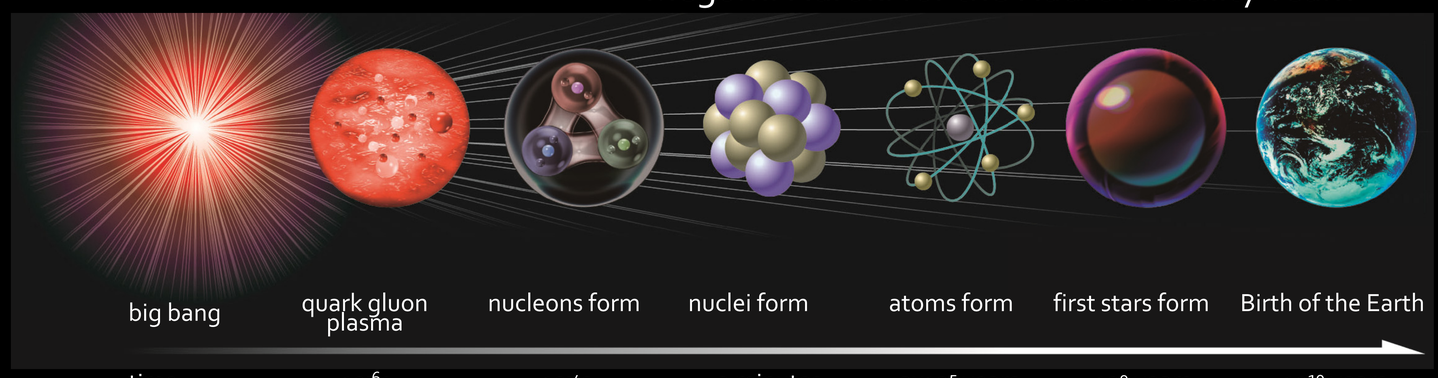
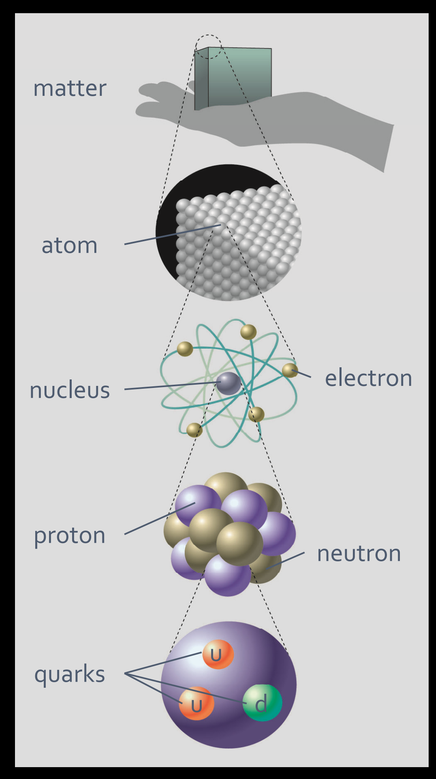
PARTICLE & NUCLEAR PHYSICS AT J-PARC

Explore History of the Universe and Formation of Matter

Megumi Naruki for the Hadron Facility Team



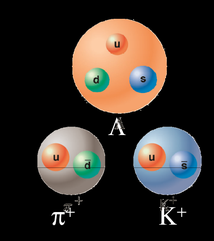


Matter-Antimatter Asymmetry
Why matter dominates over antimatter?

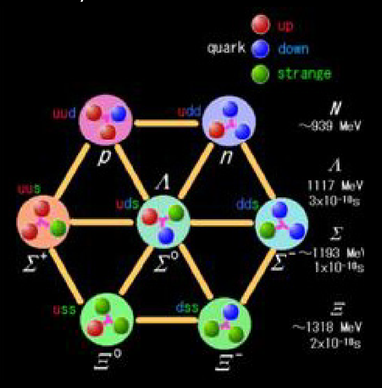
Structure of Hadron
How strong is the strong force, especially between quarks inside a hadron?

Origin of Mass
By what mechanism is hadron mass generated?

Origin of Nuclear Force
Can be described with the words of QCD?



Hadrons
- Meson (π, K…)
- Baryon (proton, neutron, strange baryon;Λ,Ξ,…)



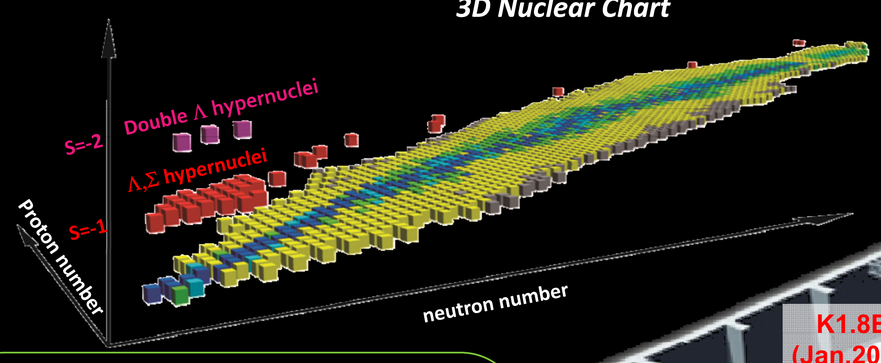
Quark Model
Hadron can be described as bound states of quarks.
QCD (Quantum ChromoDynamics)
describe strong interaction between quarks.

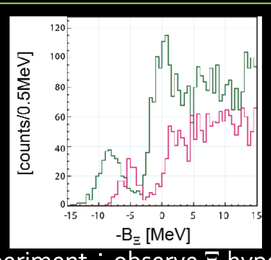
NEW VIEW OF MATTER PROBED BY KAONS

Strangeness Nuclear Physics

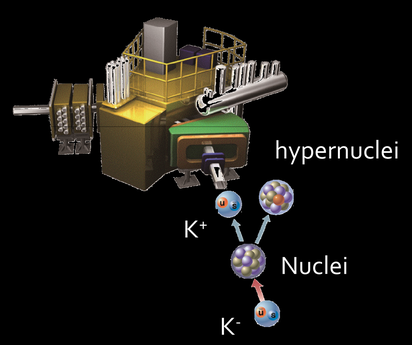
New type of hadron/nuclei that has new quantum number : Strangeness
With the high intensity kaon beam, various physics programs are planed to research new hadron/nuclei which has strangeness at the Hadron Experimental Hall.

3D Nuclear Chart

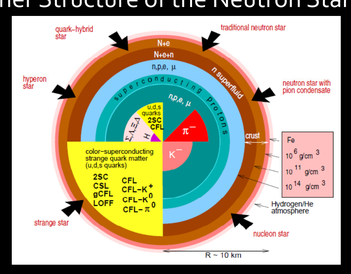




E05 experiment : observe Ξ hyper nuclei for the first time with high resolution and high statistics, determine the binding energy and life.

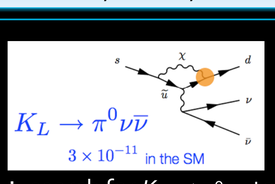


Inner Structure of the Neutron Star



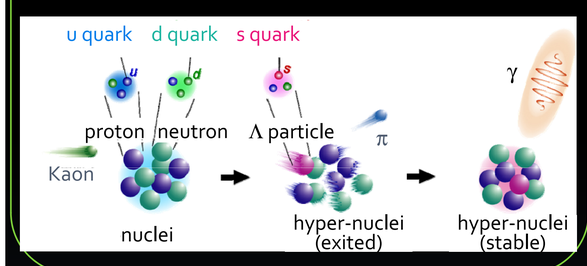
Broken Symmetry

CP violation & T violation
The universe is composed of matter, rather than anti-matter. The study of CP violation may explain the asymmetry.



E14 : search for $K_L \to \pi^0\nu\nu$ to study CP violation in neutral Kaons. New physics?

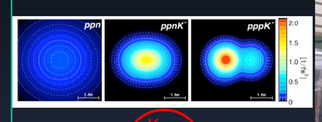
How strong is the Y-N interaction?
from nuclear force to baryon-baryon interaction



Origin of Mass

if the hadron mass is generated by the spontaneous breaking of the chiral symmetry, it would be decreased at high temperature/high density.

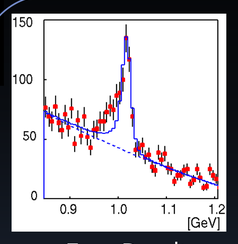
E15 : search for the strange tri-baryon system (ppK), which could be extremely dense matter.



E19 : Search for Pentaquark Θ+ . approach the QCD at non-perturbative regime.

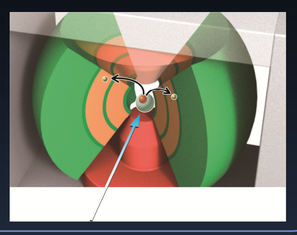
New Hadrons

search for new hadrons beyond the conventional baryons to



E325 Result: observe mass modification of ϕ meson.

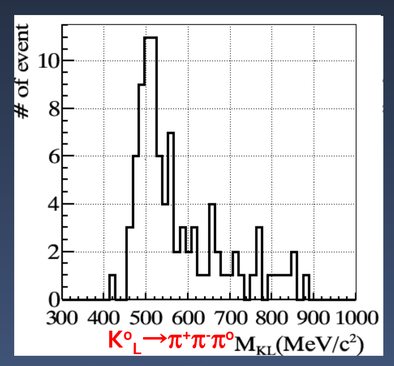
E16 : measure the mass of ϕ meson in nuclear medium.
velocity /size dependence of mass modification.



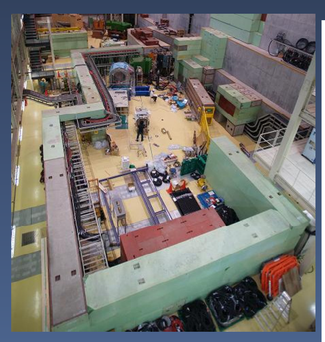
Resent Results

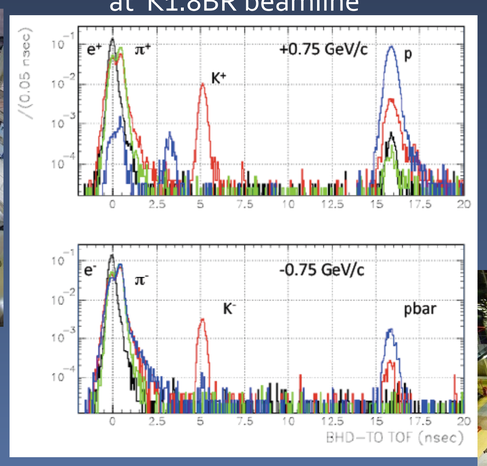
Successfully confirm the Kaon production at all secondary beamlines.
The tuning for the beamlines is now ongoing!

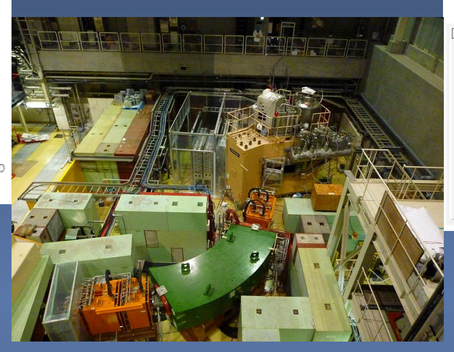
K_L production at KL beam line



Secondary particle production at K1.8BR beamline







Kaon Enhancement at double-staged K1.8 beam line