S214 Experimental search for the η/ω-nucleus bound states

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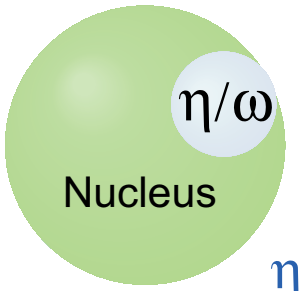
Systematic study of in-medium meson behaviour
(e.g. mass shift) for π,η,ω



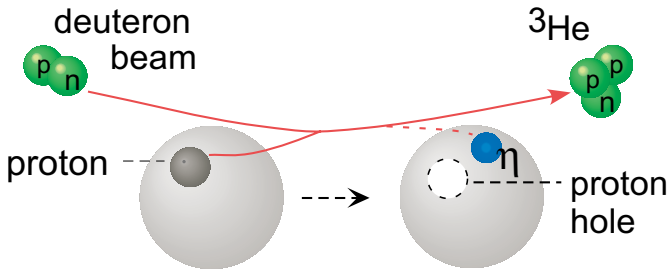
Strong interaction force
(No assistance of the Coulomb attraction)

η/ω-nucleus bound states predicted

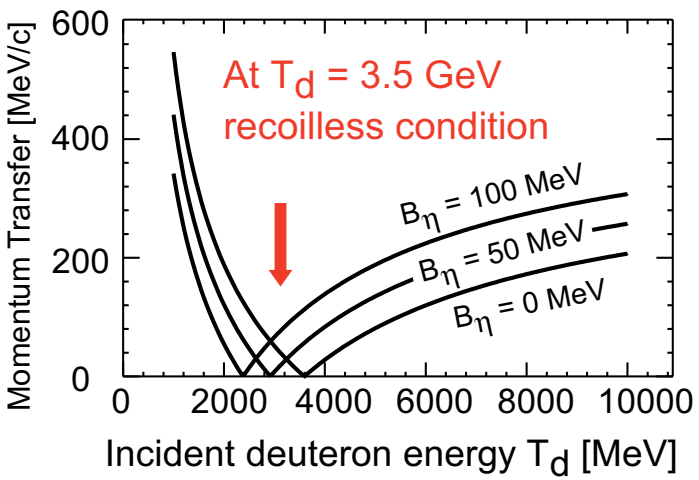
Using available optical potential parameters

In 2003,
Experimental search for the η-nucleus bound states

S214 (d, ^{3}He) reaction & theoretical spectrum



$^{12}C(d, {}^3He)^{11}B \otimes \eta$

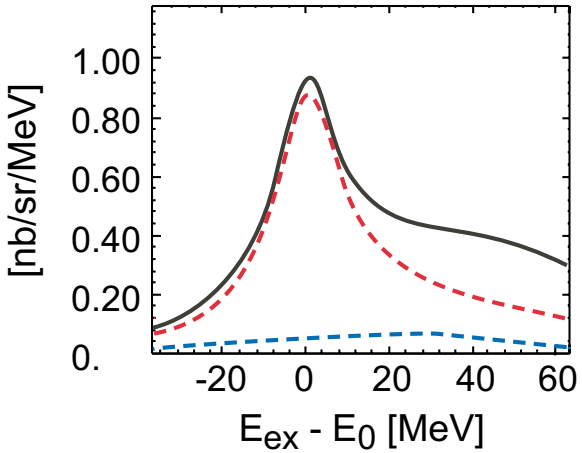


$\Delta q \sim 0$

Suppress the quasi-free η
Enhance the η bound state

$\Delta l \sim 0$

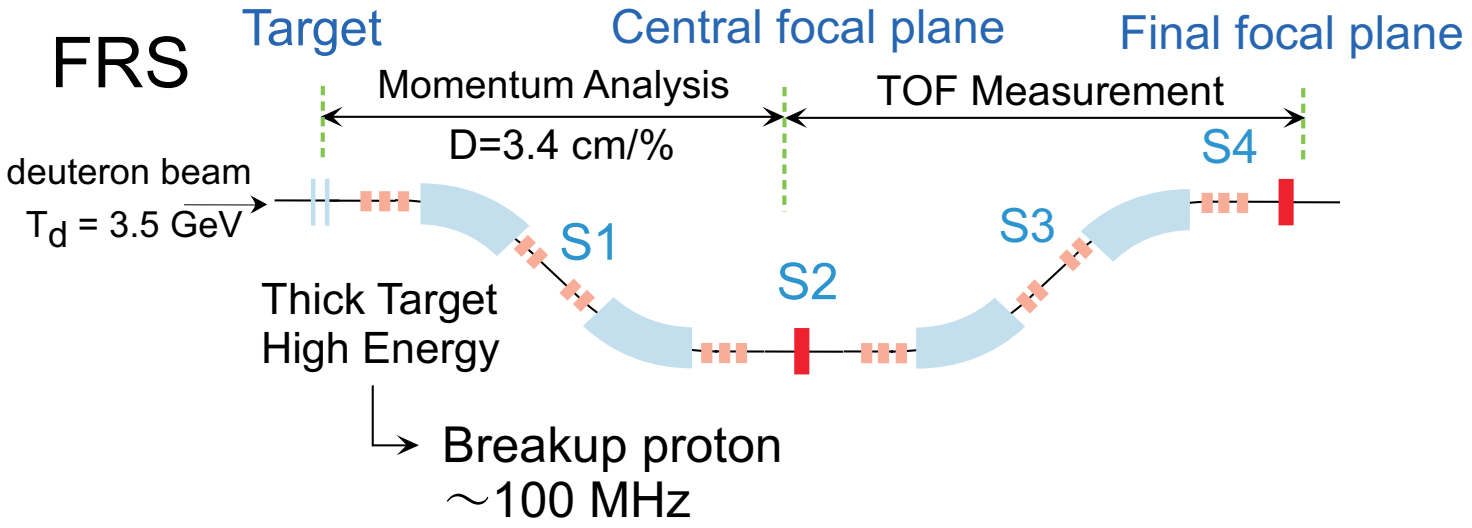
$(s_{1/2})_p^{-1} \otimes (1s)_\eta$ $(p_{3/2})_p^{-1} \otimes (2p)_\eta$



Peak location
↓
Optical potential

Continuum background
∼3.4 nb/sr/MeV

S214 Facility & Detectors



S2 & S4 detectors

Position sensitivity for the S2 detector ($\Gamma/2 \sim 10$MeV, 6mm)

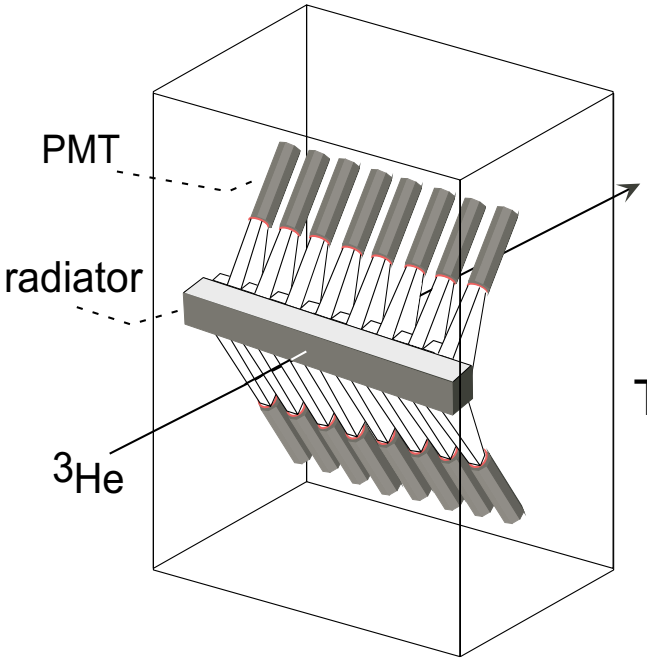
Proton suppression capability for the S2 and S4 detectors

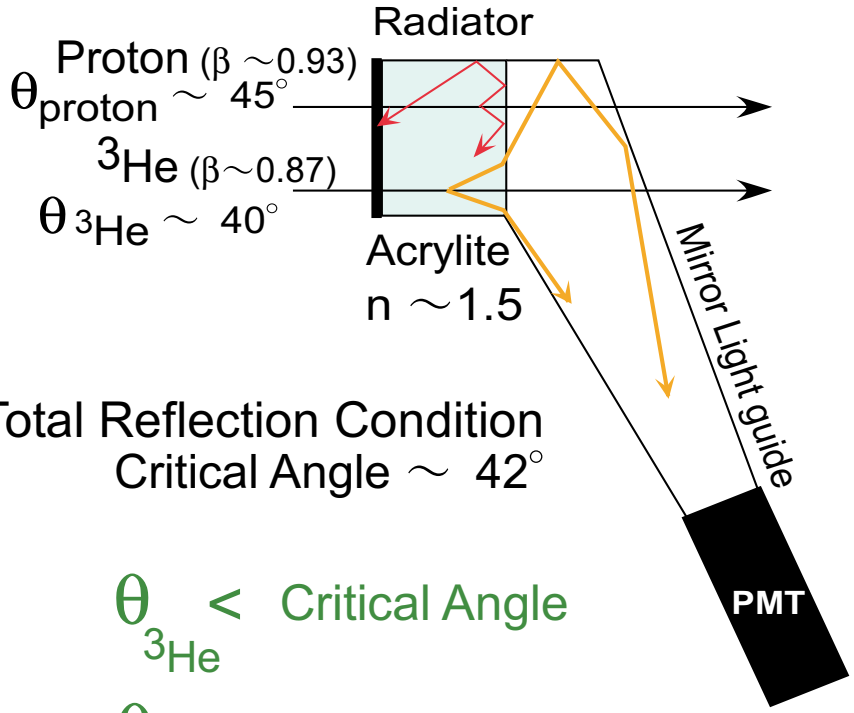
Providing the Hardware trigger for the S2 and S4 detectors

TOtal Reflection CHerenkov detector for S2 and S4

Test Experiment at FRS in Dec, 2002

S214 TORCH for S2 and S4
～proton suppression capability





Total Reflection Condition
Critical Angle ～ 42°

$\theta_{^3He}$ < Critical Angle

θ_{proton} > Critical Angle

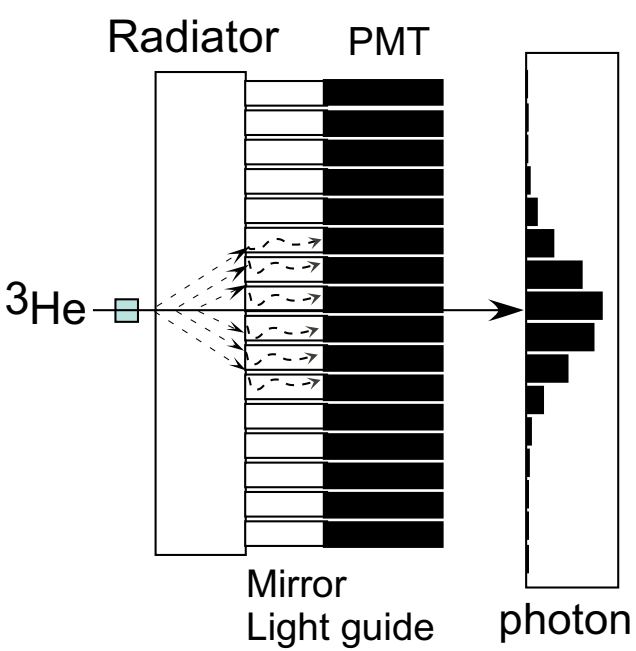
Efficiency for ^3He ～90%
Proton rejection factor～10^6

～100 MHz Trig. ➡ ～1kHz Trig.

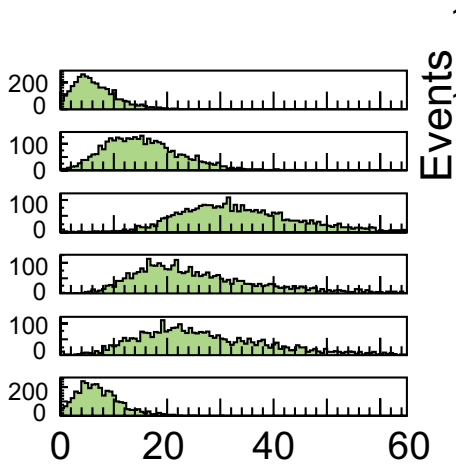
TOF difference of proton and ^3He ～10 nsec
Time resolution ～0.5 nsec

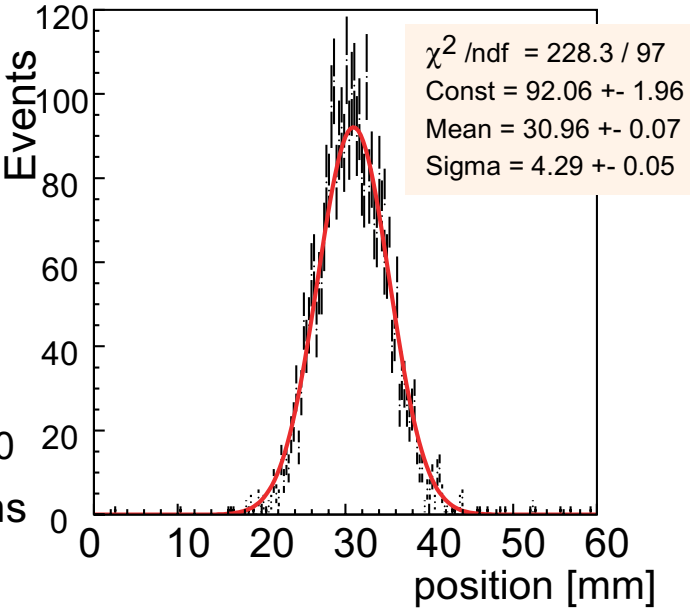
proton rejection ～100 %

S214 TORCH at S2
～incident position determination



Weighted Average by the number of photons





Position resolution of TORCH at S2 $\sigma \sim 4.5$ mm

Expected width of the η bound state $\Gamma/2 \sim 10$ MeV (~ 6 mm)

Sufficient position resolution

S214 Future Plan

In March 2003,
Test Experiment at GSI with the deuteron beam

- Position calibration and Position dependent resolution
- Background measurement (constant background, breakup proton) in the realistic condition

Search for the η nucleus bound state in 2003

Search for the ω nucleus bound state

S214 Collaborator list for the test experiment in Dec 2002

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