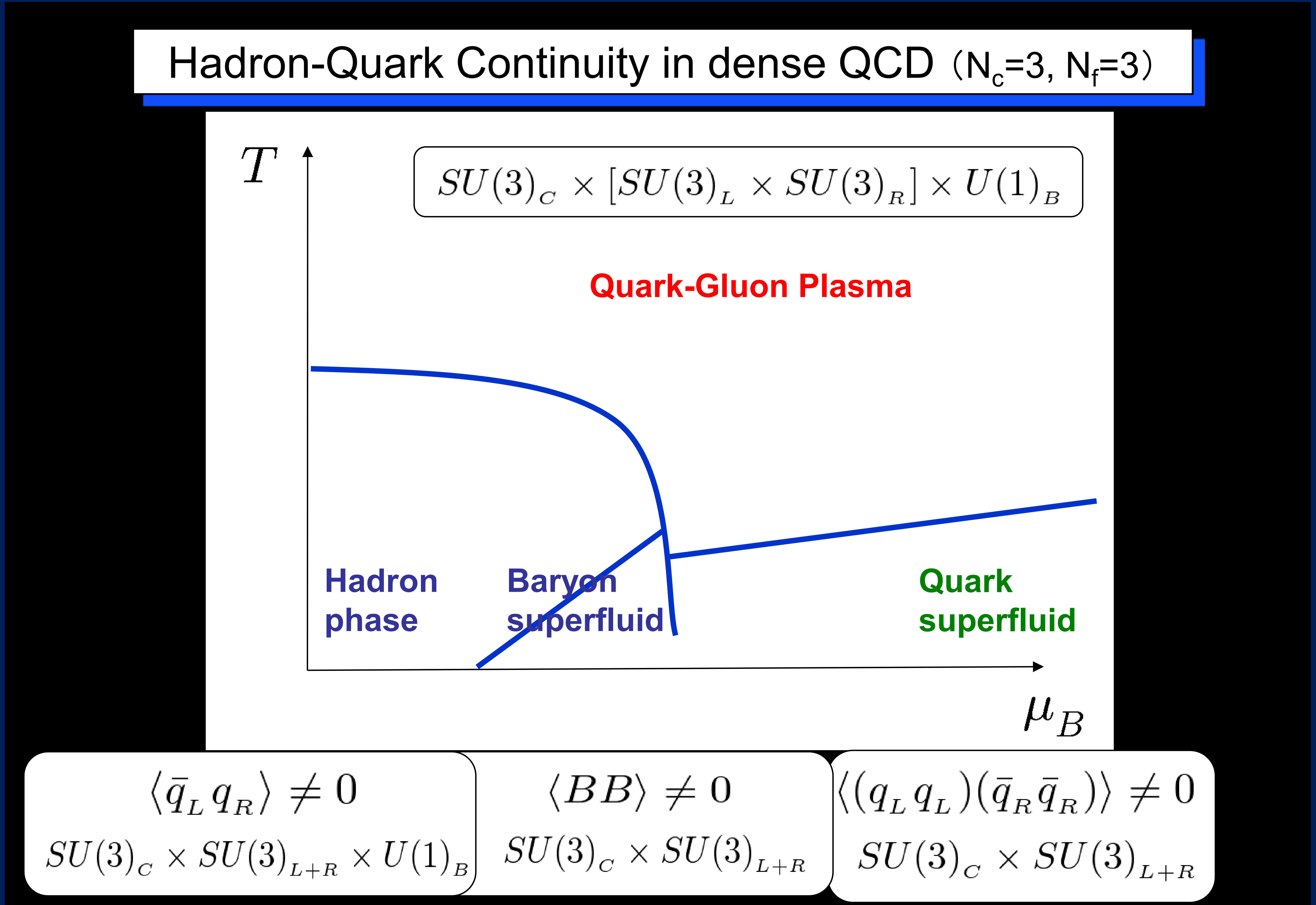




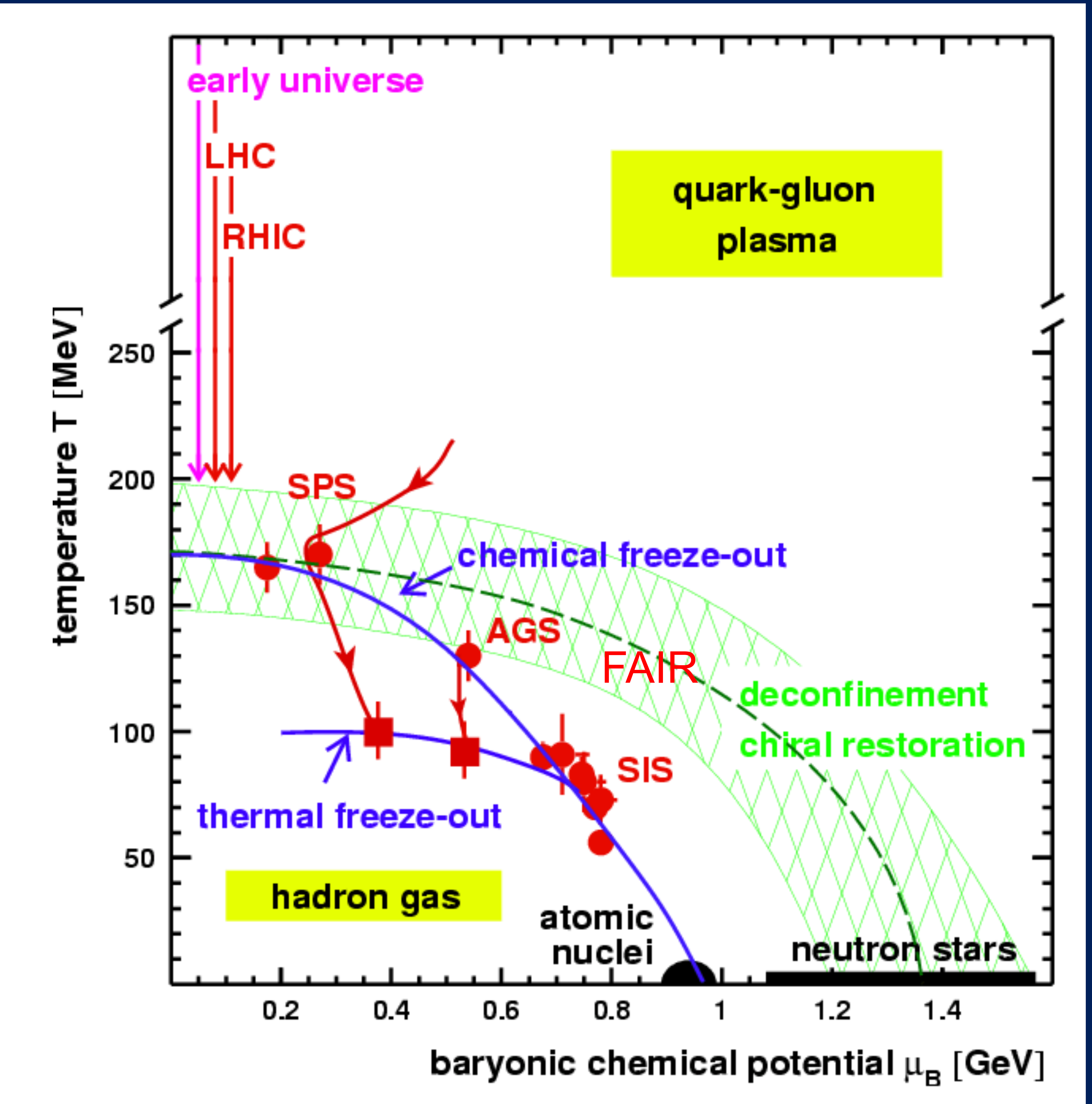
W Weise, Nucl.Phys.A553 (1993) 59c

Where are we now?

Experimentally-accessible regions are rather limited
Lattice is powerful, but is limited to μ_B~0



Chiral symmetry is always broken at finite density



NuPECC report

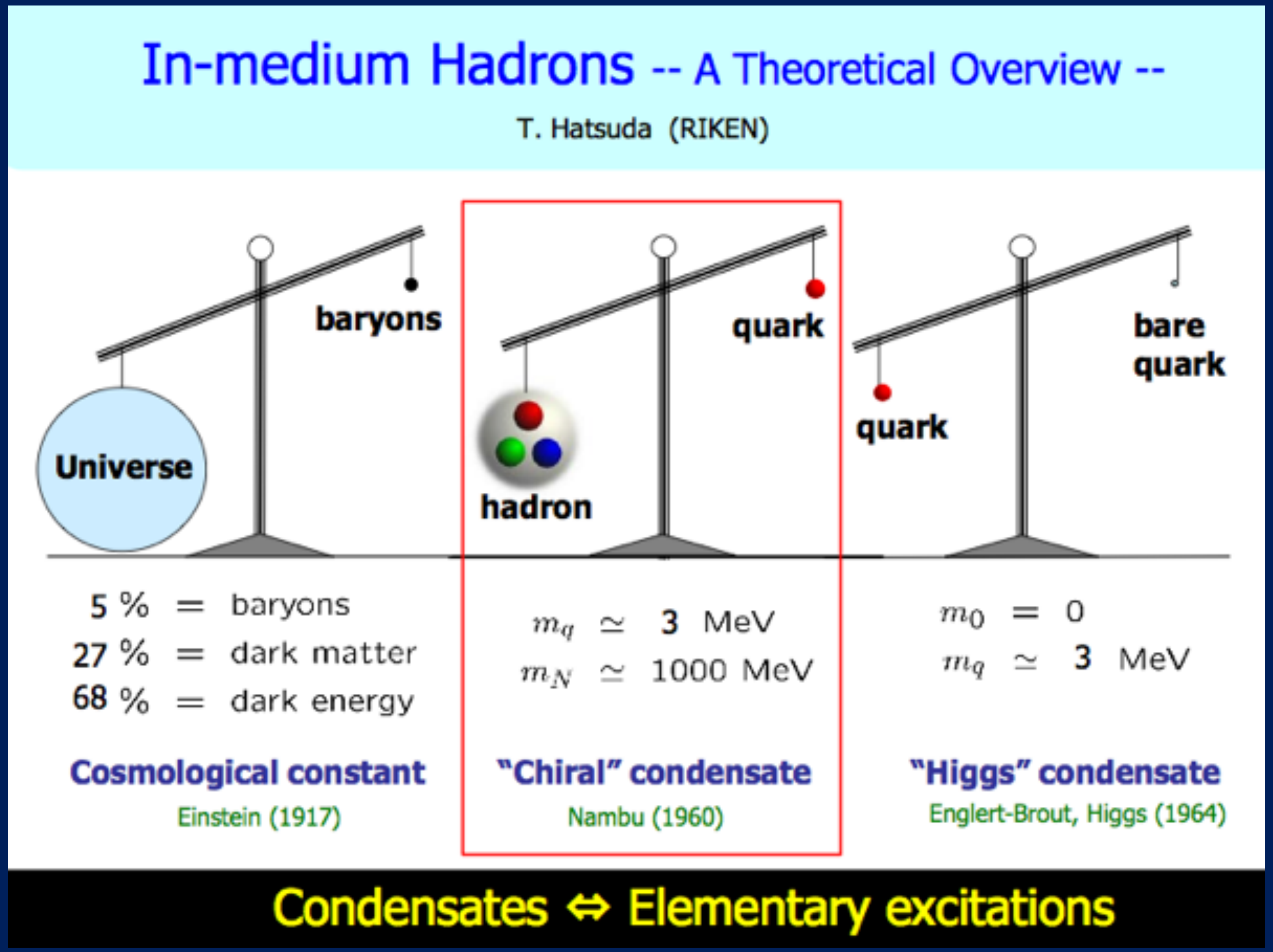
A good starting point for

MIN2016

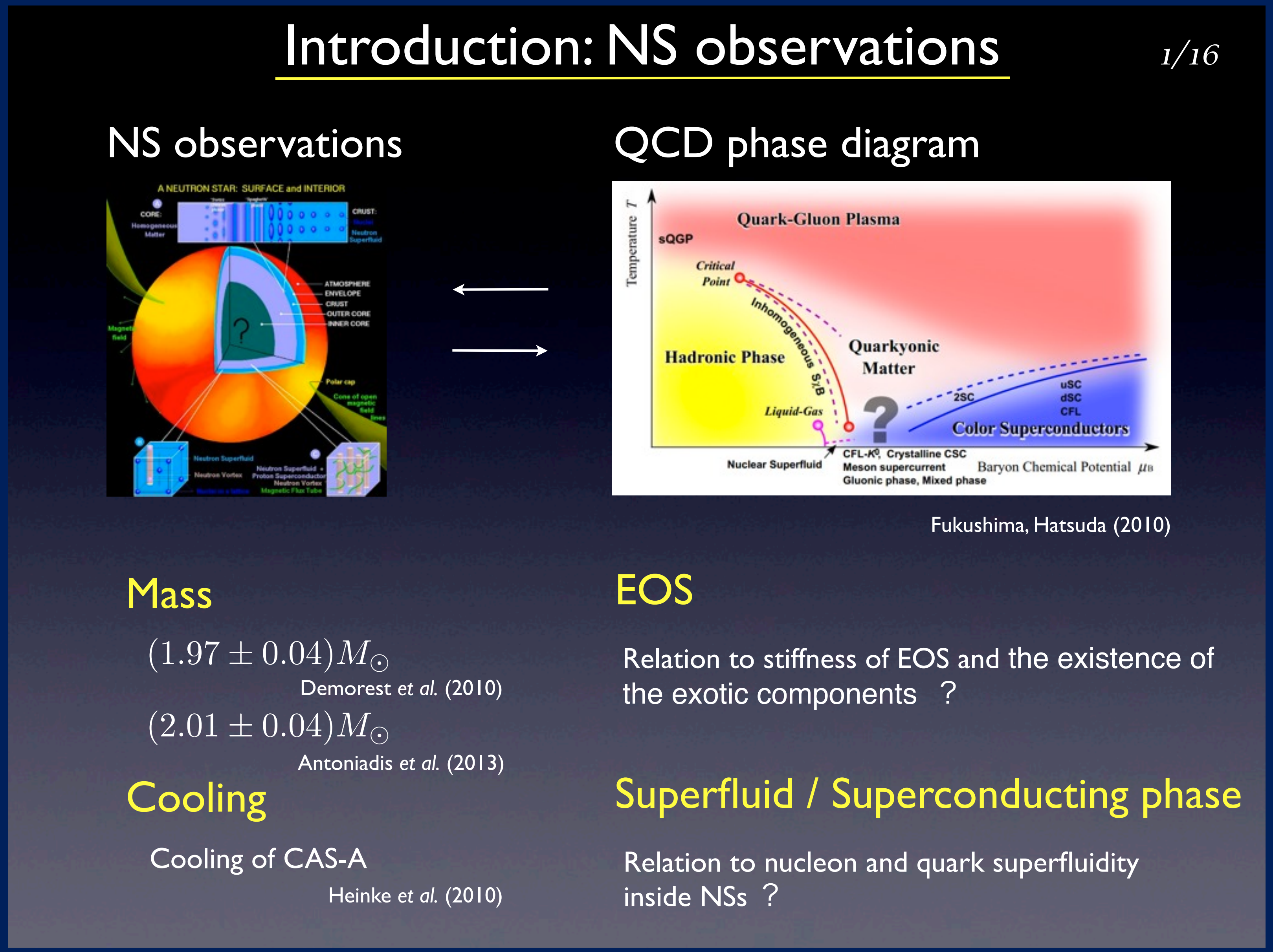
would be to recall

what were discussed at

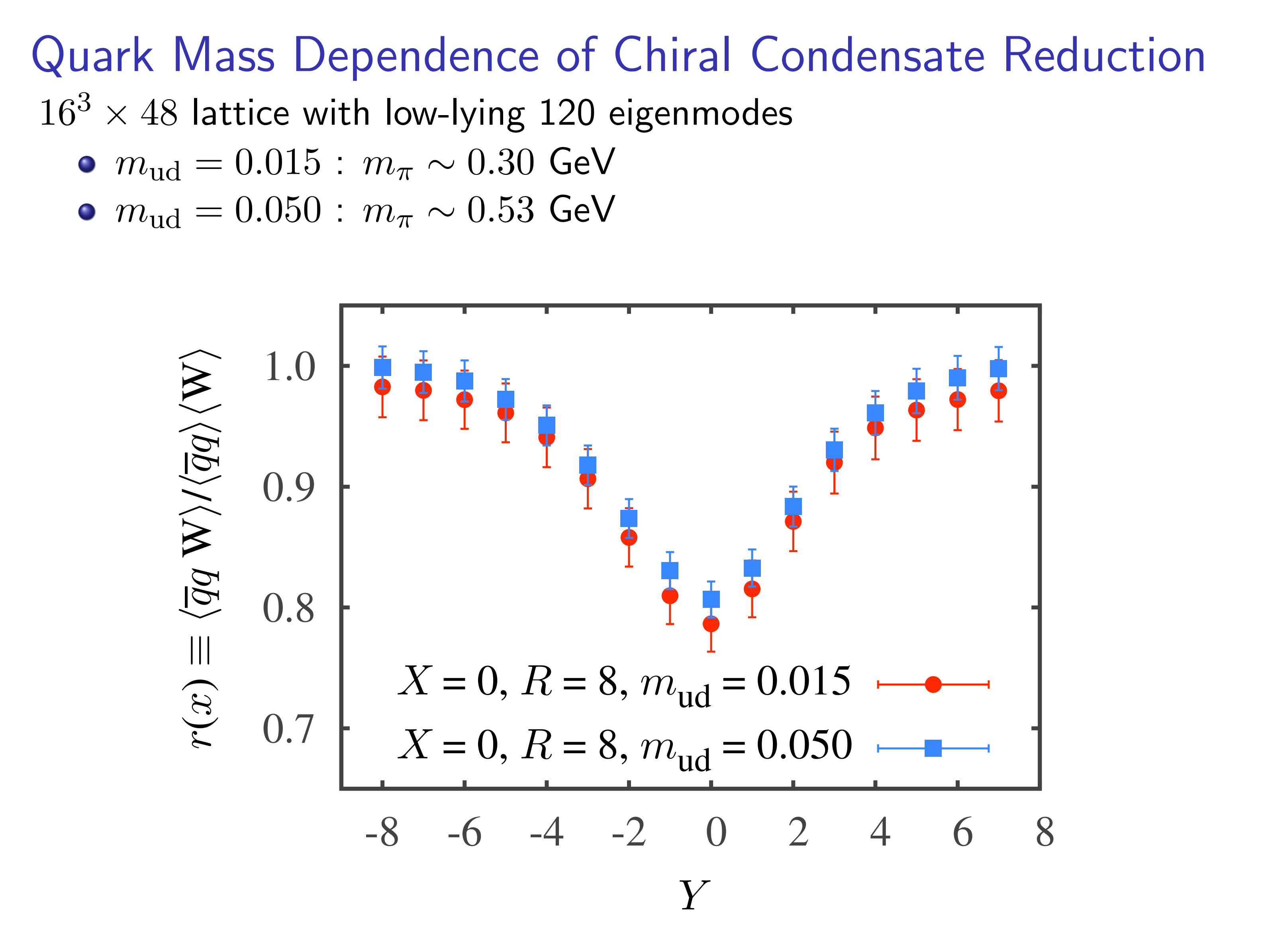
HIN2013 (held @ YITP)



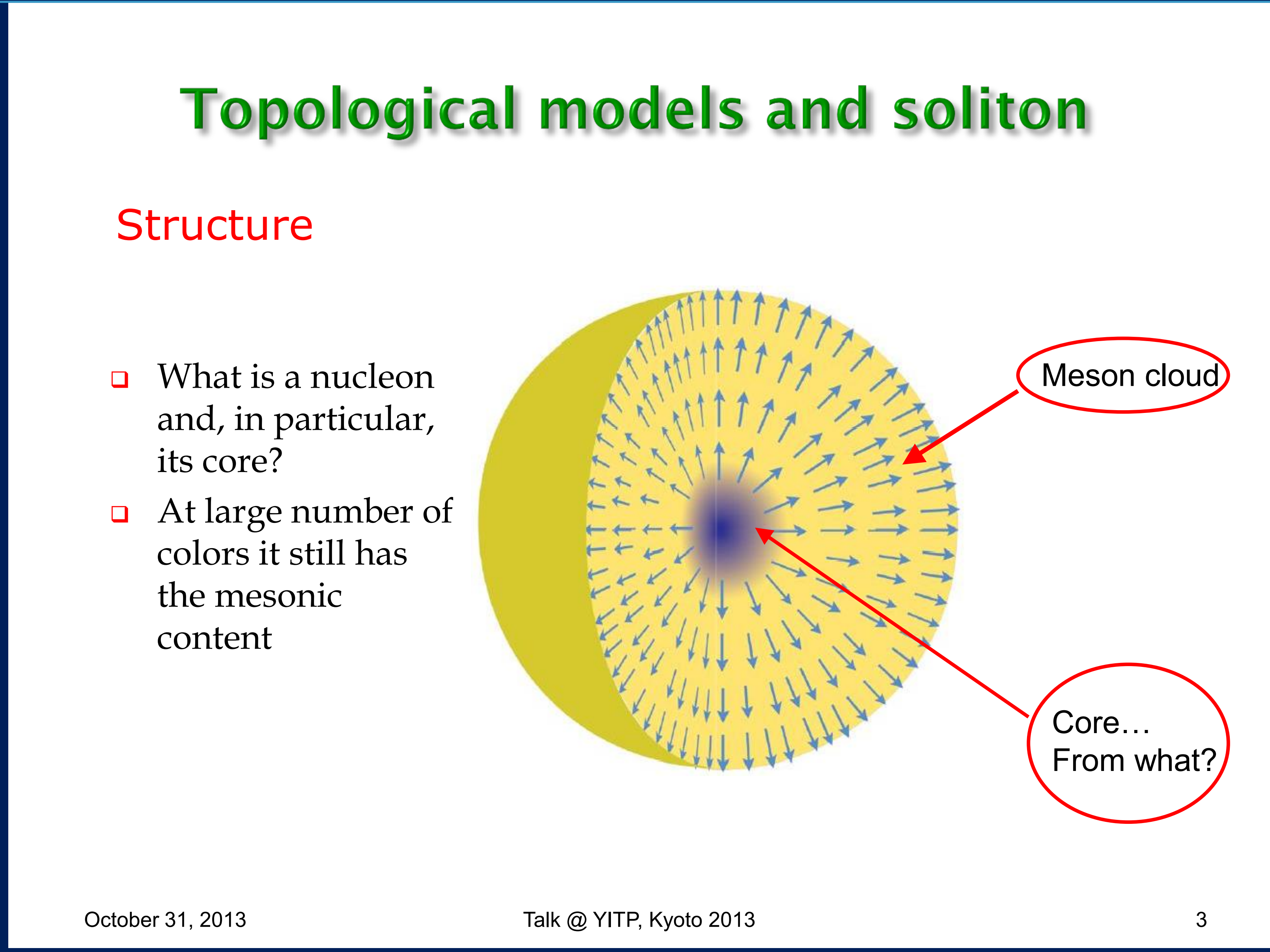
T Hatsuda, In-medium Hadrons - A Theoretical Overview -



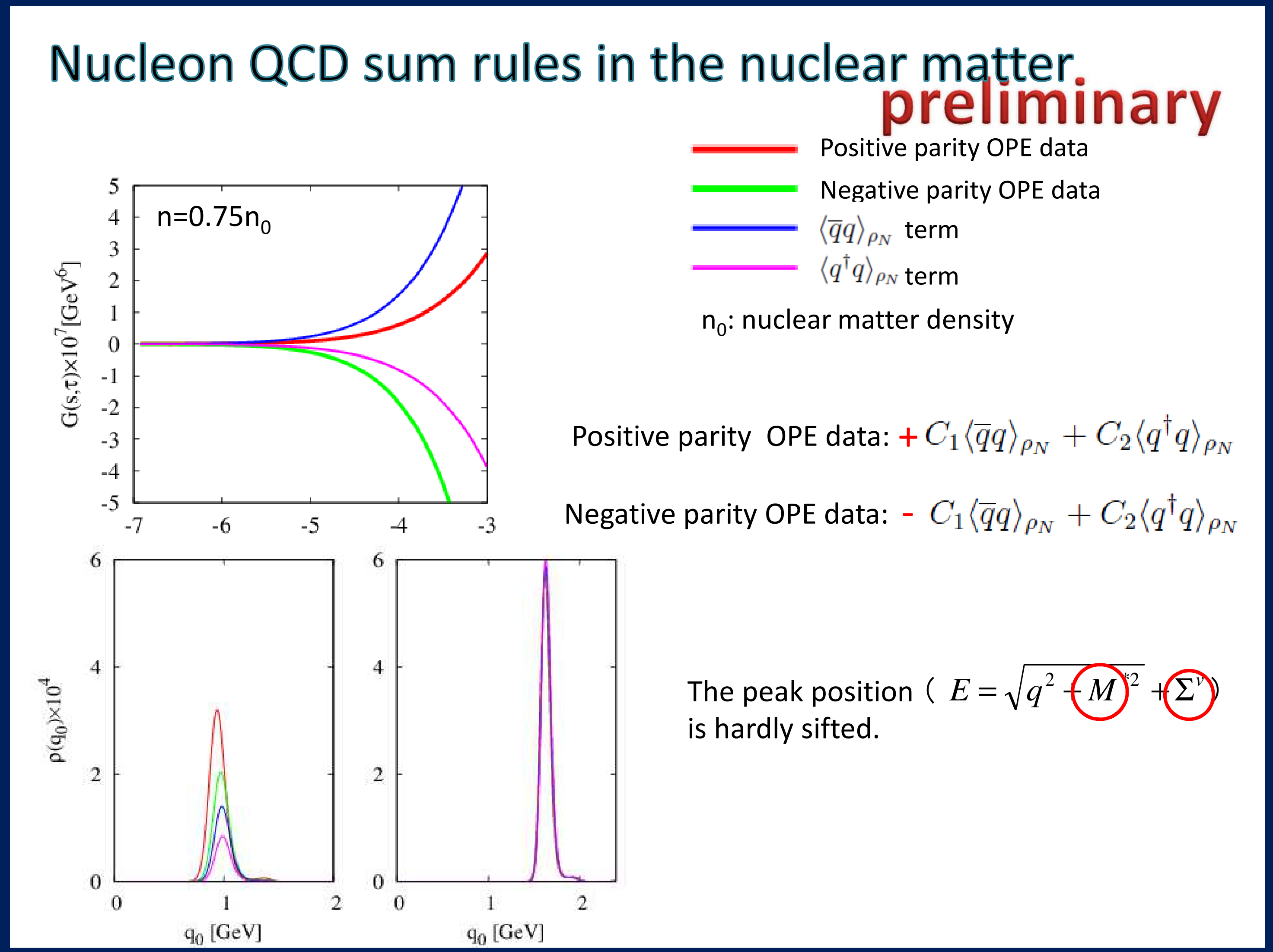
K Masuda, Hadron-Quark Crossover and Neutron Star Observations



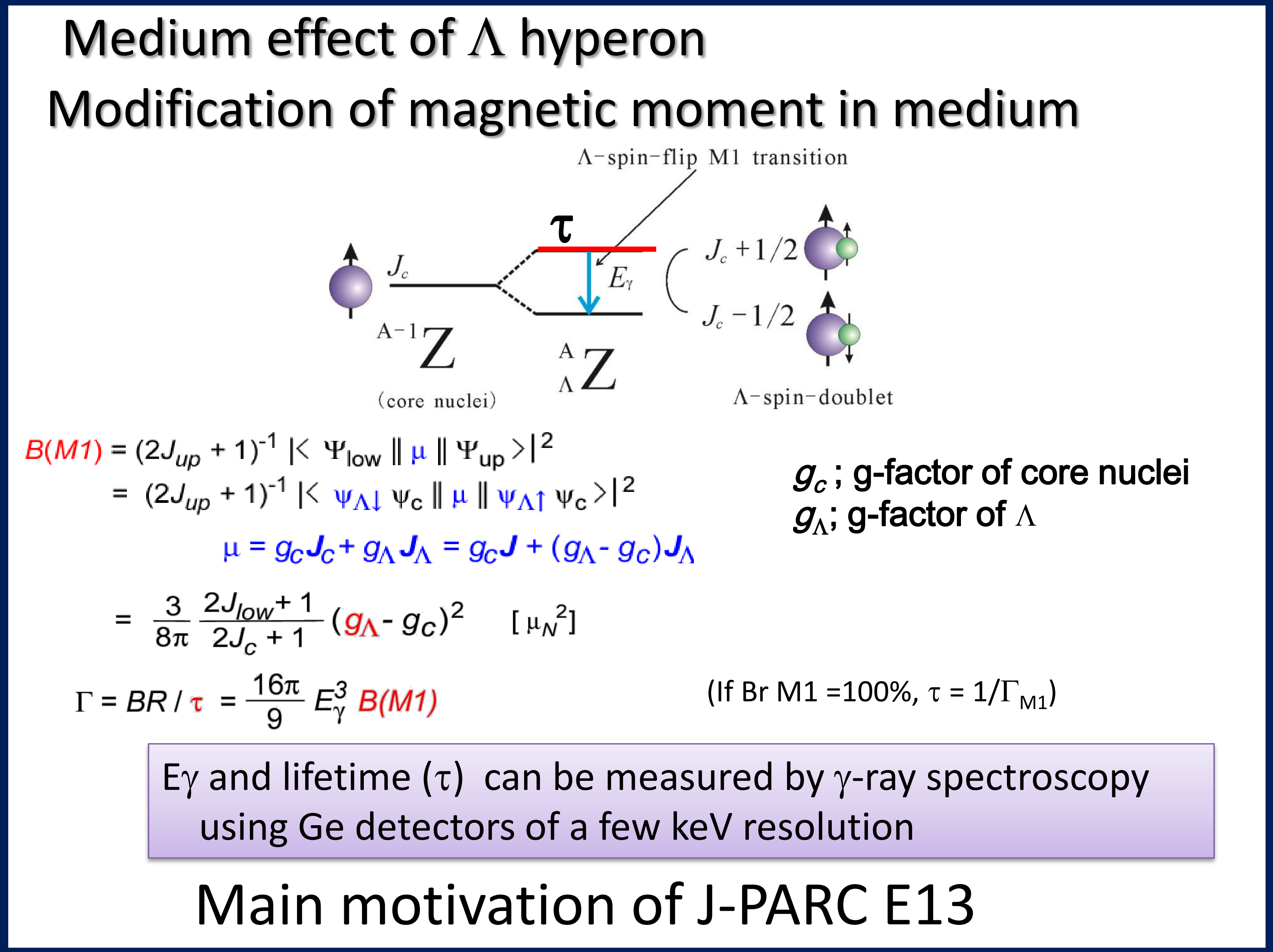
T Iritani, Partial restoration of chiral symmetry in the flux tube from lattice QCD



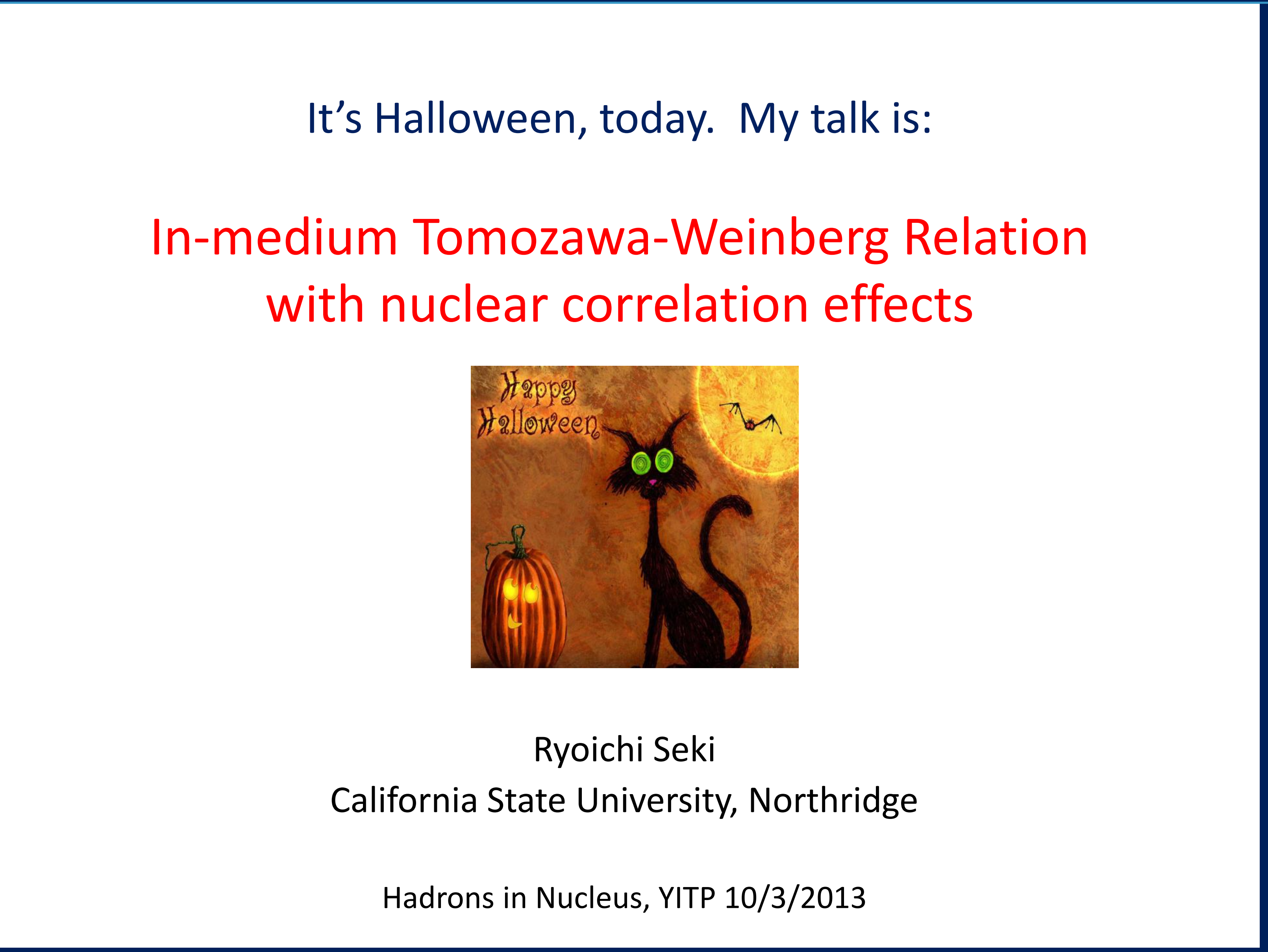
U Yakhshiev, Structure changes of the nucleon in nuclear matter



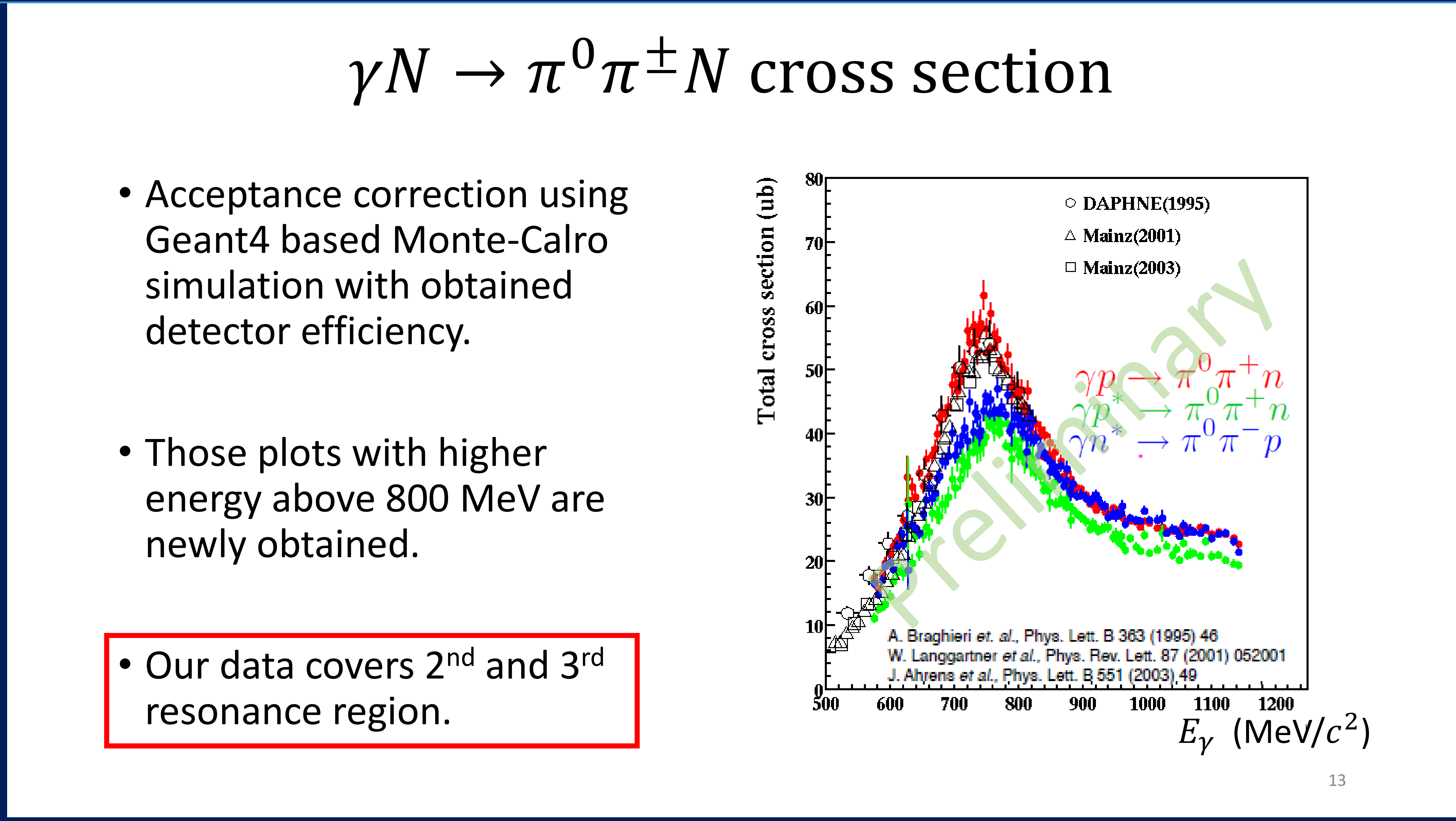
K Ohtani, Nucleon spectral function in nuclear medium from QCD sum rules



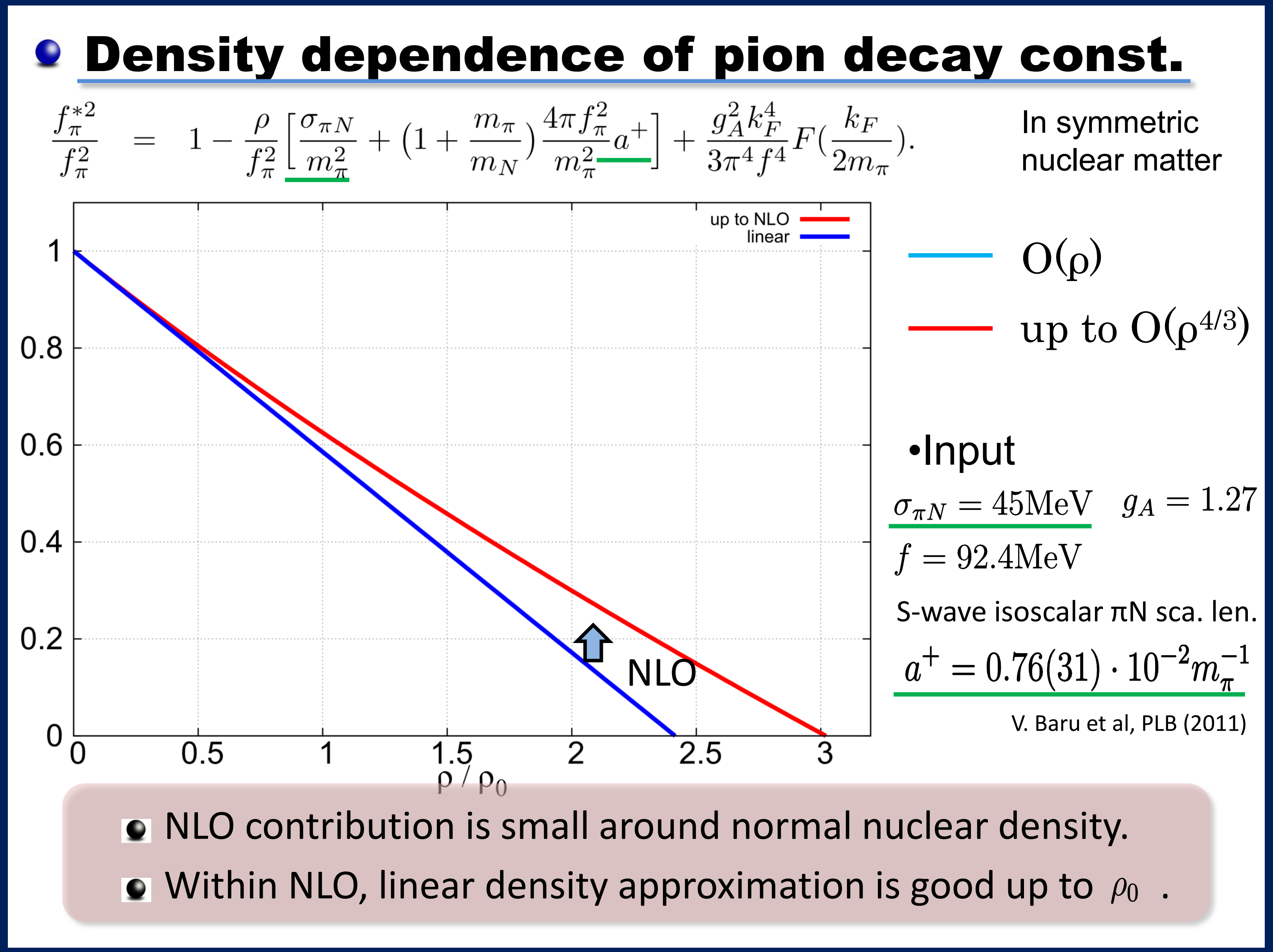
M Ukai, Study of the Λ g-factor in hypernuclei via the γ-ray spectroscopy at J-PARC



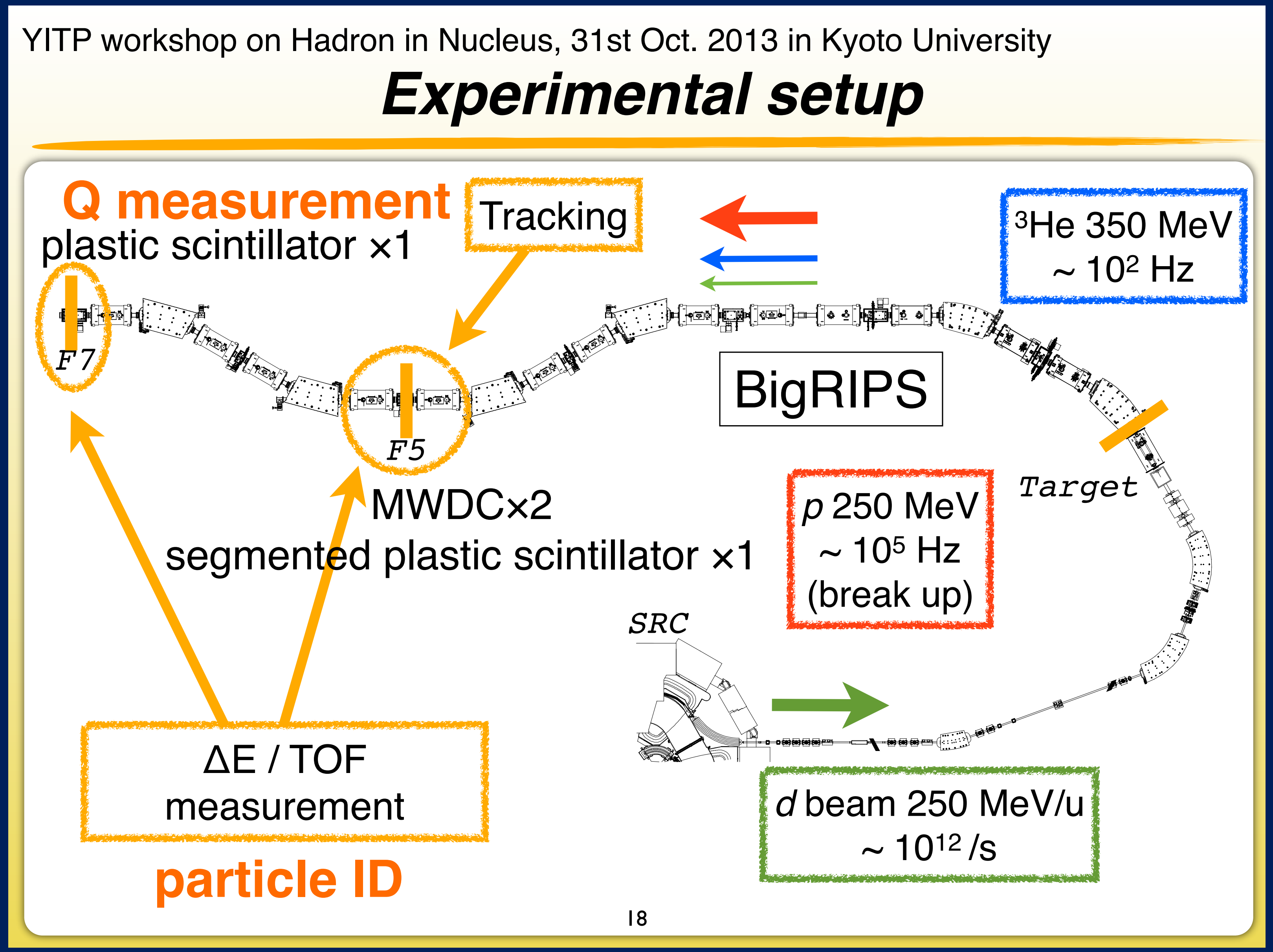
R Seki, In-medium Tomozawa-Weinberg Relation with nuclear correlation effects



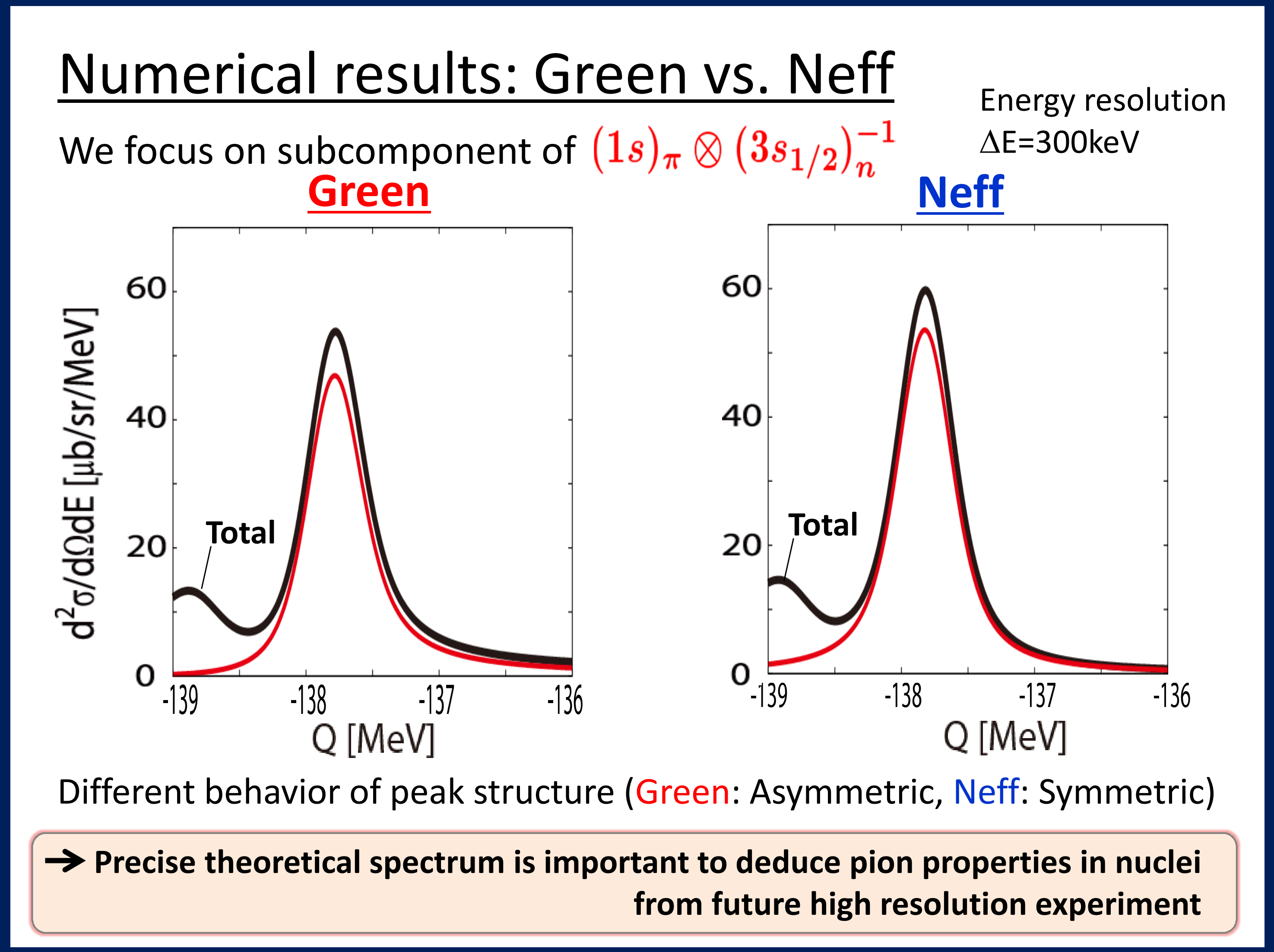
S Matsumoto, $\pi^0\pi^\pm$ photoproduction on the deuteron at ELPH



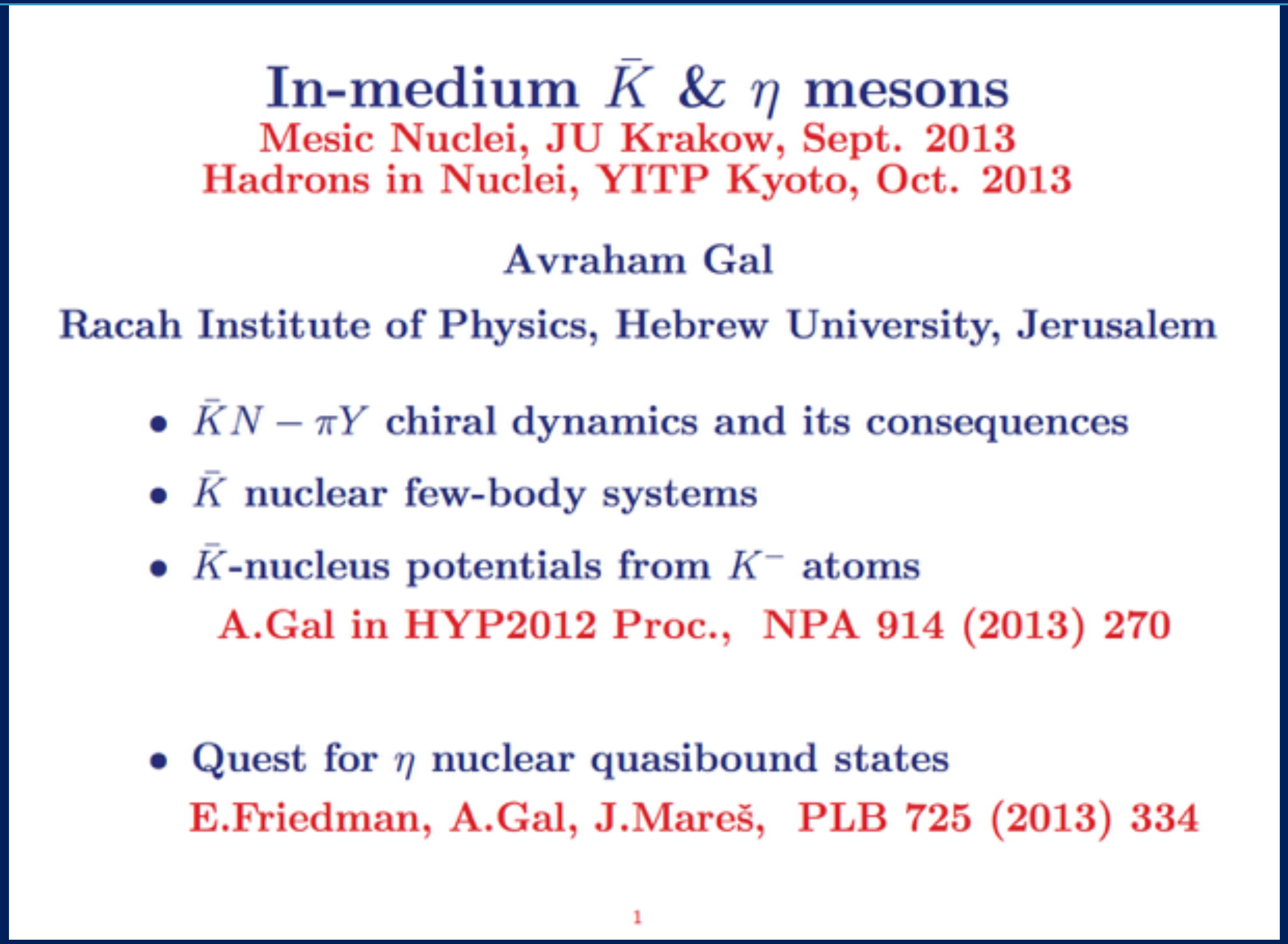
S Goda, Partial Restoration of Chiral Symmetry and In-medium Pion Properties



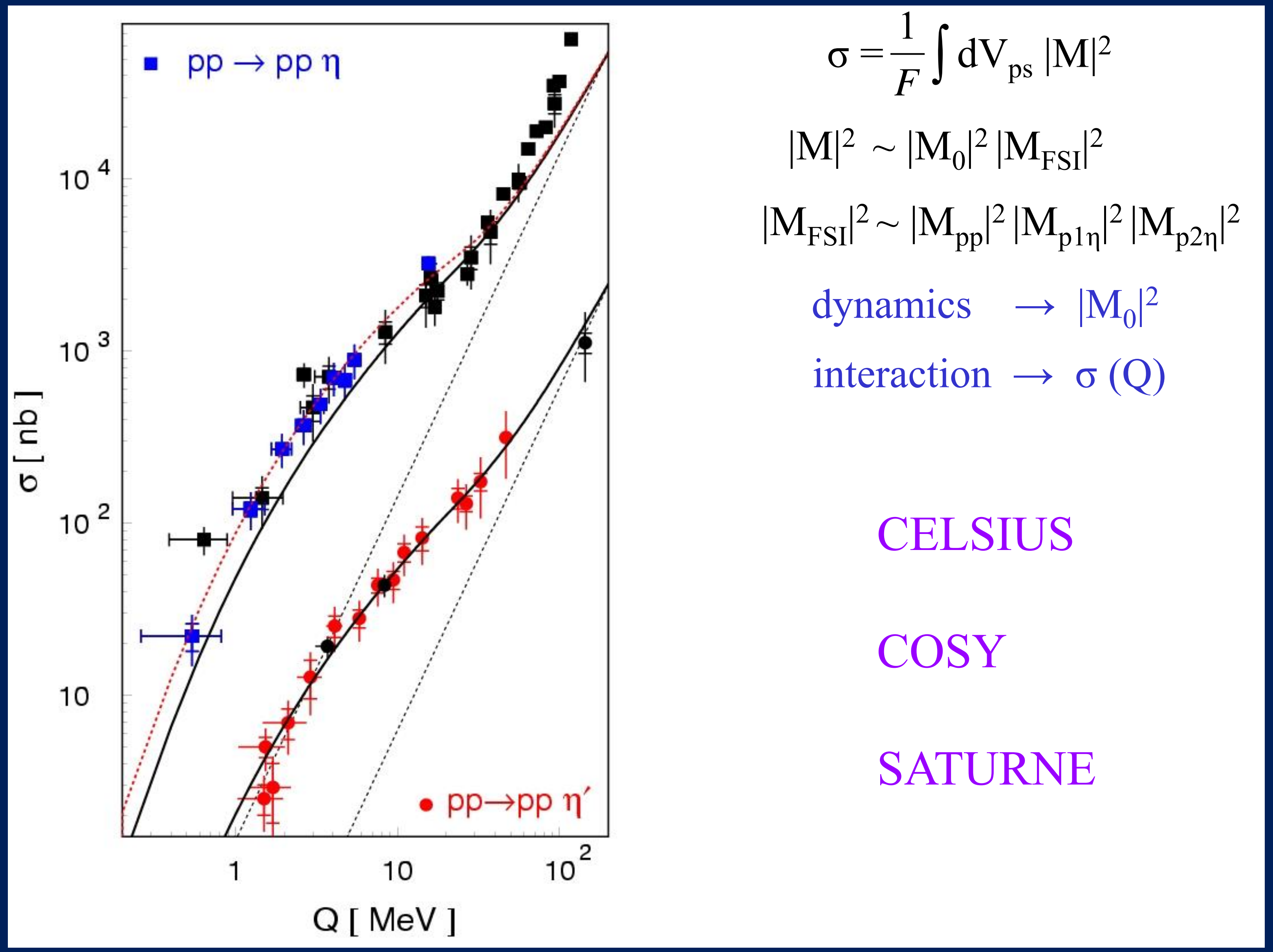
T Nishi, Systematic study of deeply-bound pionic atom and future perspectives



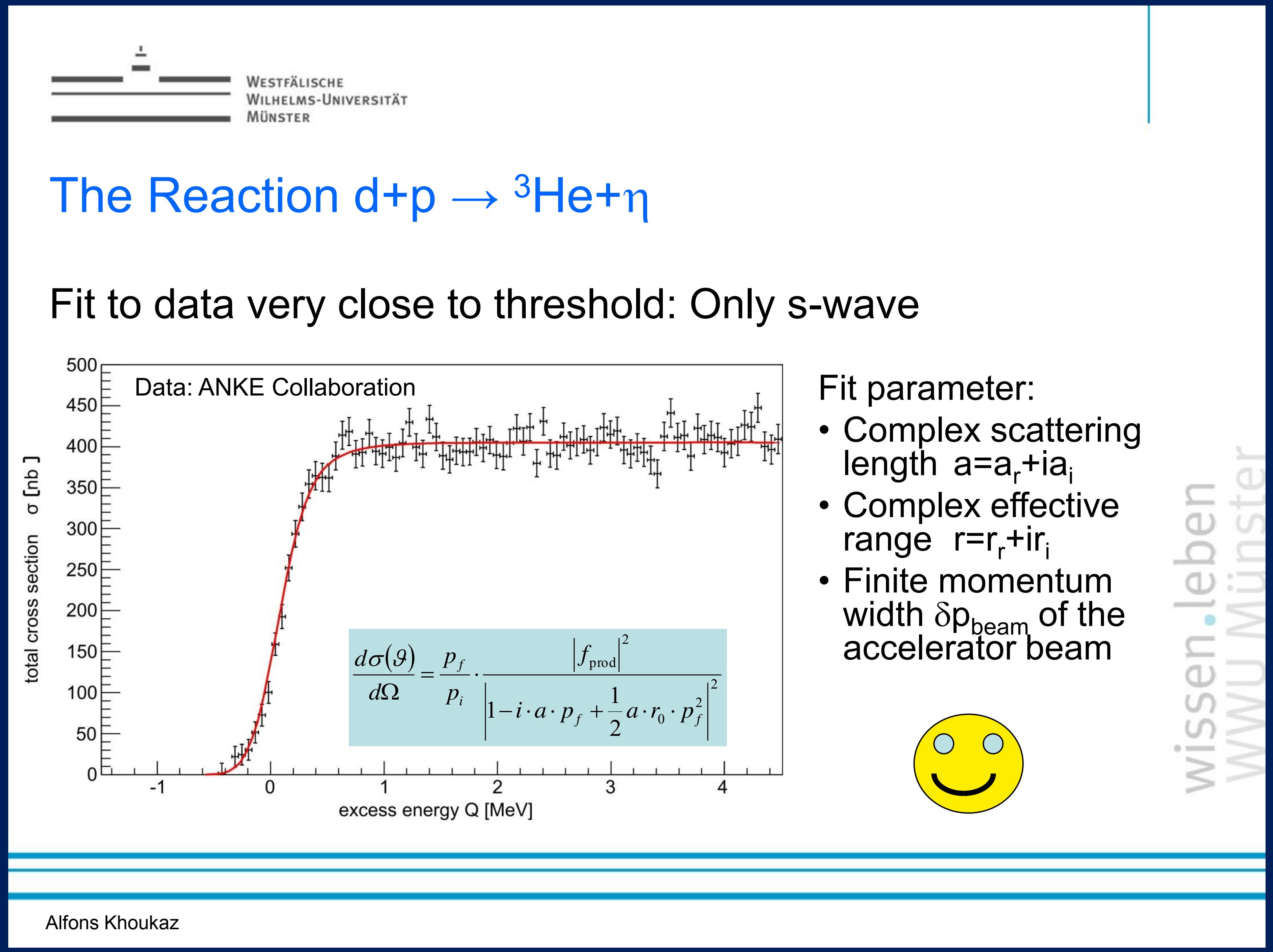
N Ikeno, Formation spectra of deeply bound pionic atoms in the (d,^{3}He) reactions



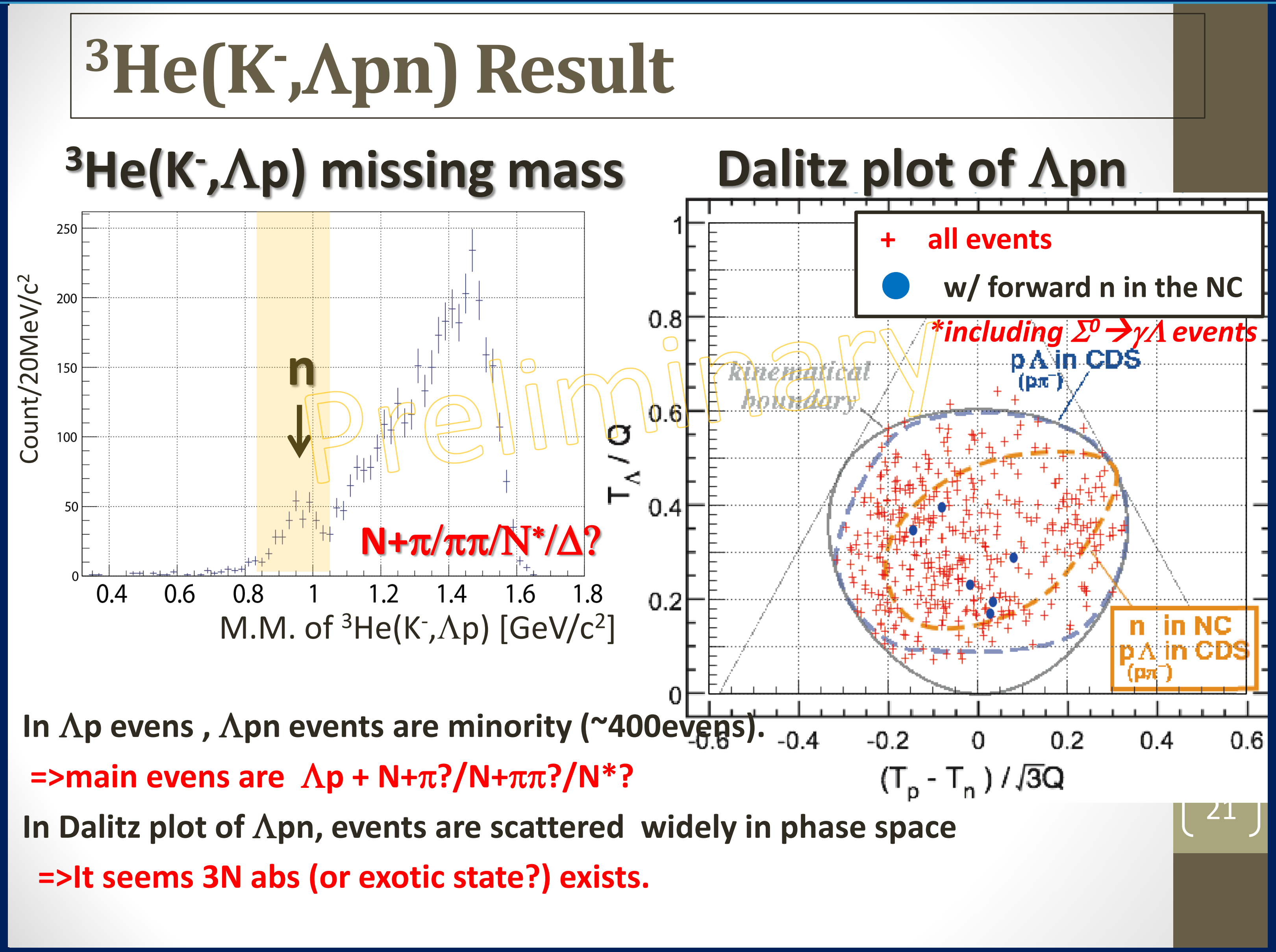
A Gal, In-medium K^{bar} & η mesons



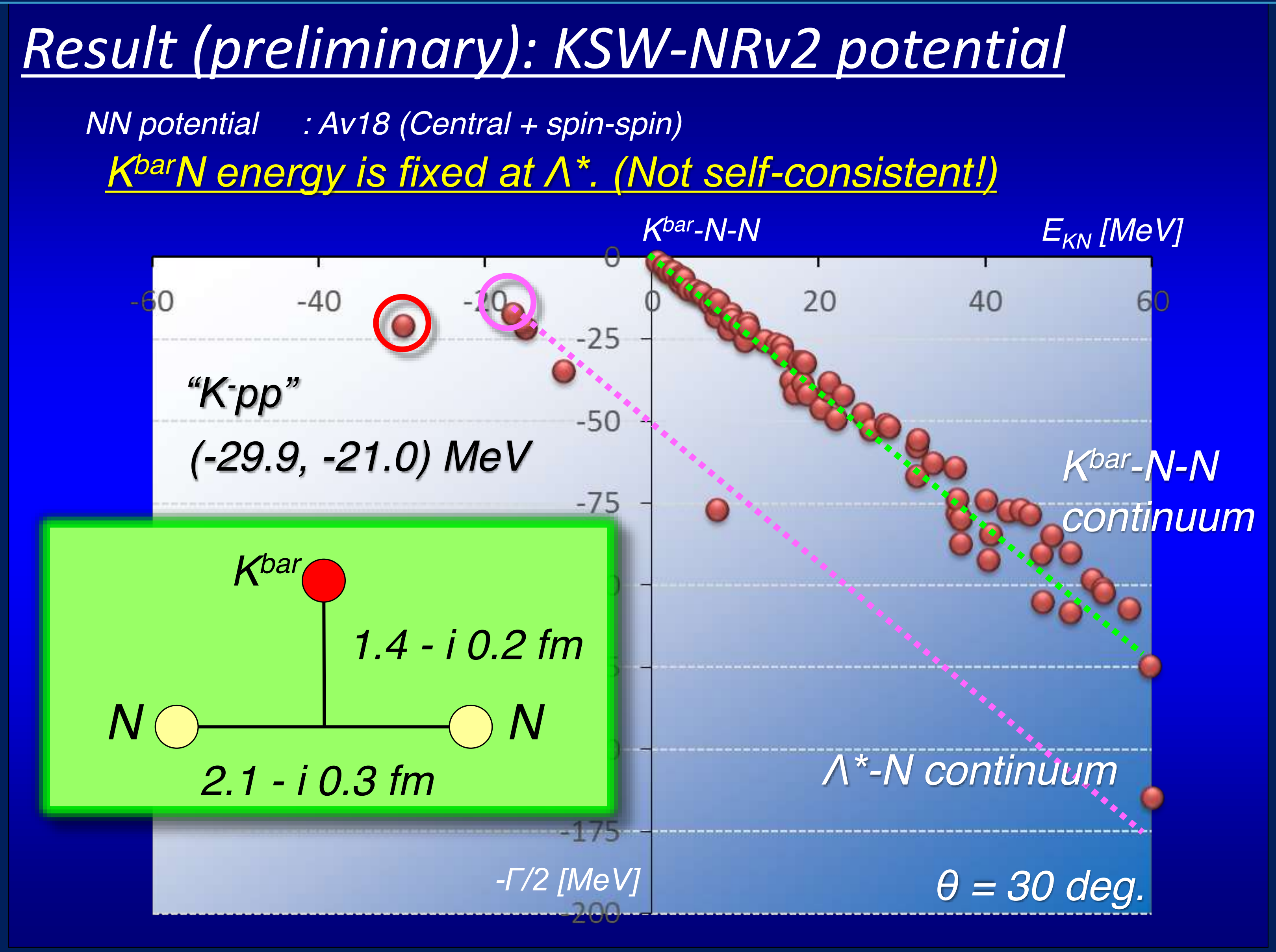
P Moskal: Search for the eta-mesic helium in the deuteron-deuteron fusion reaction



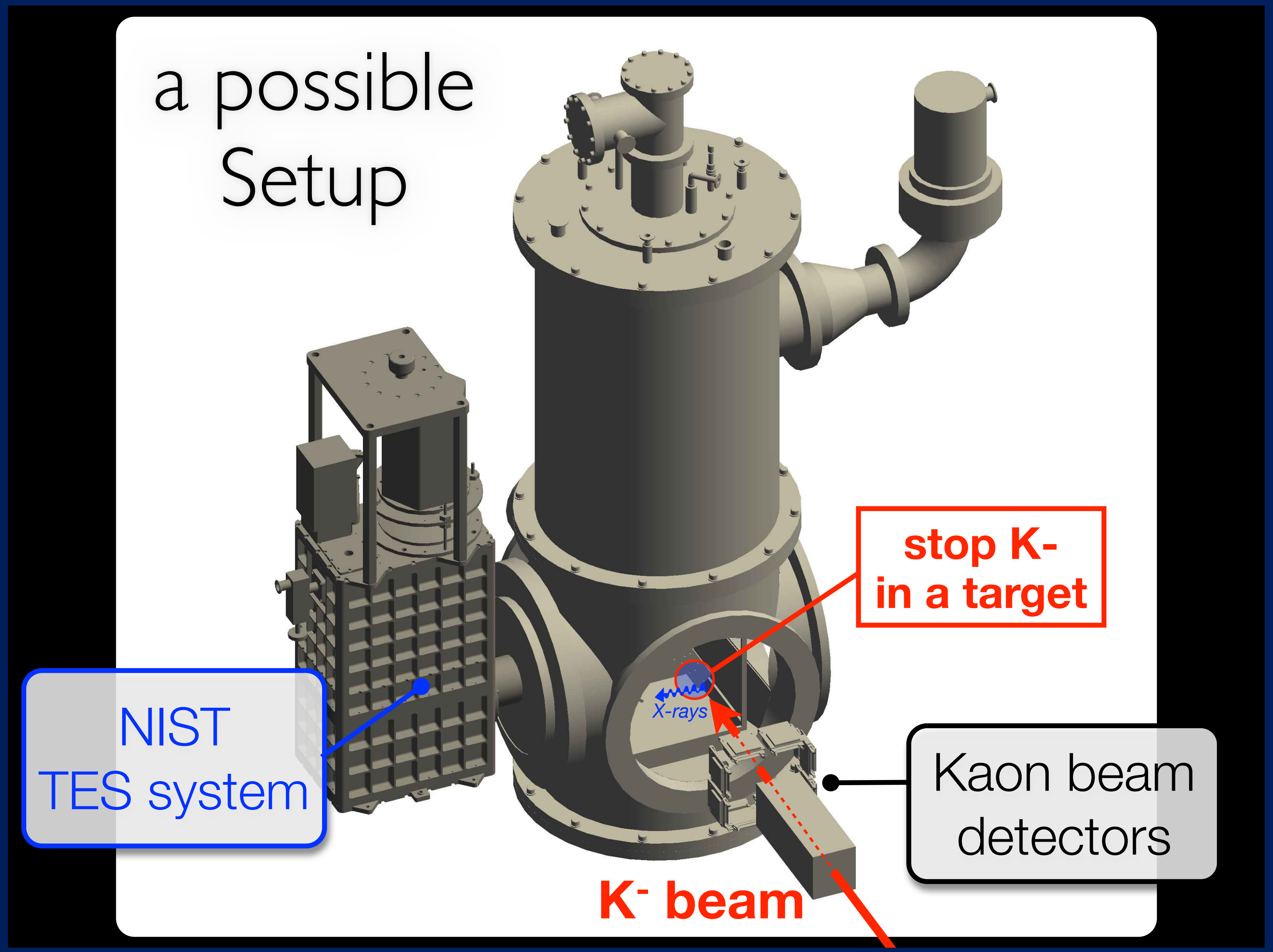
A Khoukaz, Investigation of the 3He-η system in deuteron-proton collisions at COSY-ANKE



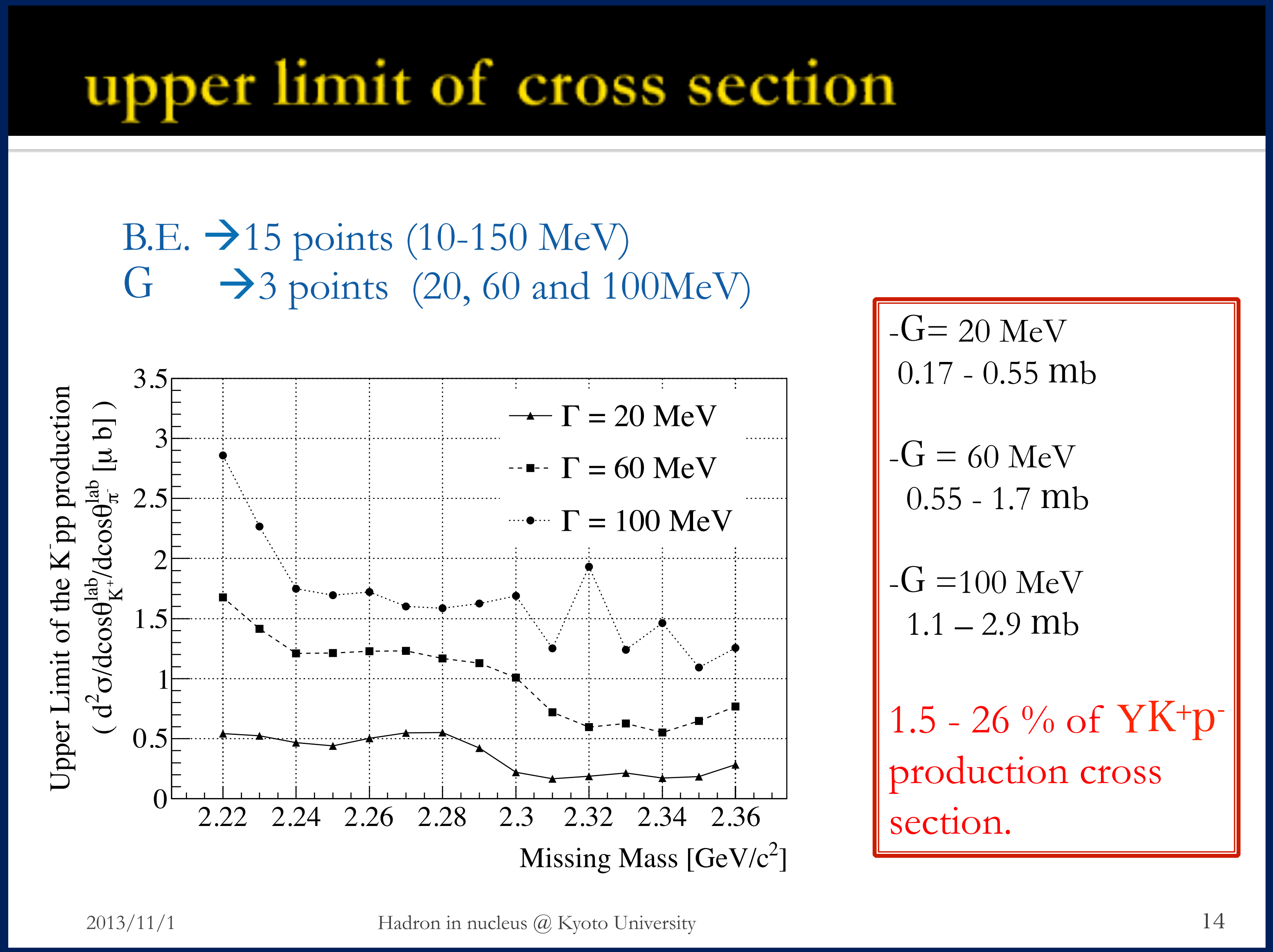
Y Sada, Analysis status of the J-PARC E15 experiment



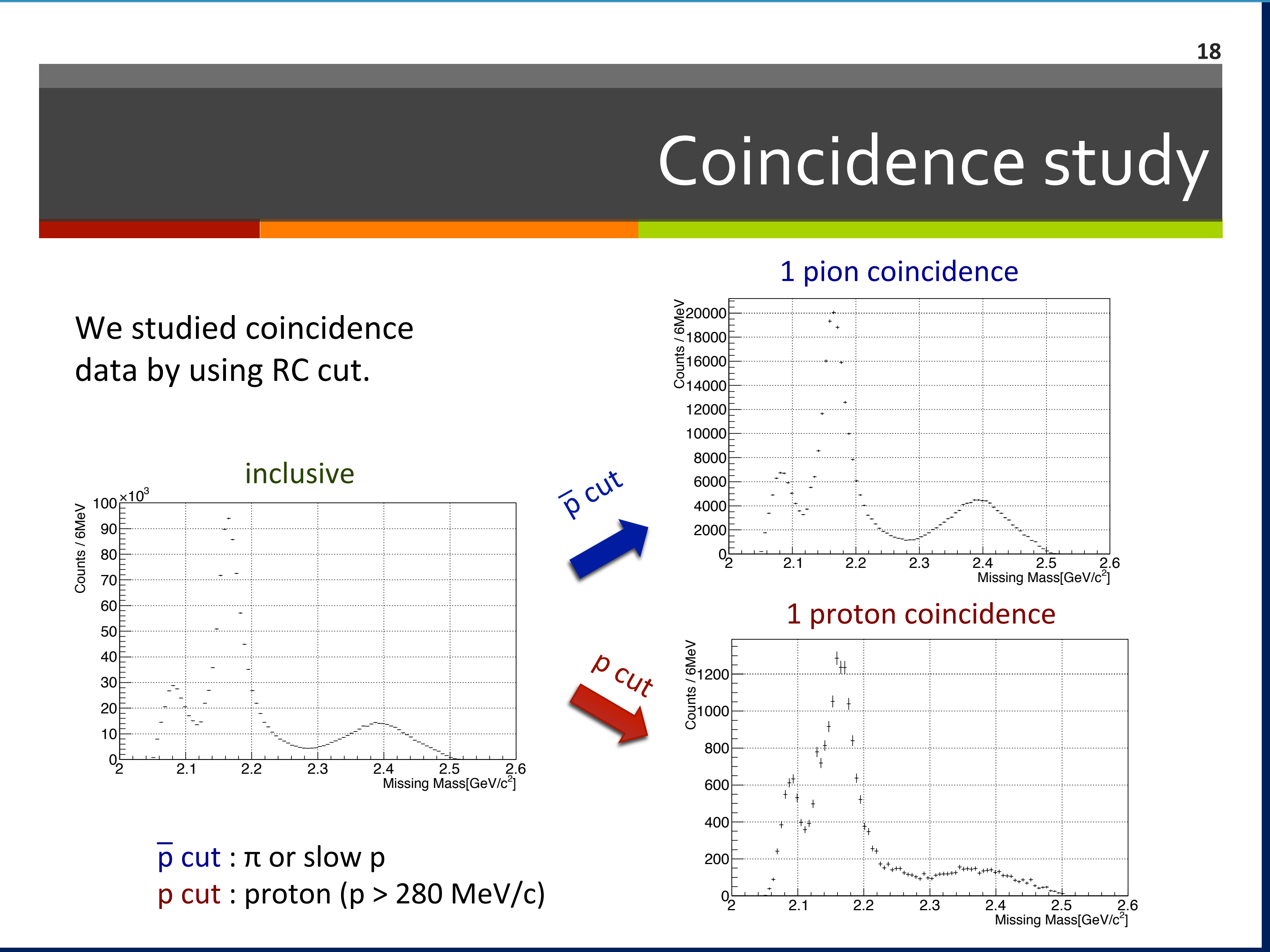
A Doté, Study of K$^-$pp with an effective K^{bar}N potential on coupled-channel complex scaling model



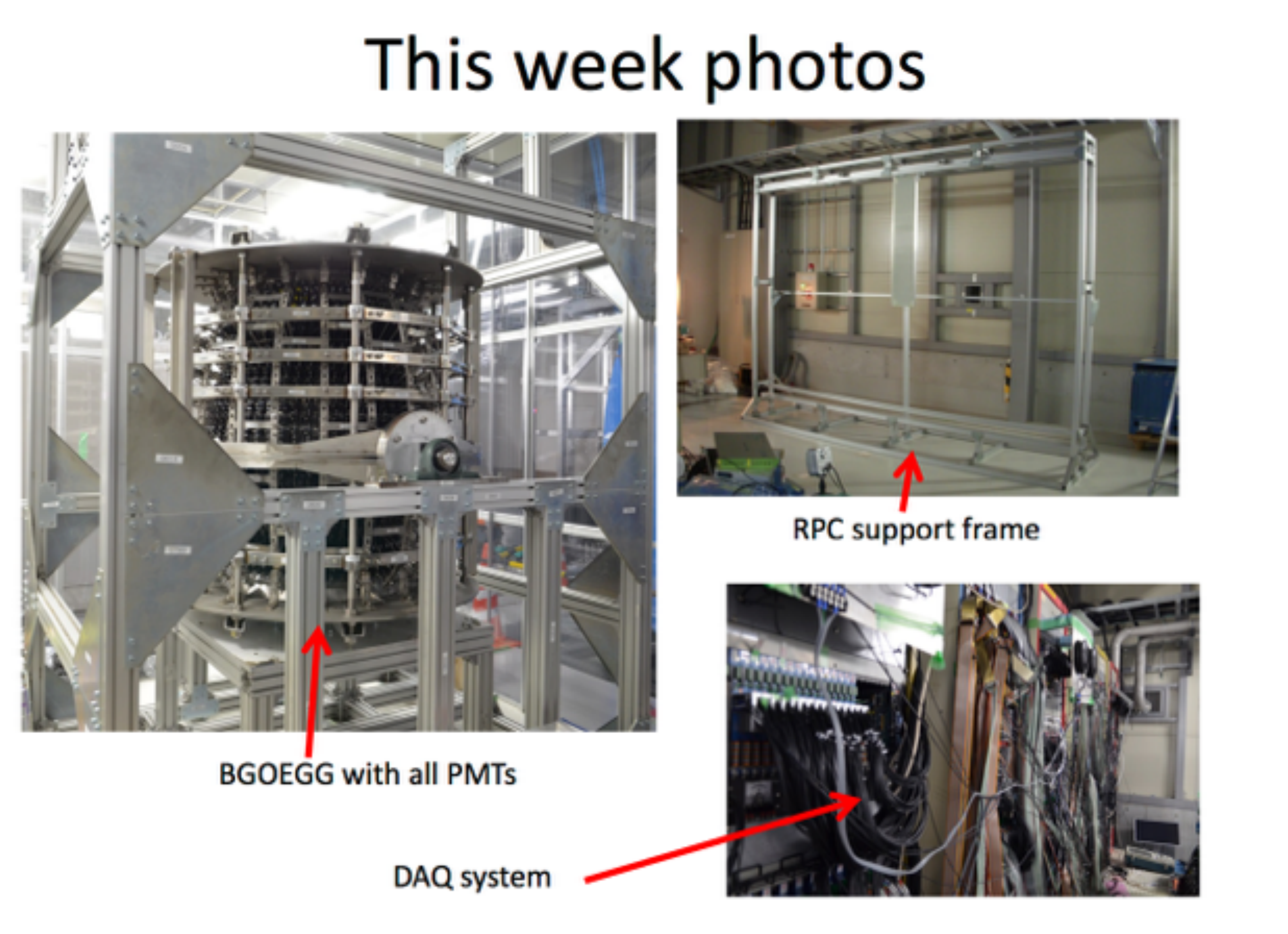
S Okada, High-resolution hadronic-atom x-ray spectroscopy with transition-edge-sensor micro-calorimeters



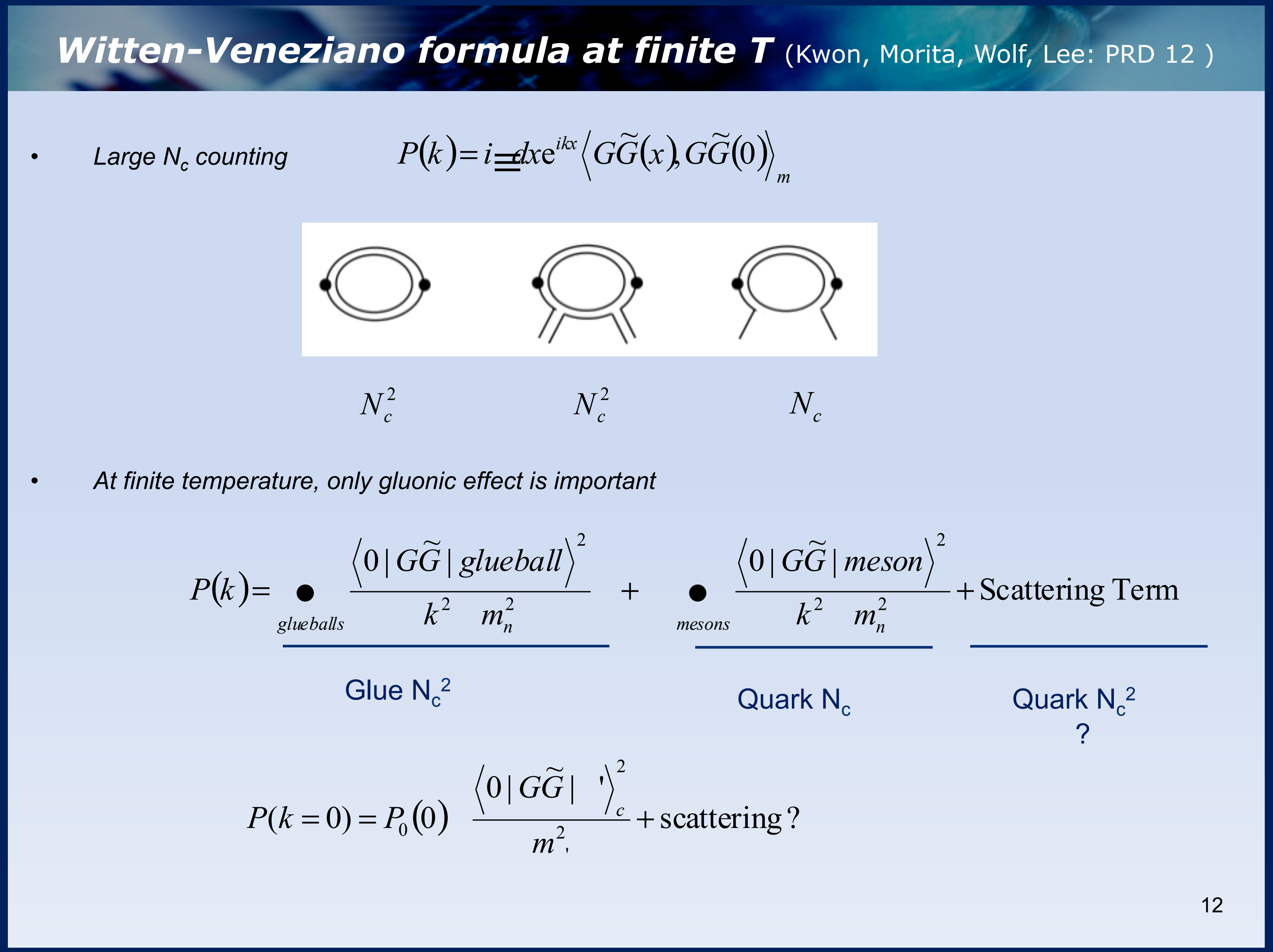
AO Tokiyasu, Search for the K$^-$pp bound state via photon-induced reaction



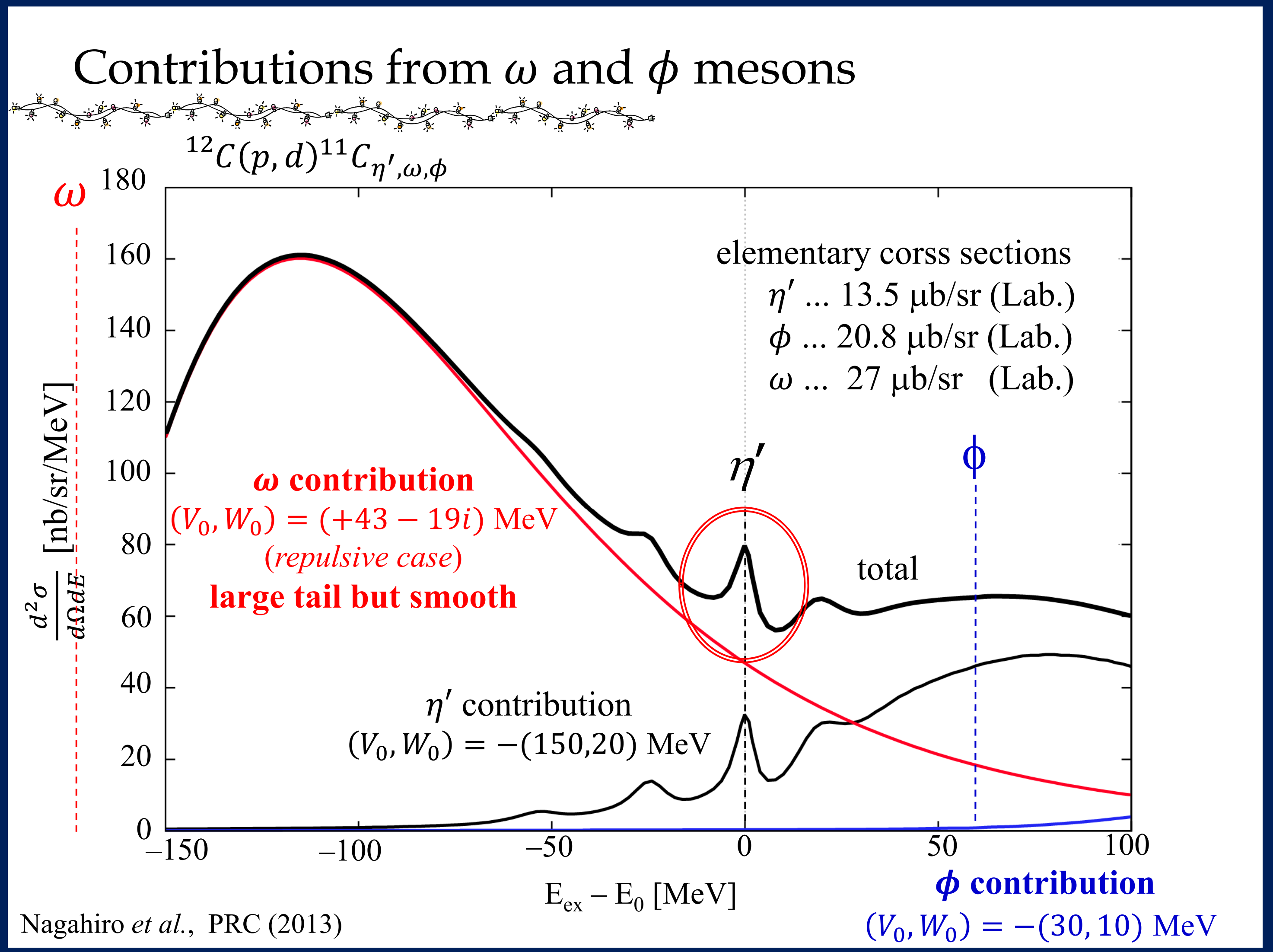
H Ekawa, K$^-$pp search experiment in the d(p,K$^+$) reaction at J-PARC



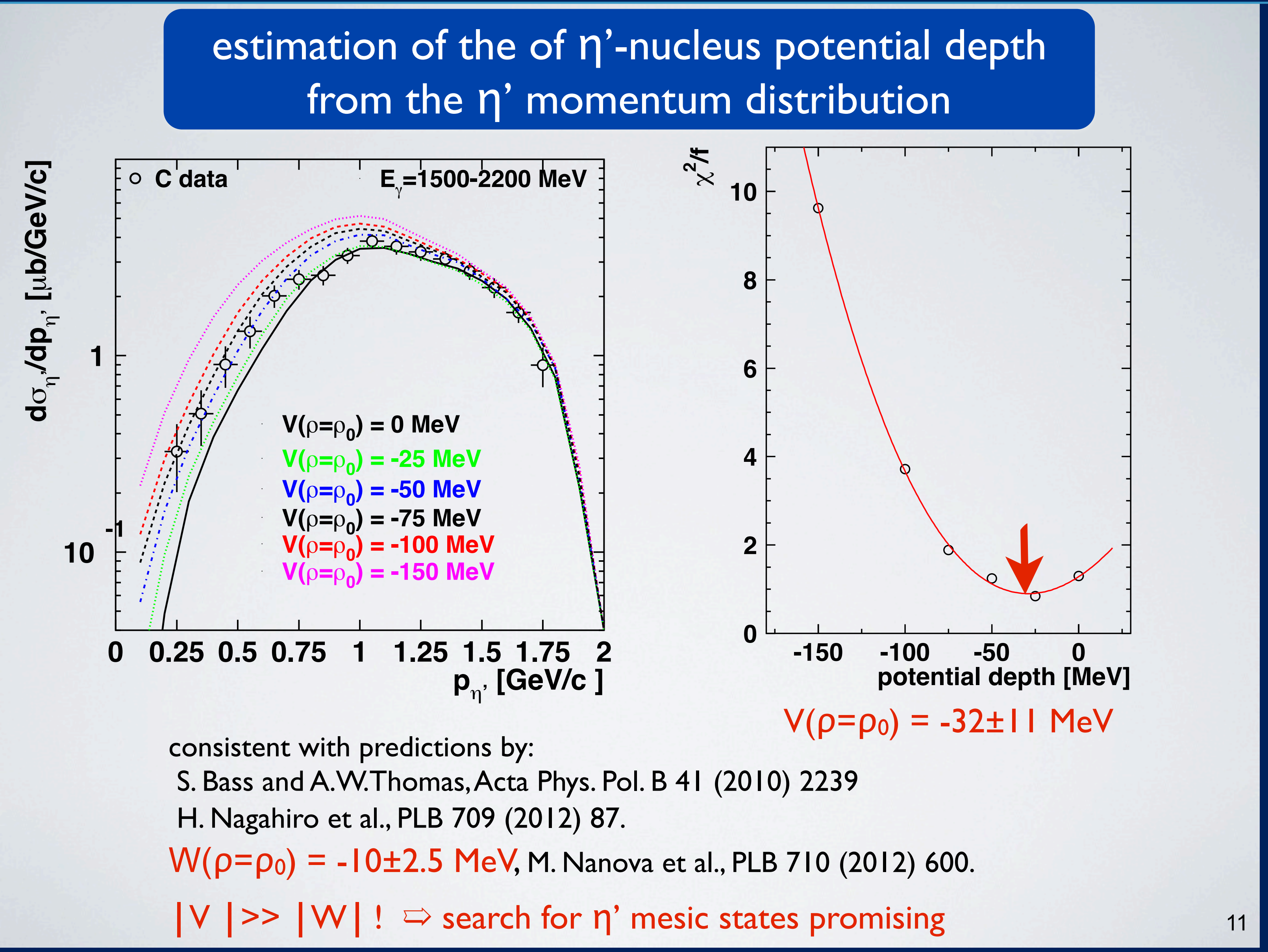
M Miyabe, Recent status and plans at SPring-8 LEPS2 facility



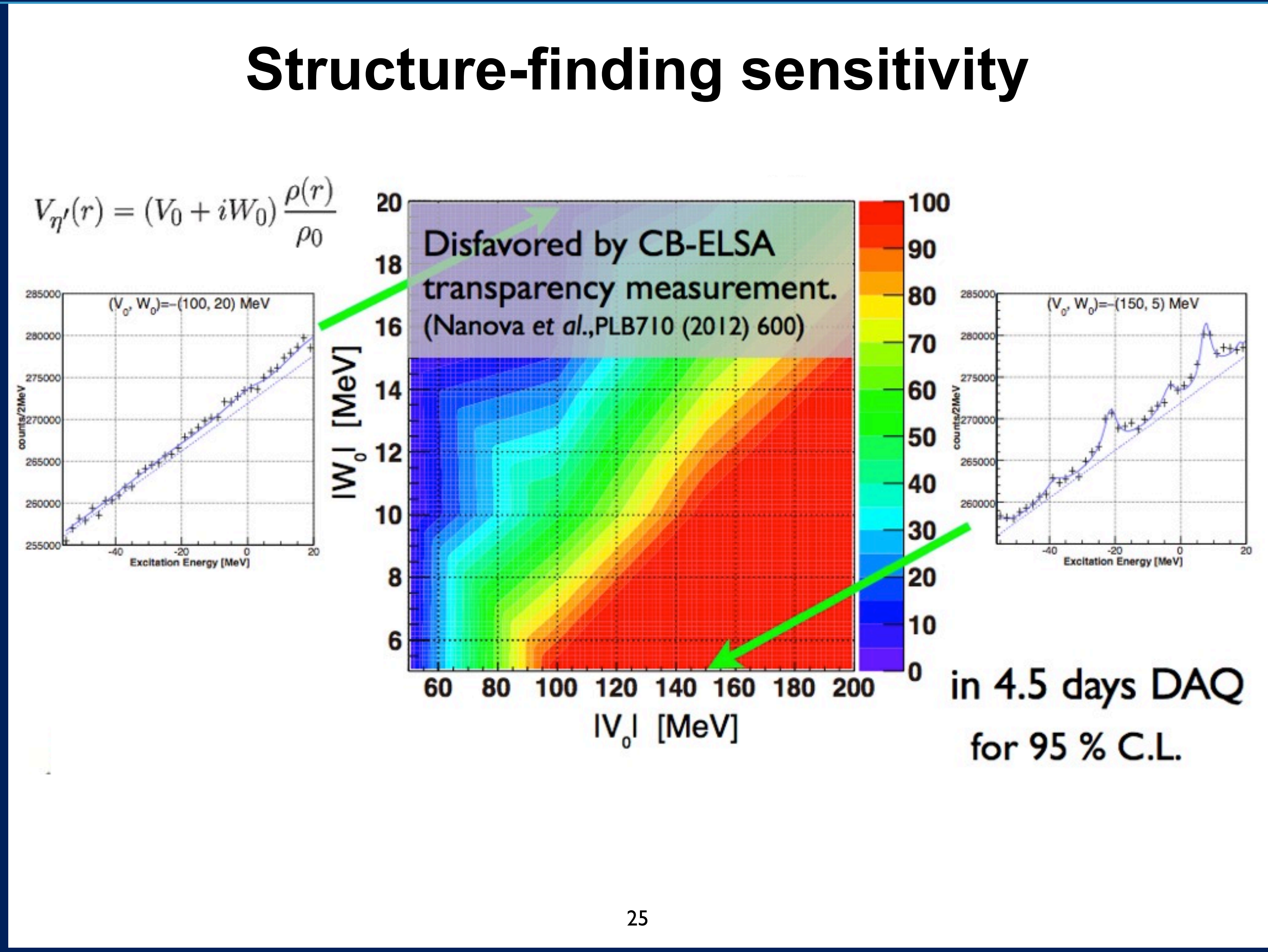
SH Lee, Another look at η‘ in medium



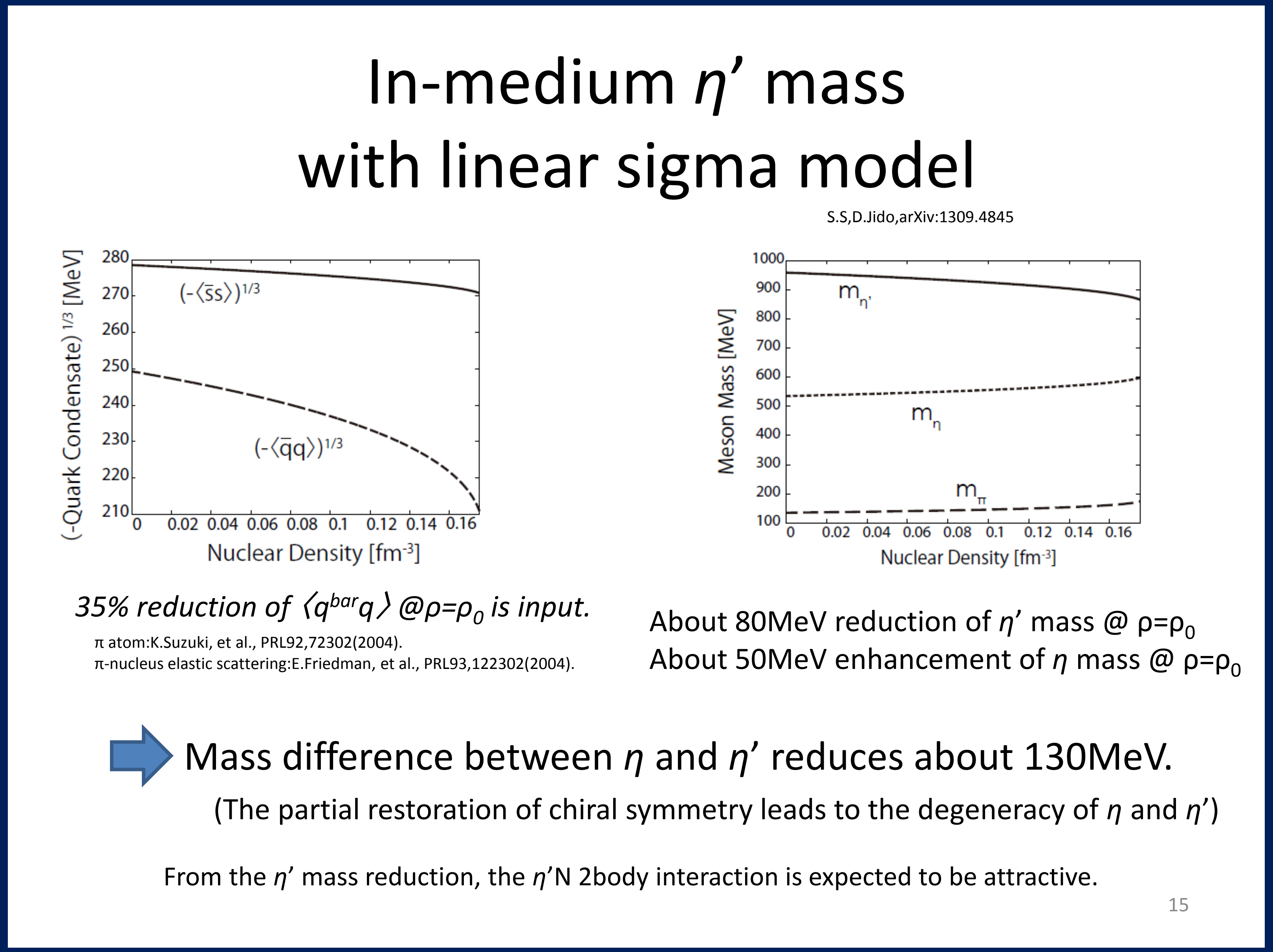
H Nagahiro, η’(958)-nucleus bound states and their formations by missing mass spectroscopies



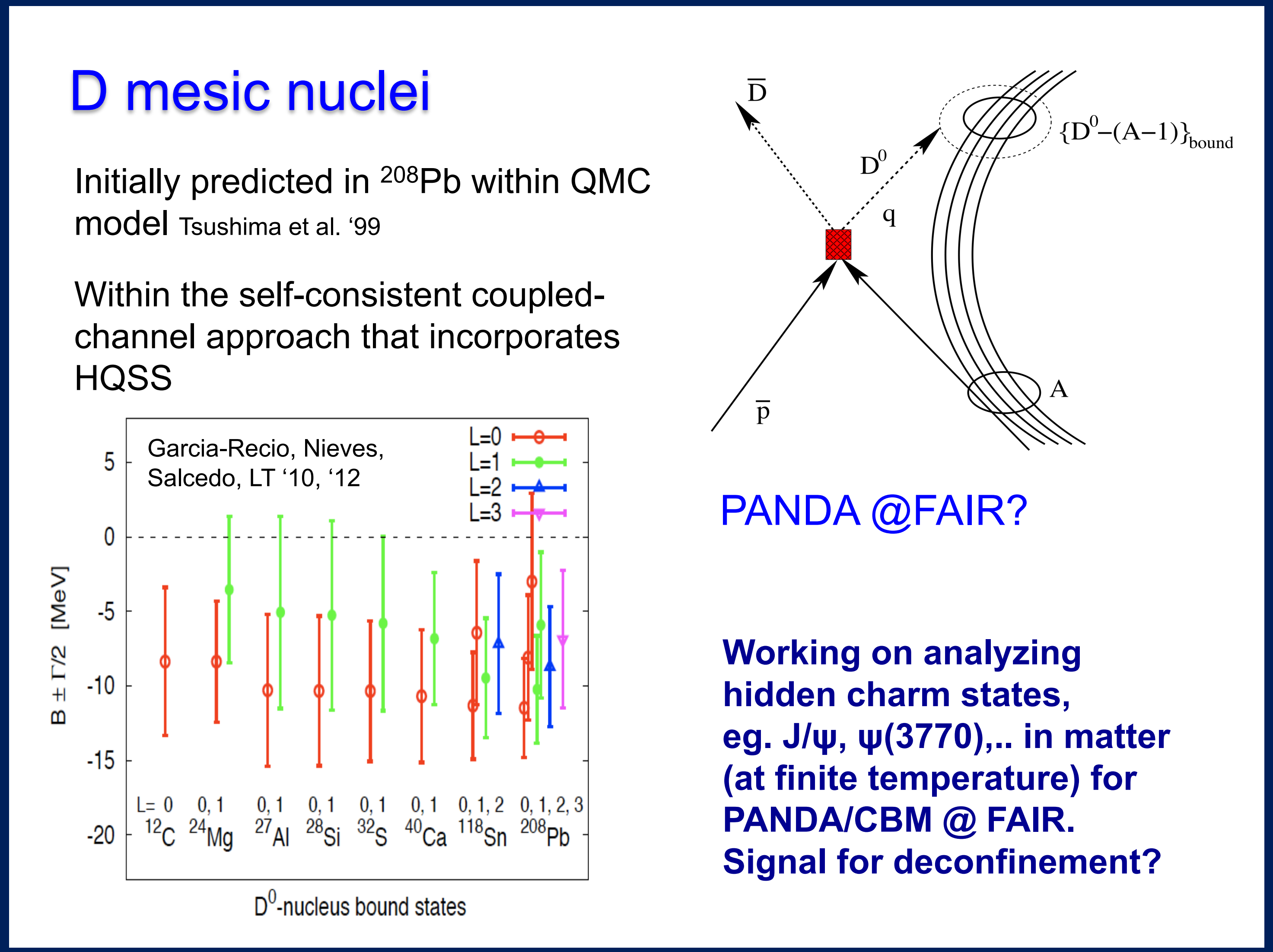
M Nanova, η’-nucleus optical potential and the search for η’ mesic states in photo nuclear reactions



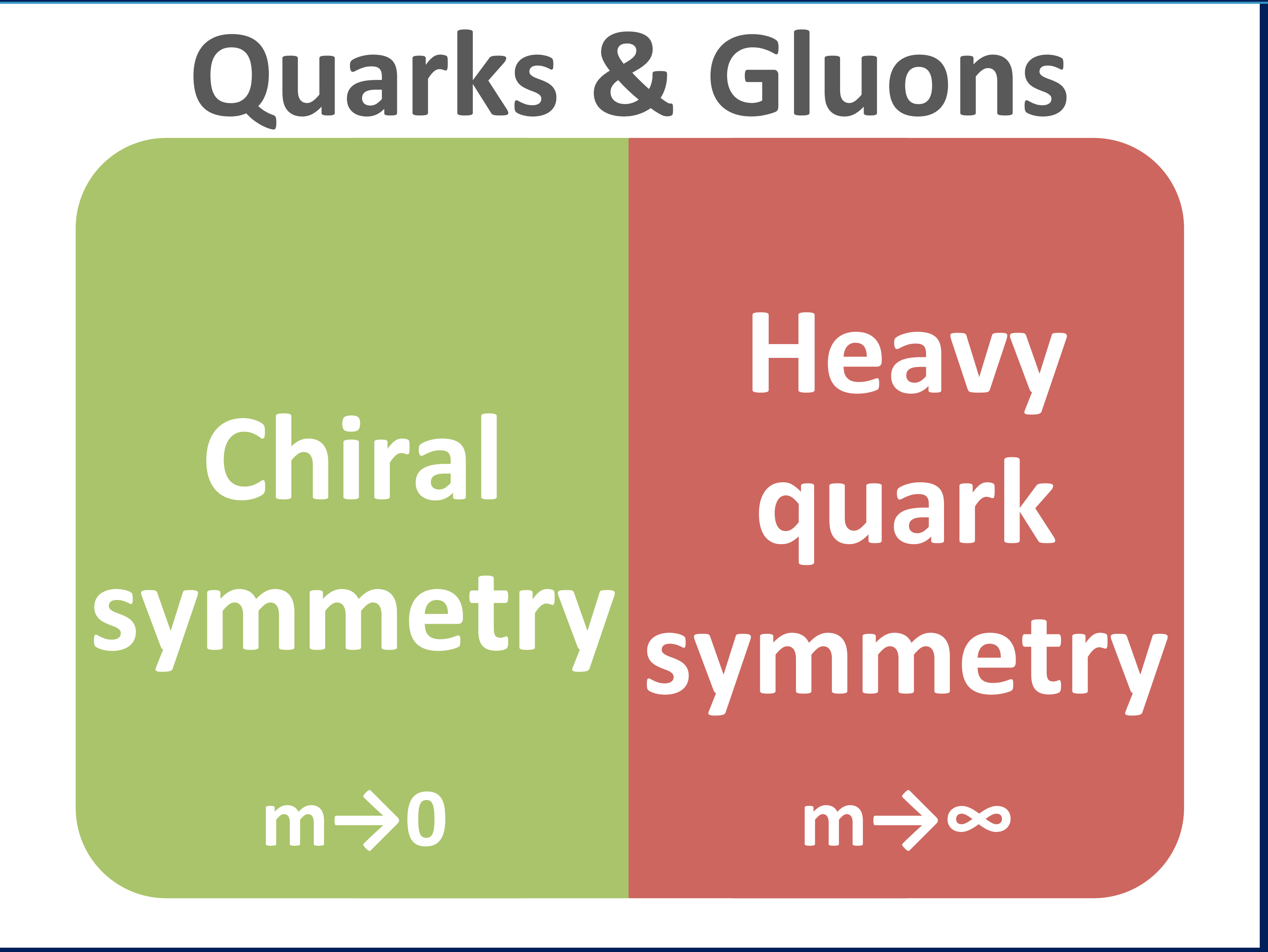
YK Tanaka, Plan of η’ mesic nucleus spectroscopy with (p,d) reaction at GSI and FAIR



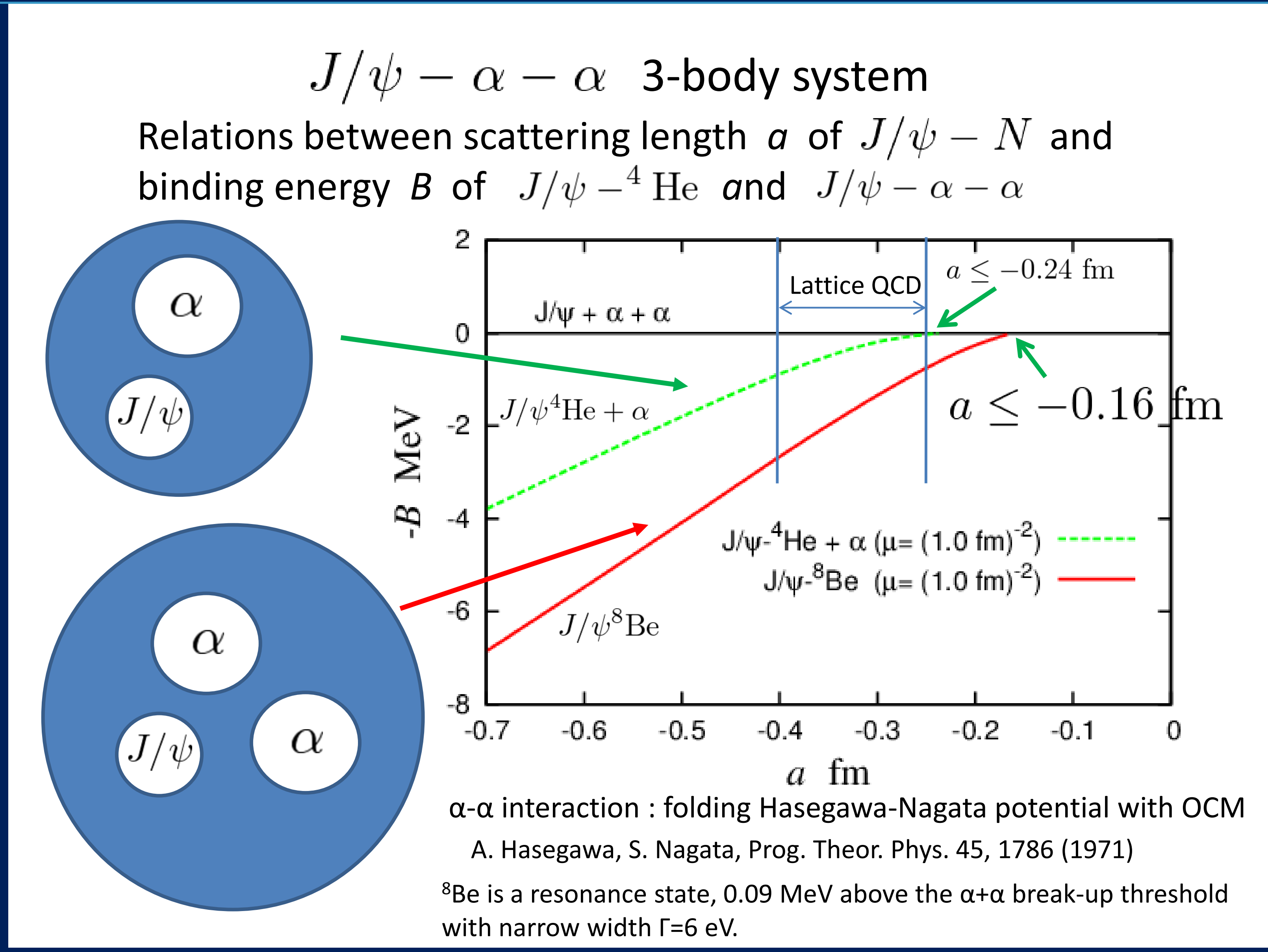
S Sakai, In-medium η' mass and η'N interaction in vacuum based on a chiral effective theory



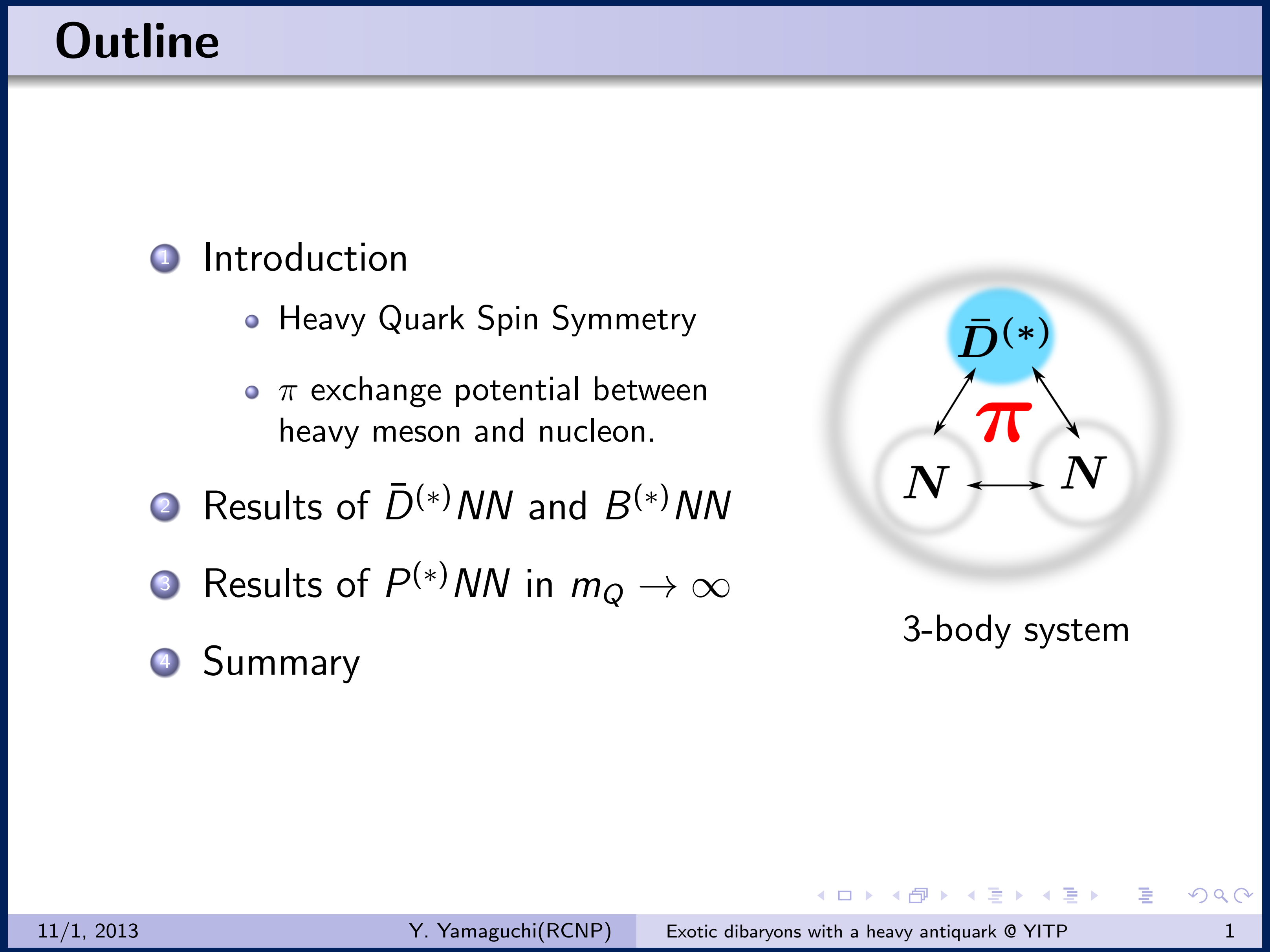
L Tolós, Strange and Charmed Mesons in Nuclear Matter and Nuclei



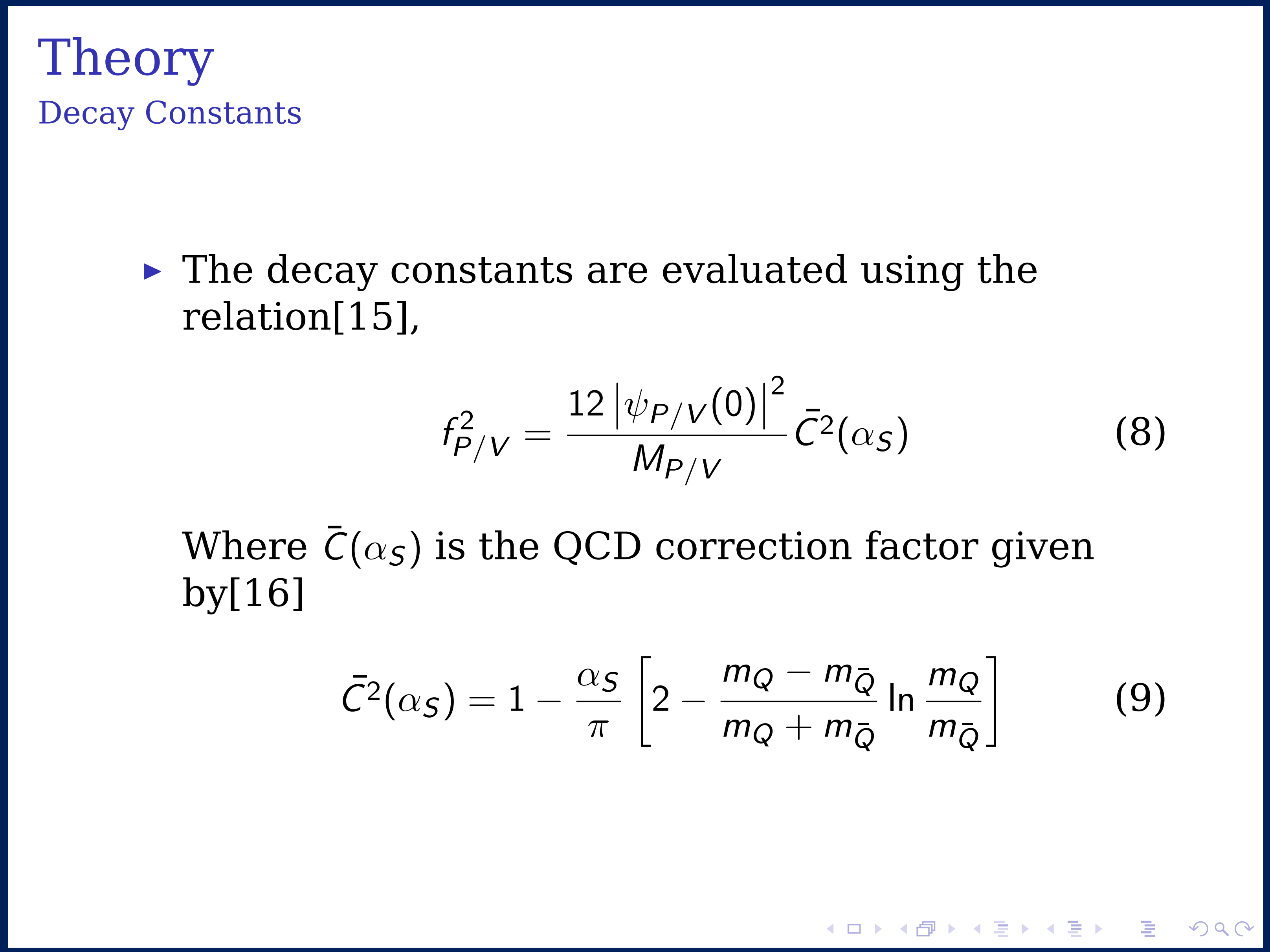
S Yasui, Charm hadrons in nuclear medium



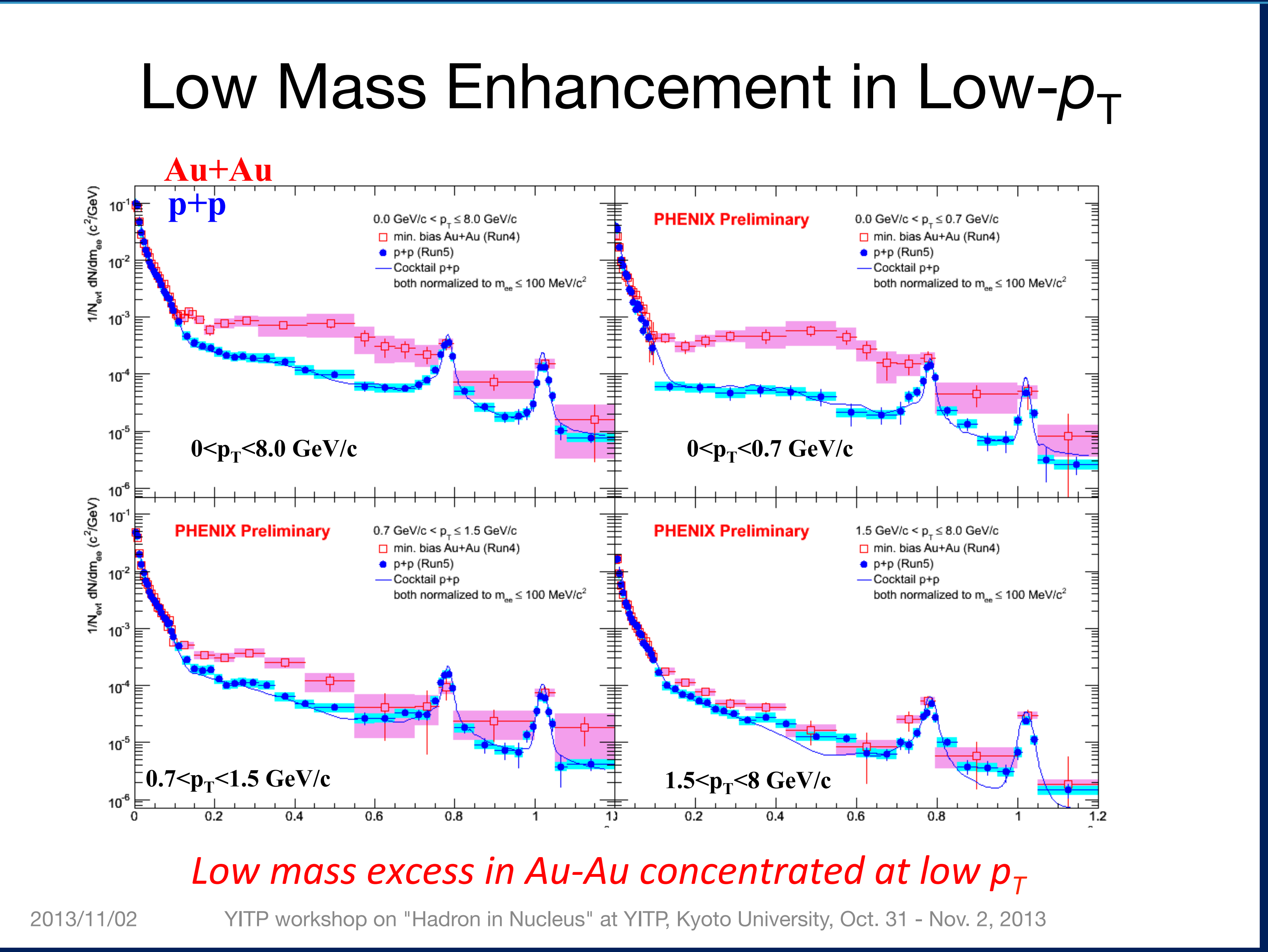
A Yokota, Possible existence of charmonium-nucleus bound states



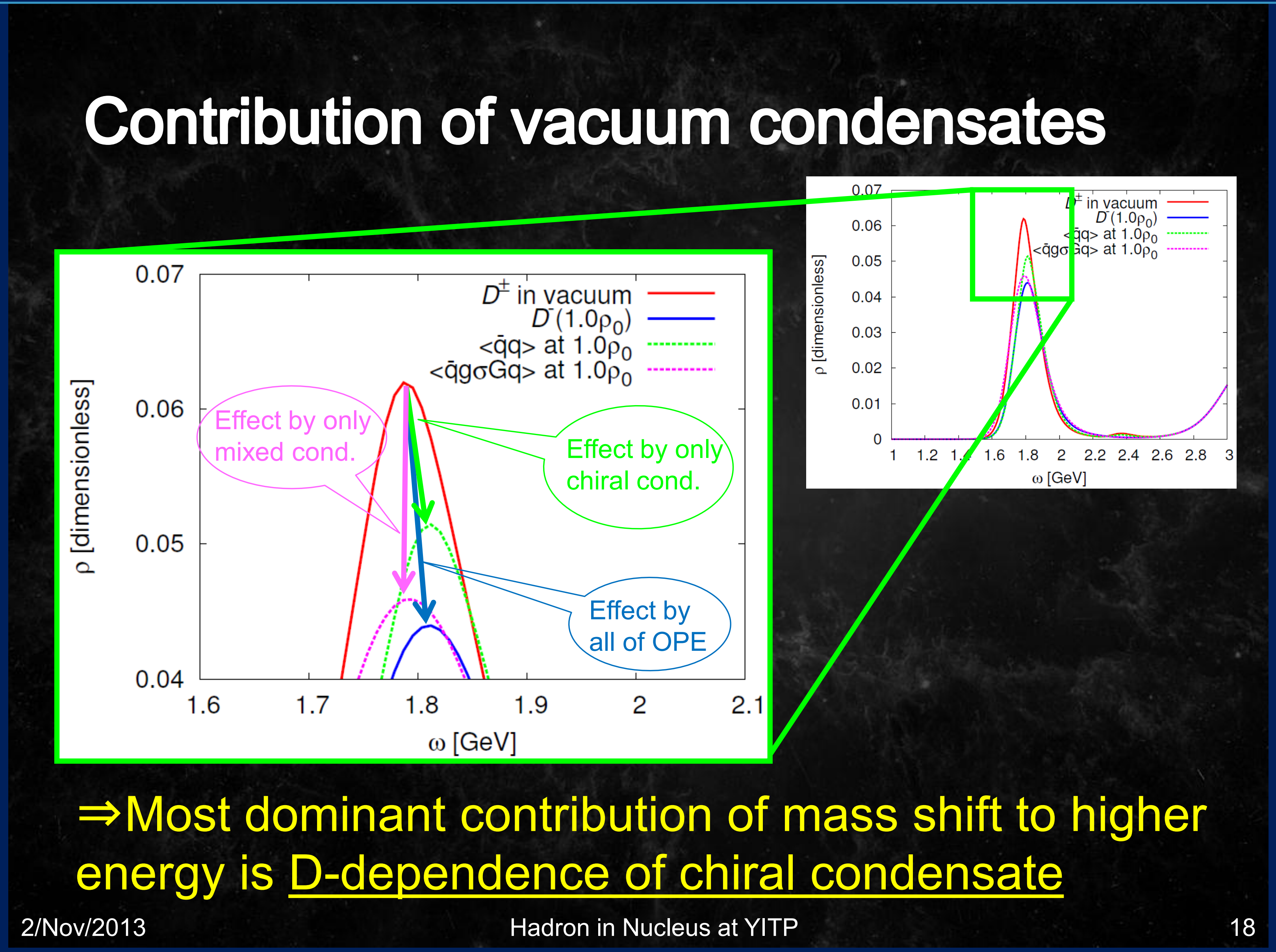
Y Yamaguchi, Exotic dibaryons with a heavy antiquark



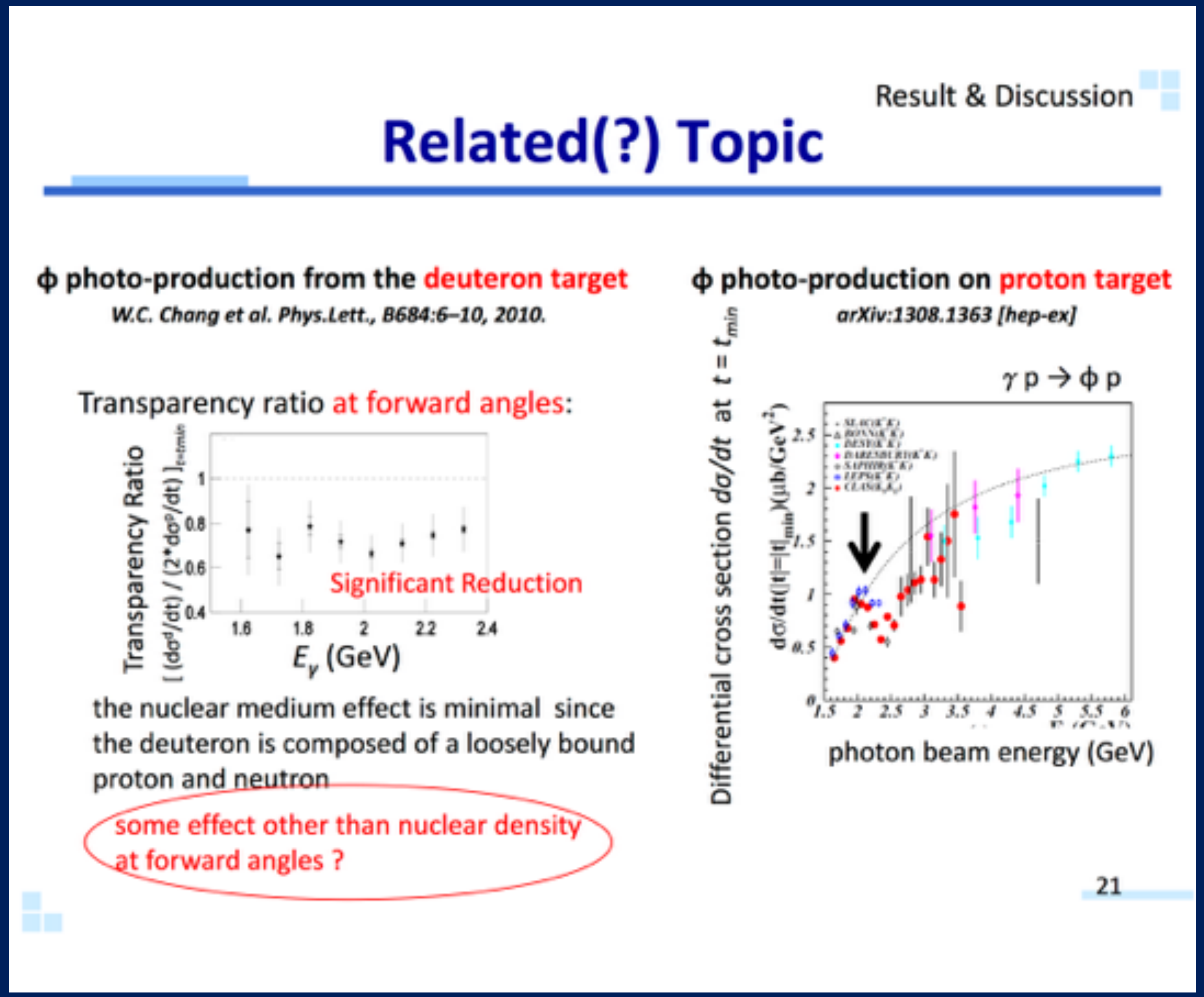
AK Rai, Quarkonia and their decay properties



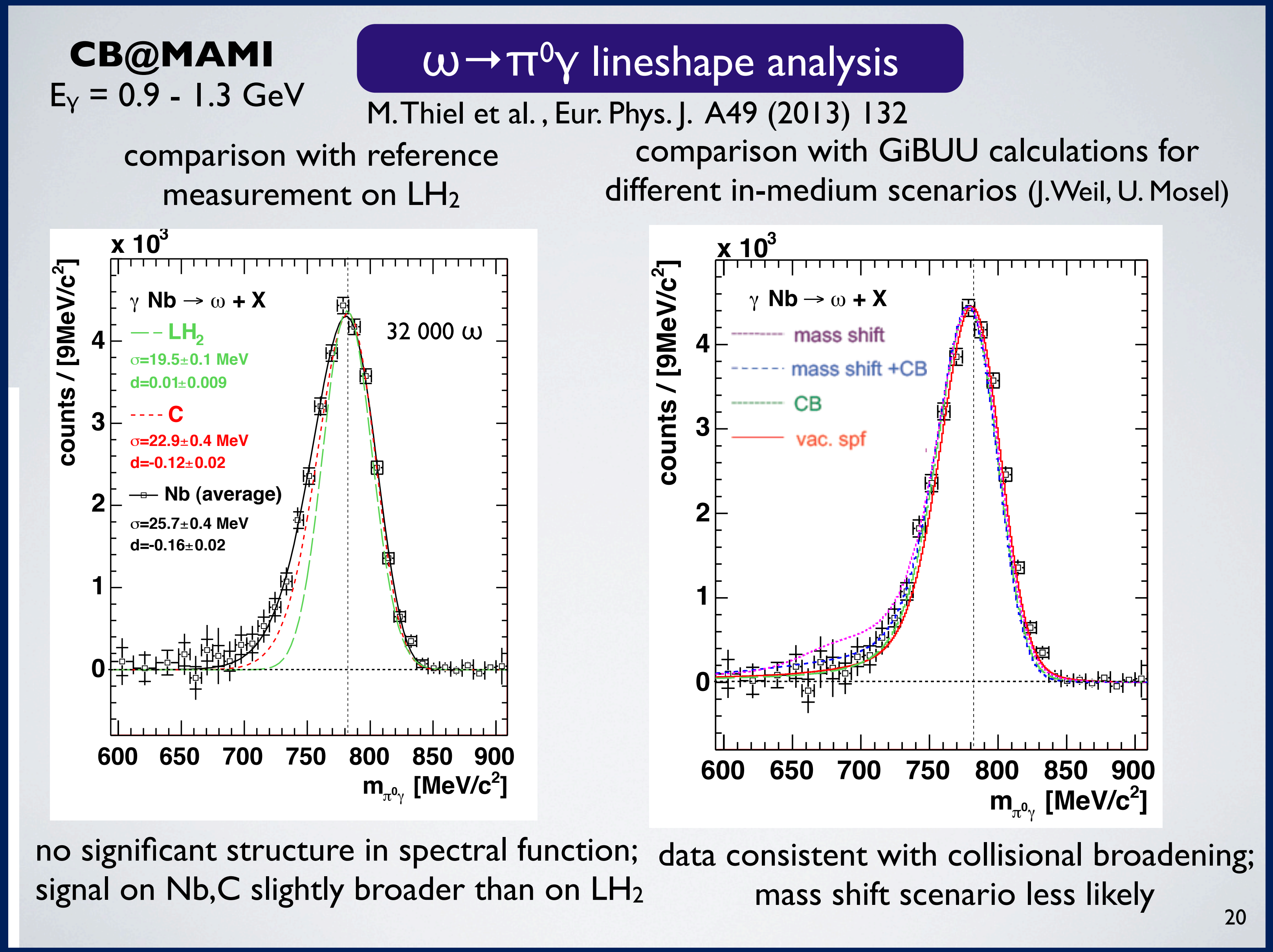
H Hamagaki, Study of Hadron Properties in QCD Medium using the High-Energy Heavy-Ion Collisions



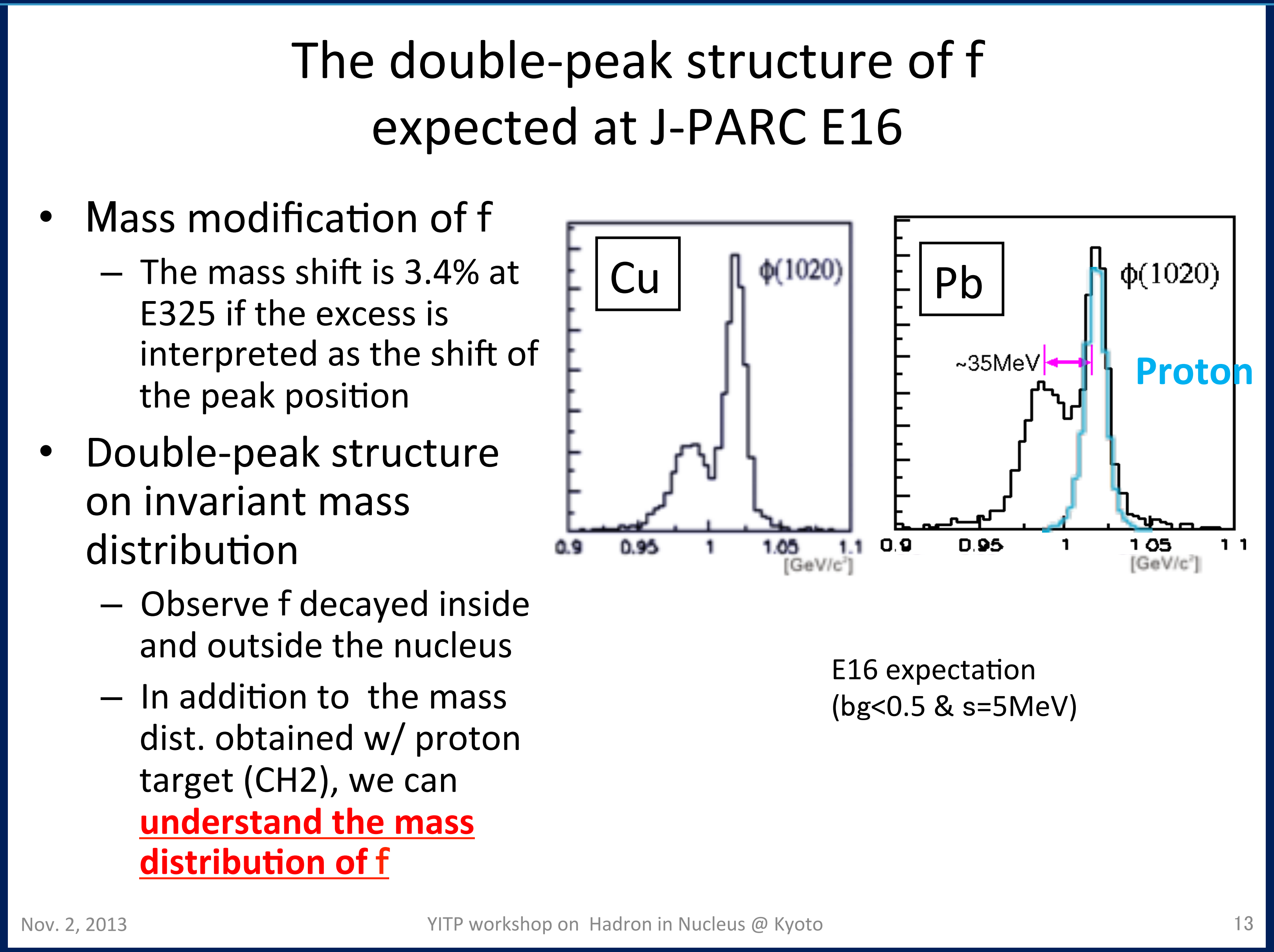
K Suzuki, Medium modification of heavy meson spectra from QCD sum rules



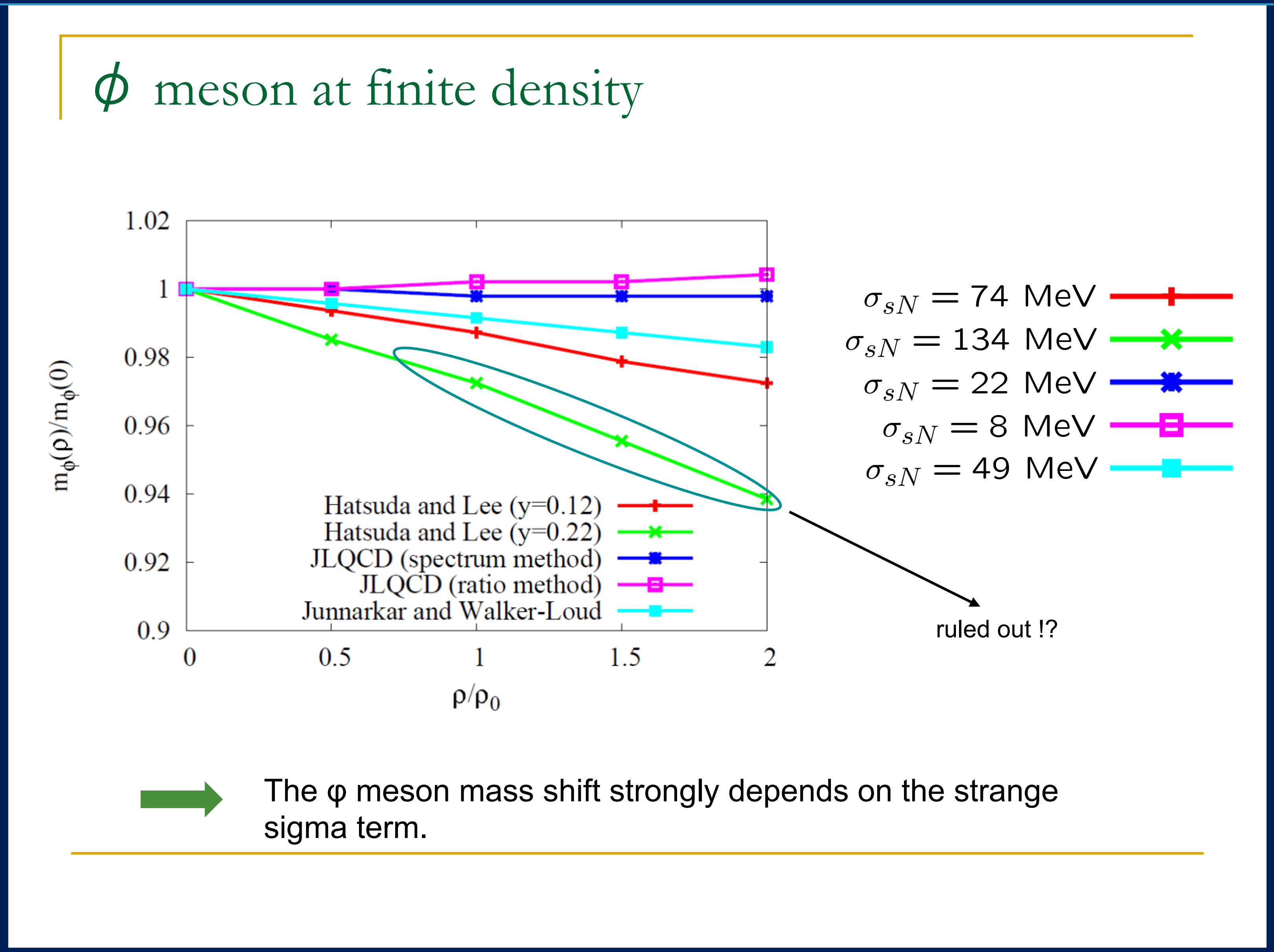
T Sawada, Backward ϕ photo-production from C and Cu targets at Eγ = 1.5 - 2.4 GeV



V Metag, In-medium properties of hadrons studied with CBELSA/TAPS and HADES



Y Aramaki, Experimental approach to the mass modification in nucleus by the J-PARC E16 experiment



P. Gubler, The phi meson at finite density from a QCD sum rules + MEM approach

π, K, η, η'

vector mesons

N, Λ

K-pp

c, b, ..

HEHI

neutron star

Theory - Experiment interaction essential in this field

However …

Theorist's dreams are…

Wish list by an innocent theorist

1 Spectral difference between chiral partners
π-σ, ρ-a_1, ω-f_1, etc

Determination of D=6 chiral condensates in the vacuum?
Tau-decay in nuclei ?

2 Individual properties of NG and "Higgs" bosons
π, K, η (NG), σ (Higgs), η' (anomaly)

$\sigma \rightarrow 2\gamma$, $\eta \rightarrow 2\gamma$, $\eta' \rightarrow 2\gamma$

Mesic nuclei
Dipion

3 Individual properties of vector bosons
ρ, ω, K* and φ

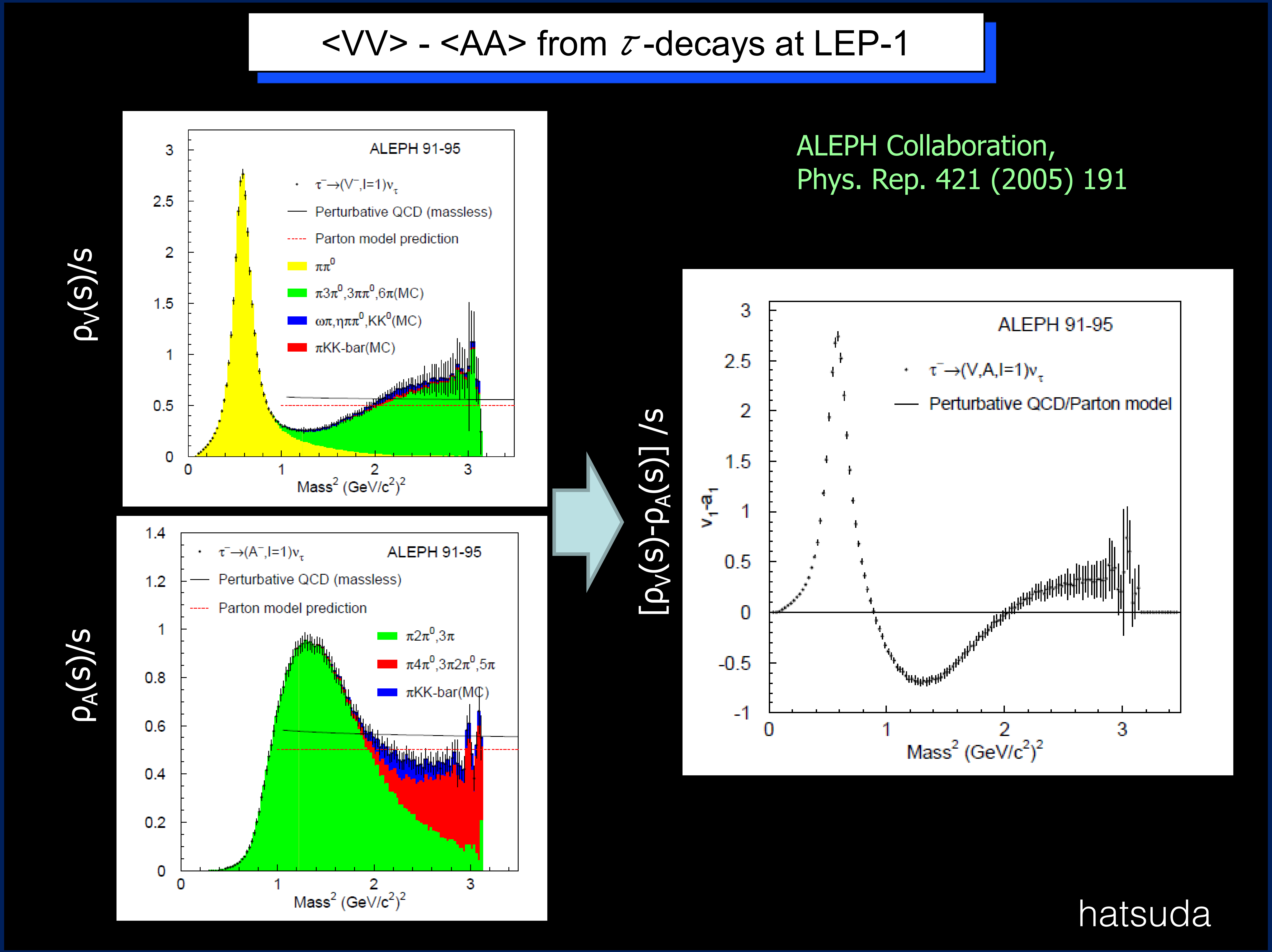
Dileptons
Hadronic decay

Precision/systematic studies
(dispersion relation, different targets, …)

hatsuda

Experimentalist's nightmare

e.g., how to do this ↓ in medium??



MIN2016 -

New (young) people

New results

New ideas

Lively discussion