STATUS REPORT ON J-PARC E05

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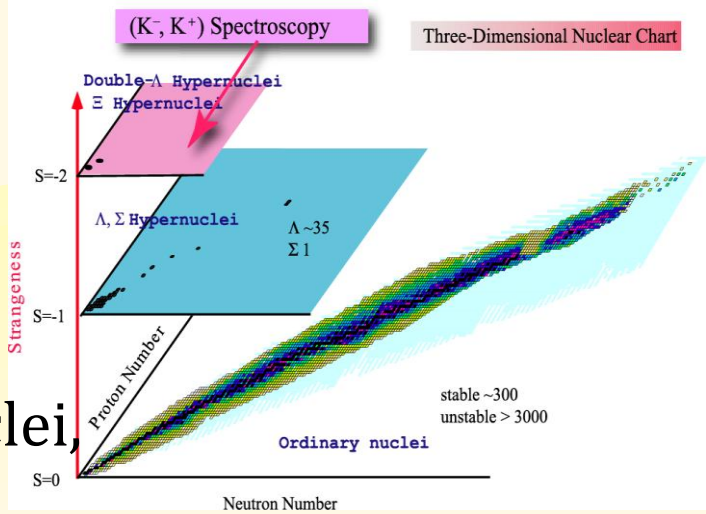
Introduction

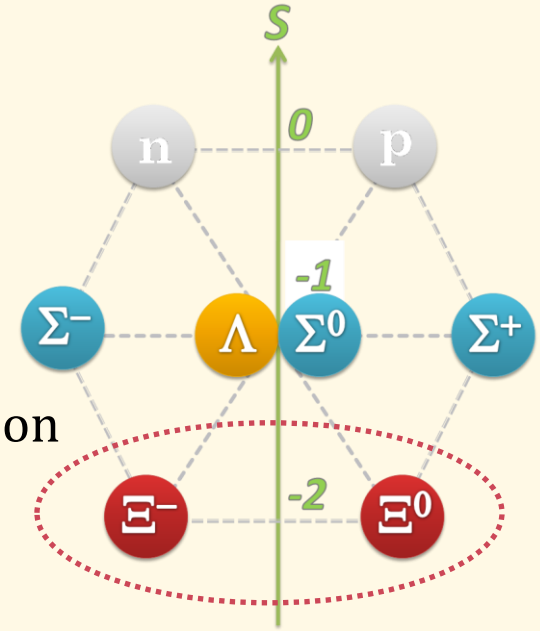


S = -1

- So far, we know Λ-N interaction well extracted from structure of Λ-hypernuclei, including spin component.
  - (π,K) reaction with SKS
  - γ-ray spectroscopy with Hyperball
- successful theoretical understanding.

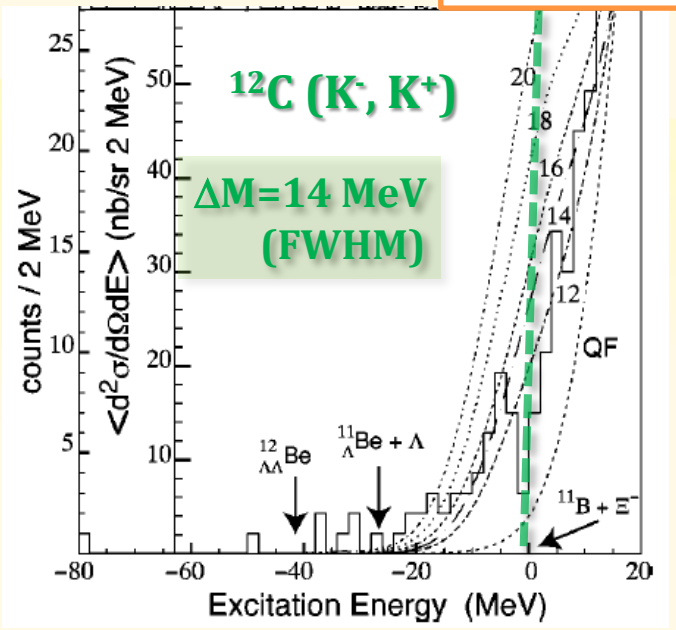
S = -2

- Information is very limited.
  - ΛΛ-hypernuclei => weakly attractive Λ-Λ interaction
    - ex.) NAGARA event : unique ID of species, ${}^{6}_{\Lambda\Lambda}\mathrm{He}$
- Ξ-hypernuclei :
  - No definite evidence for a bound state.
  - There were several experiments using (K^-,K^+) reaction.



Ξ-hypernuclei : previous experiment

BNL-E885



P.Khaustov et al., PRC61(2000)054603

- Previous experiment : BNL-E885
  - not clear evidence of Ξ-hypernuclear bound state.
    - because of limited mass resolution
  - suggest weakly attractive potential of -14 MeV depth.
    - by shape analysis of QF-tail
    - almost unique information on Ξ-hypernuclei up to now

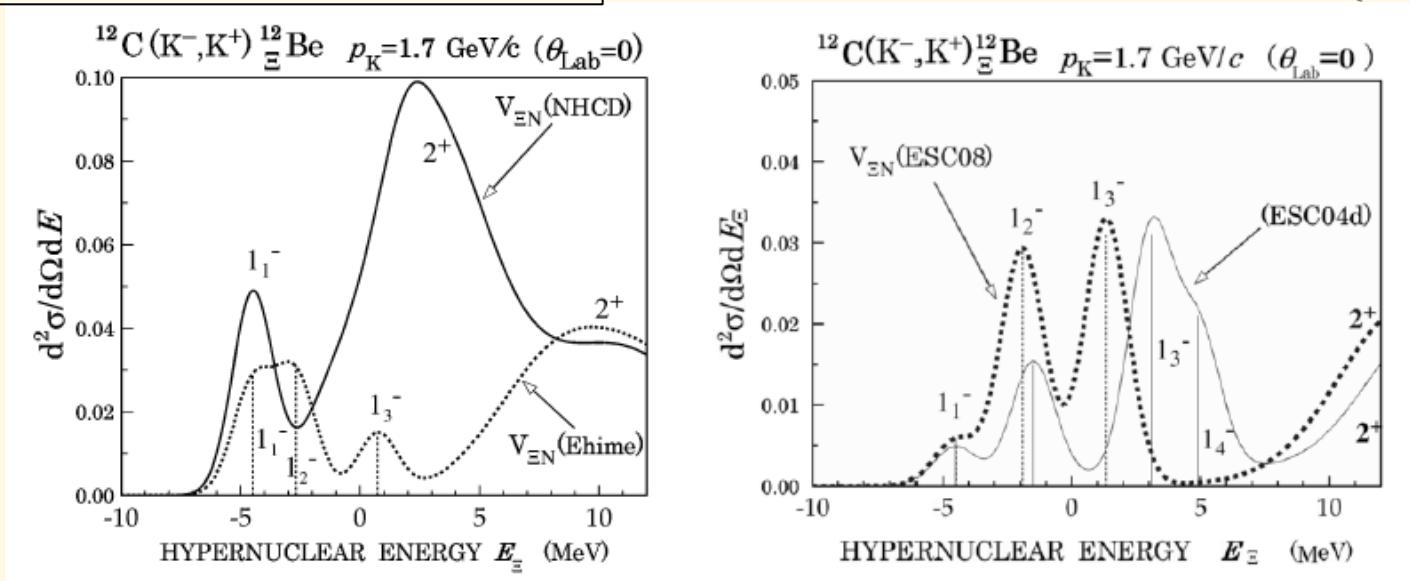
Ξ-hypernuclei : theoretical models

- Various *B*-*B* interaction models exist.
  - Their predictions are quite different for Ξ-N int.

Experimental information is strongly awaited.

DWIA spectra with various int.

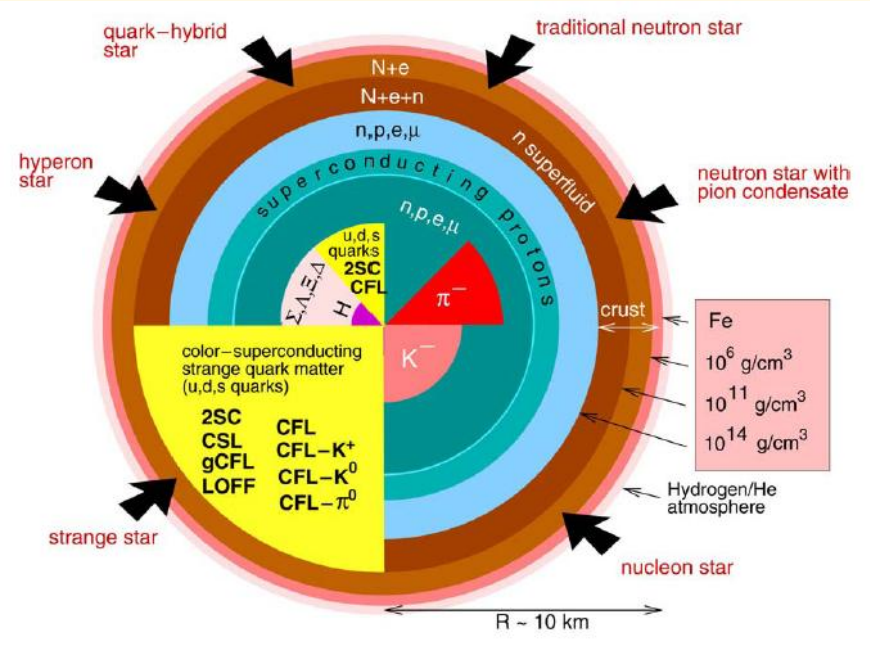
T.Motoba et al., NPA835(2010)223

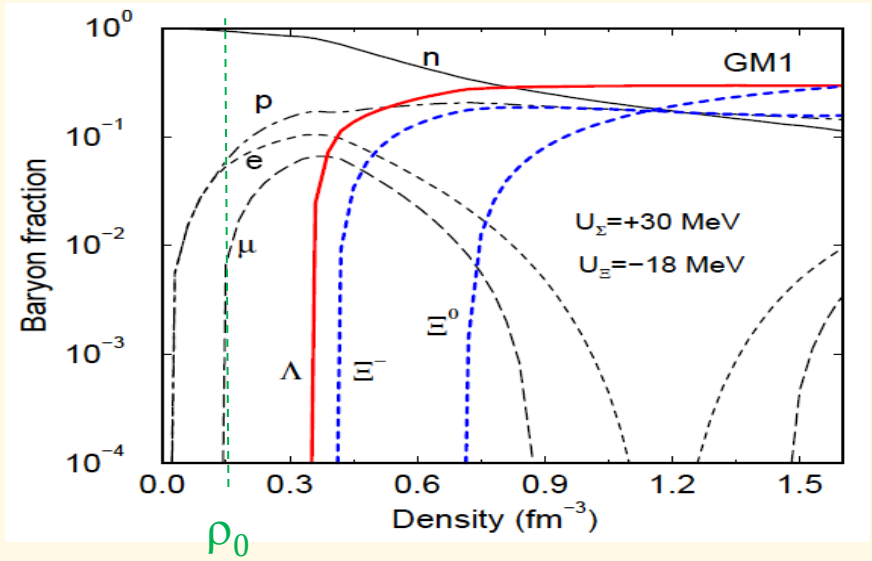


Ξ-hypernuclei : appearance in N.S ?

- Strangeness in dense nuclear matter
  - Inspect into the core of neutron stars
  - Strangeness will take the key role

If Ξ-N is attractive (U_Ξ~-18MeV),
Ξ will appear next to Λ in neutron stars.





F.Waber, PPNP54(2005)193

J.Schaffner-Bielich, NPA804(2008)309

Experiment

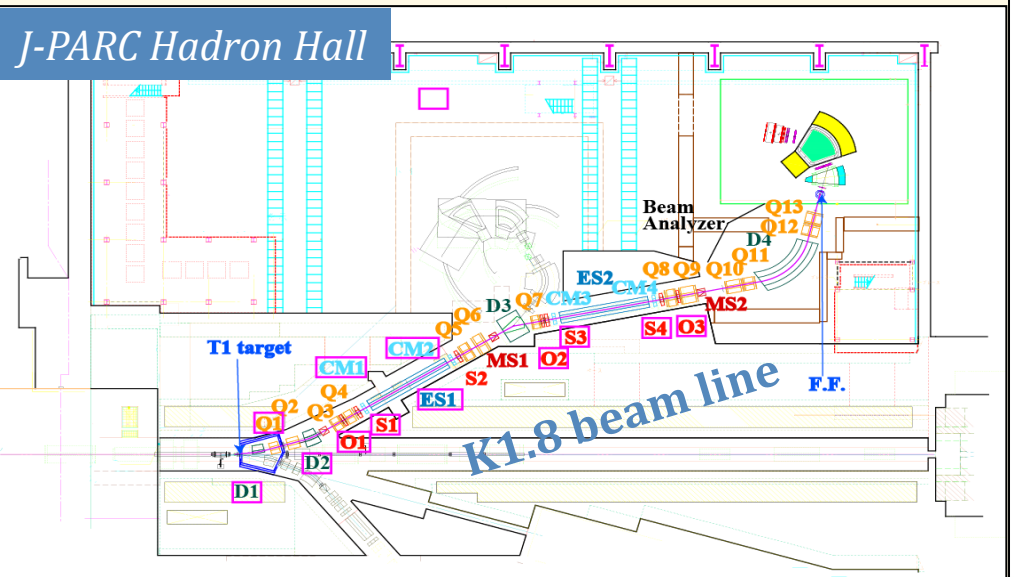
J-PARC E05: Ξ-Hypernuclear Spectroscopy

- Spectroscopic study of Ξ-hypernucleus
- using $^{12}C(K^-, K^+)$ reaction ; -> $^{12}_{\Xi}Be$
- Missing mass spectroscopy
  - measure momentum of both incident K^- and outgoing K^+
  - with **high-resolution (~3MeV)** and **enough statistics**
- Goal
  - observe peaks of Ξ-hypernuclei for the first time.
  - Binding energy => potential depth (real part)
  - Width => ΞN->ΛΛ conversion width (imaginary part)

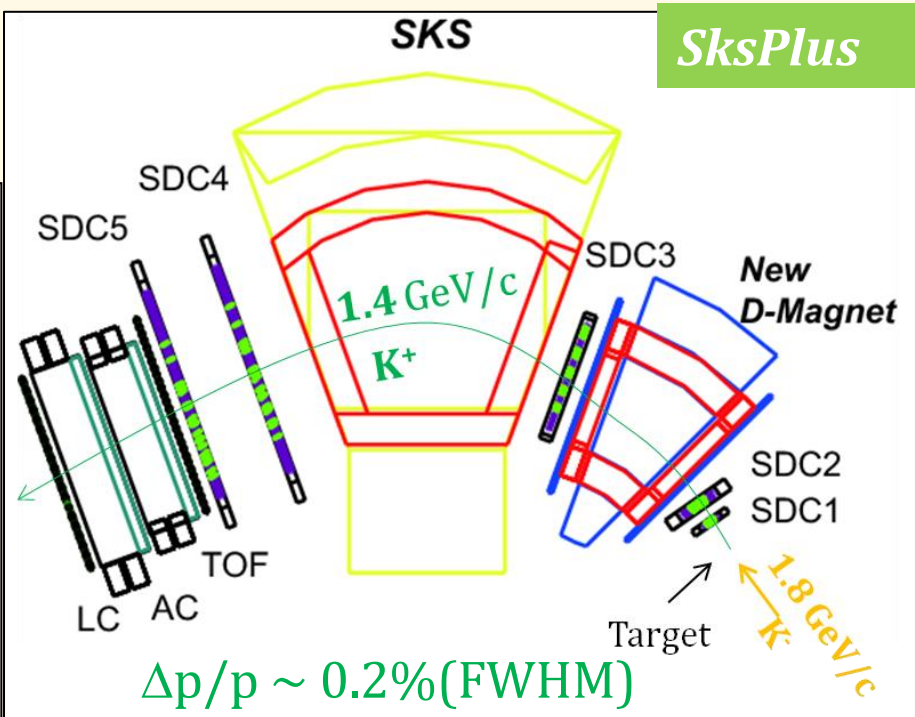
Experimental Setup

- **K1.8 beam line + SksPlus**
  - **K^- : 1.8 GeV/c, Beam Spectrometer ($\sim 10^{-4}$)**
  - **K^+ : 1.3~1.4 GeV/c, SksPlus (2×10^{-3})**
    - **New D-mag. is added to obtain stronger mag. field.**
    - **prior momentum resolution than acceptance(40msr)**

J-PARC Hadron Hall



SksPlus



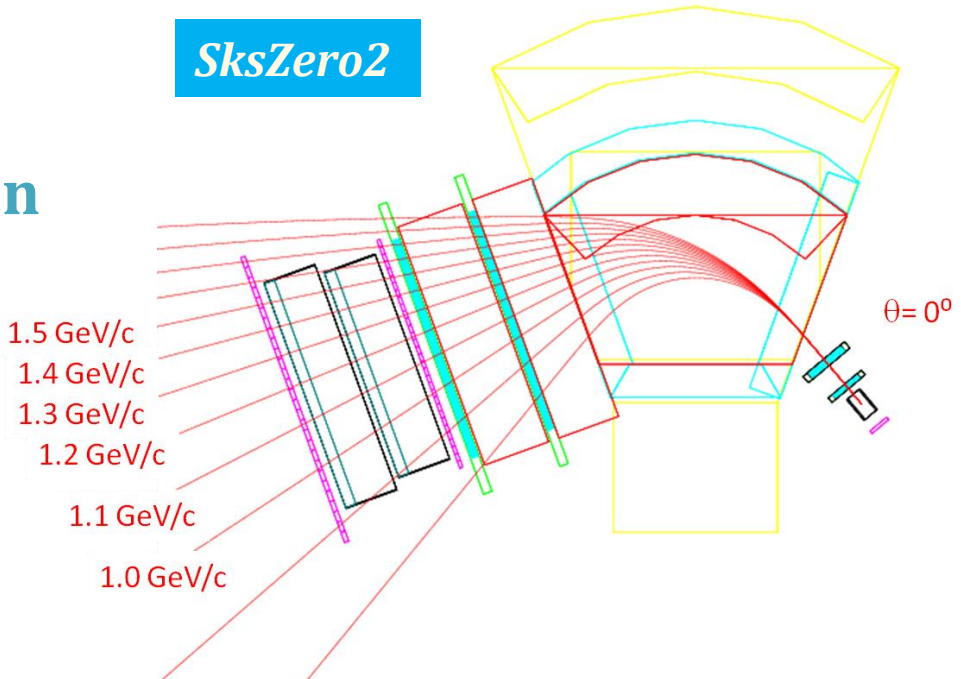
$\Delta p/p \sim 0.2\%$(FWHM)

Recent discussion on experimental plan

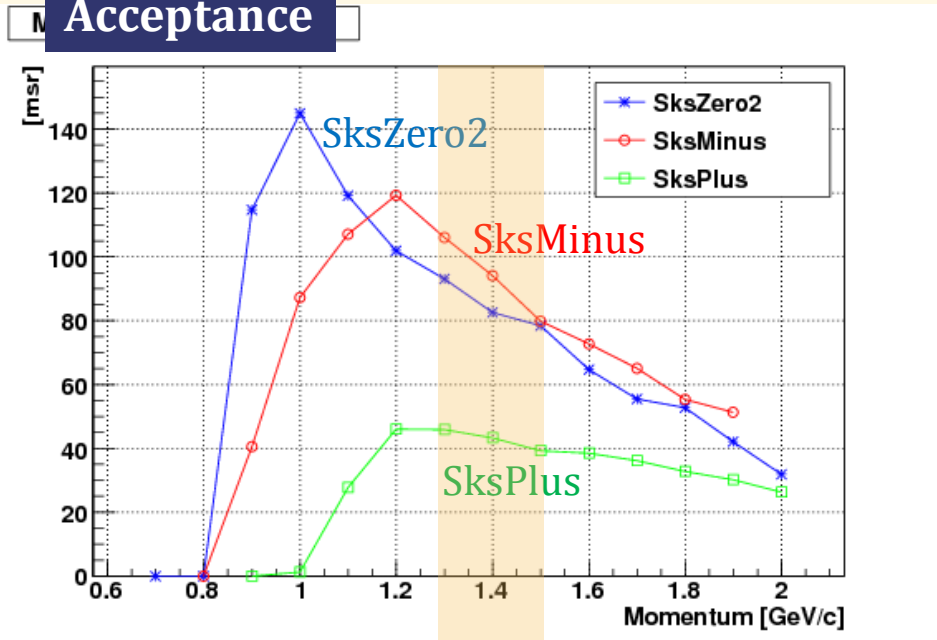
Setup modification for low intensity beam

- Accelerator intensity is very limited.
  - **now, ~% of design value (270kW)**
- In original E05 plan, statistics are miserable. => not realistic
- **need more acceptance**

- **SksZero2 configuration**
  - only move normal SKS downstream detectors to high-momentum side

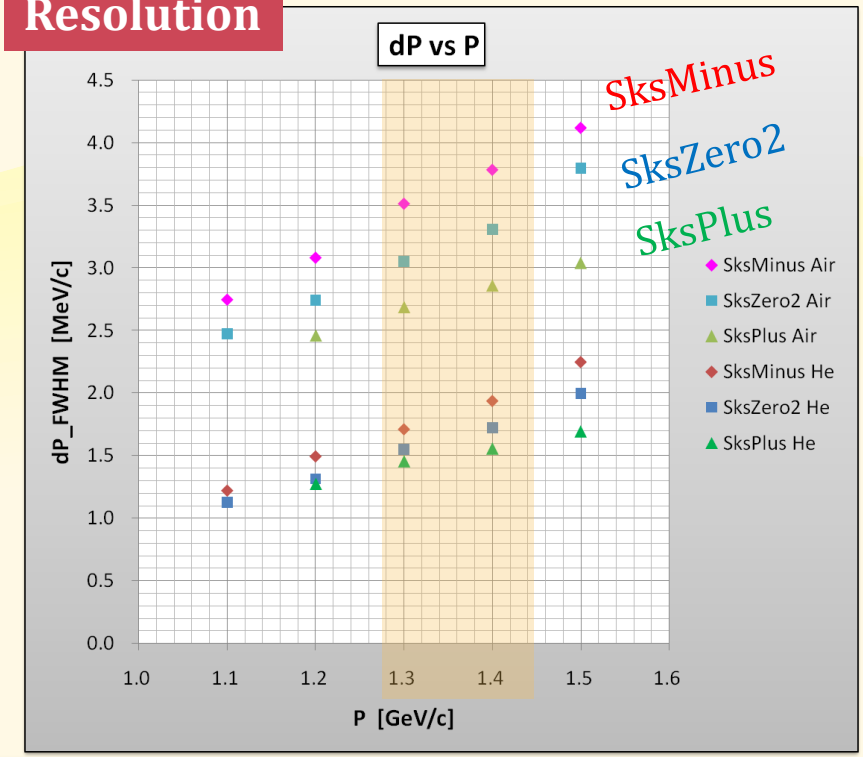


Acceptance



Acceptance is larger ~100msr

Resolution



	Δp [MeV/c]	Δp/p [%]	ΔM [MeV]
SksPlus	2.86	0.20	3.3
SksZero2	3.31	0.24	3.7
SksMinus	3.78	0.27	4.0

Resolution is acceptable level
ΔM ~ 3.7 MeV

Yield Estimation (E05 original)

- $Y(^{12}_{\Xi}\mathrm{Be}) = N_{beam} \times N_{target} \times d\sigma/d\Omega \times \Delta\Omega \times f_{decay} \times f_{analysis}$

  $= 3.3\times10^{10}[/\mathrm{day}] \times 5.4 \times 6.02\times10^{-7}/12\ [/\mu\mathrm{b}]$

  $\times\ 0.06[\mu\mathrm{b/sr}] \times 0.04[\mathrm{sr}] \times 0.5 \times 0.7$

  $= 7.5$ events/day

  ~ 225 events/month

Yield Estimation (30kW, w/SksZero2)

- $Y(^{12}_{\Xi}Be) = N_{beam} \times N_{target} \times d\sigma/d\Omega \times \Delta\Omega \times f_{decay} \times f_{analysis}$

  $= 3.3\times10^{10}$[/day] x 5.4 x $6.02\times10^{-7}/12$ [/μb]

  30/270

  x 0.06[μb/sr] x ~~0.04~~[sr] x 0.5 x 0.7

  0.08

  = ~~7.5~~ events/day

  1.7

  ~ ~~225~~ events/month

  50

We can take ~50/month statistics at 30kW as the first step of E05.

Now planning….

Summary

- J-PARC E05 is planed to observe Ξ-hypernuclei via (K^-,K^+) missing mass spectroscopy.
- It provides essential information to S=-2.
- Ξ-N interaction are extracted from B and Γ.
- Resolution and statistics are important at the experimental point of view.
- We are preparing an experimental plan for low intensity version. Larger acceptance and acceptable resolution are achieved.