北海道大学
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Neutronic studies on a pulsed thermal neutron source based on the Be(p,n) reaction by using a compact proton accelerator

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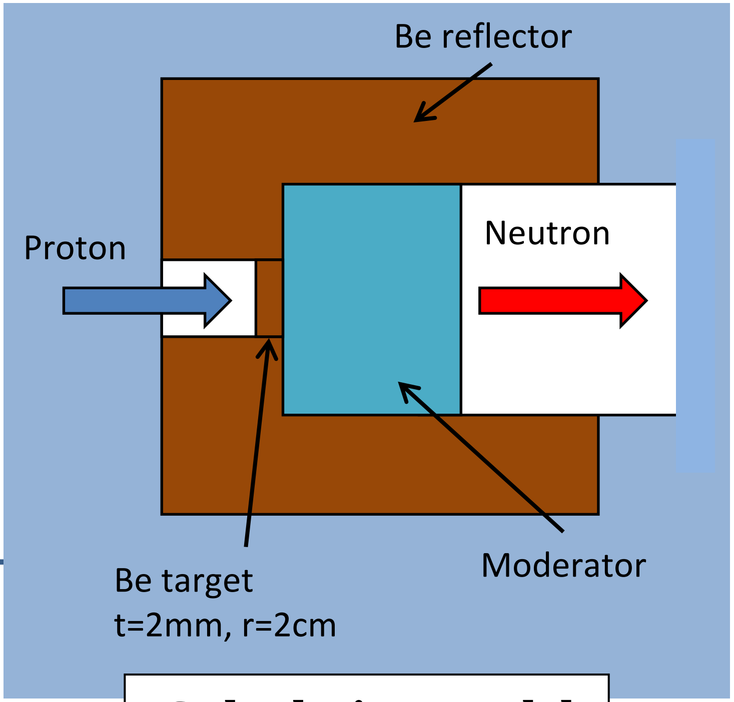
Introduction

Purpose

Development of a high-performance pulsed thermal neutron source for imaging.

Calculation method

- Simulation code : MCNPX ver.2.6
- Nuclear data : ENDF/B-V, -VI and -VII
- Neutron is generated by the Be(p,n) reaction
  - — Proton energy : 11 MeV
  - — Neutron yield : 2.15×10^{13} n/sec/mA
- Thermal neutrons defined here are less than 0.5 eV



Calculation model

We have carried out these subjects

- Choice of a material for moderator in terms of intensity, brightness and pulse width
- Optimizing TMRA
- Estimating for the effect of some design parameters on thermal neutron flux

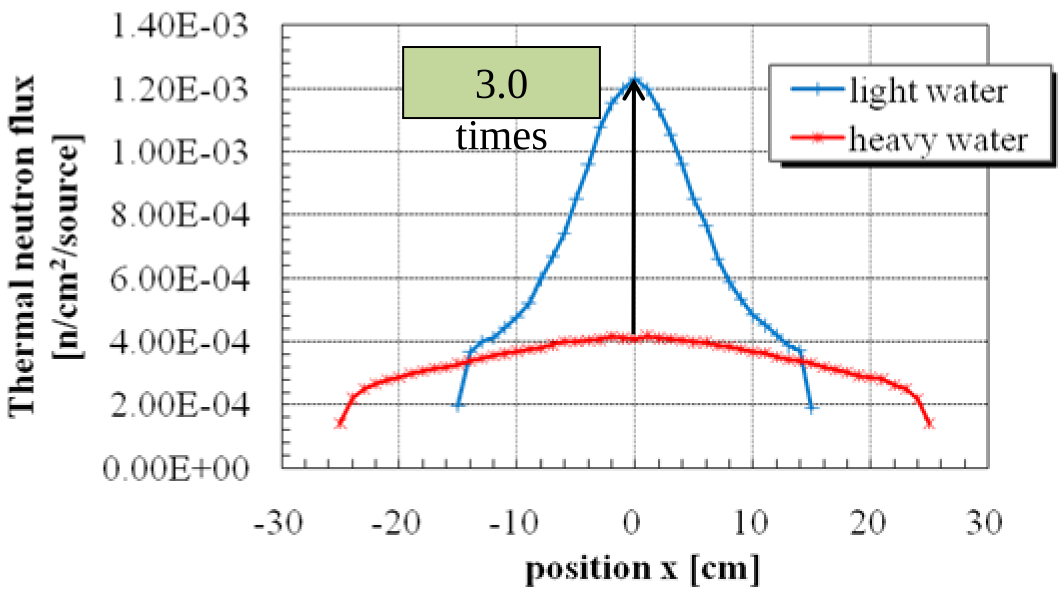
Choice of moderator material between H_2O and D_2O

Comparison of characteristics of H_2O with those of D_2O as a moderator.

H_2O moderator (30 x 30 x 4 (cm)) ( ) : ratio to D_2O case

- Brightness : 1.23×10^{-3} n/cm^2/source (3.0 times)
- Peak intensity : 2.89×10^{-4} n/cm^2/sec/MeV/source @ 49.2meV (3.3 times)
- FWHM : 61 μ sec @ 27.7meV (11 %)
- Time- and area- integrated intensity : 3.48×10^{-7} n/cm^2/source at 5 m (0.58 times)

*Size of D_2O moderator : 50 x 50 x 18 (cm)



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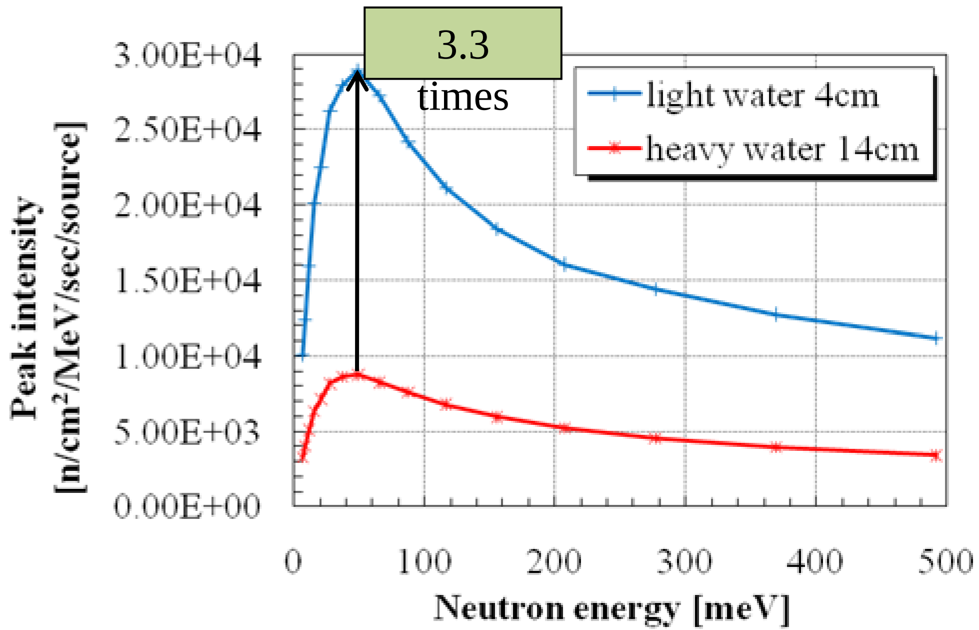

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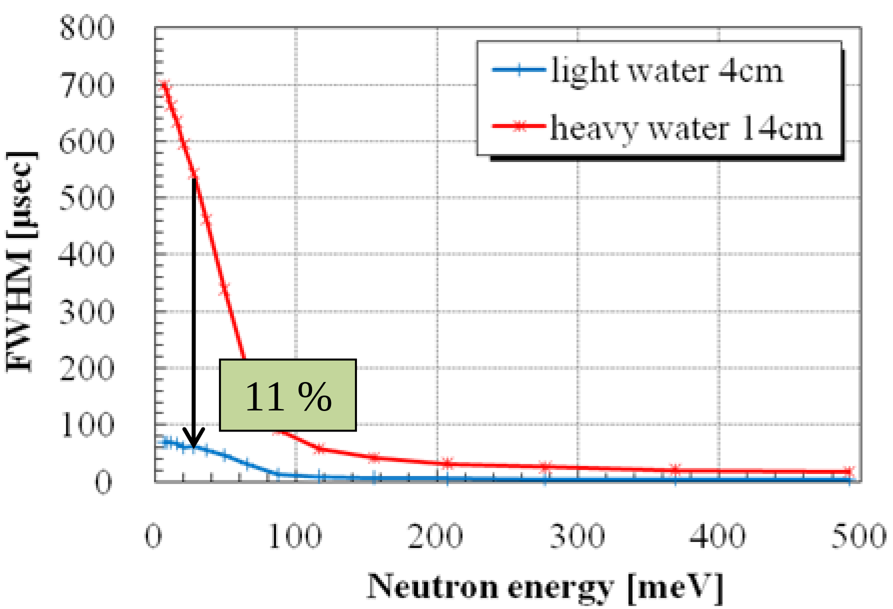

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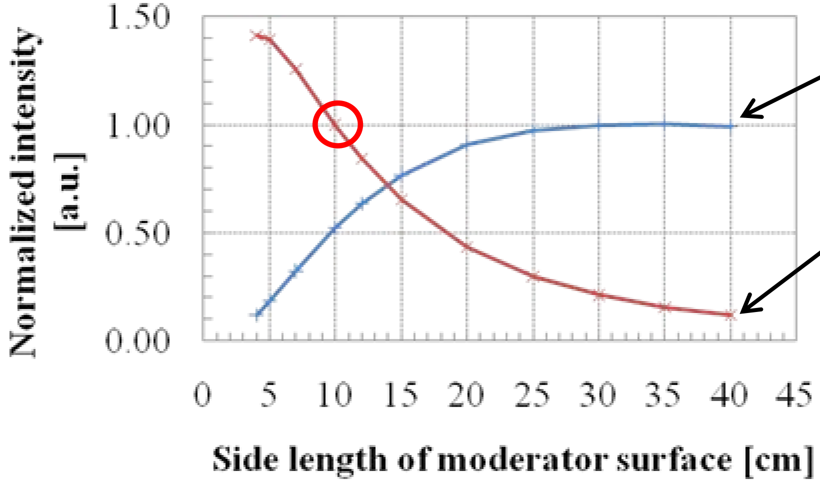
However, compared at same L/D, the intensity of H_2O moderator is about 1.6 times as large as that of D_2O.

→ D_2O moderator don't have advantages on imaging.

H_2O is much better than D_2O as a moderator for a pulsed thermal neutron.

→ We chose H_2O as a moderator material.

Optimizing TMRA

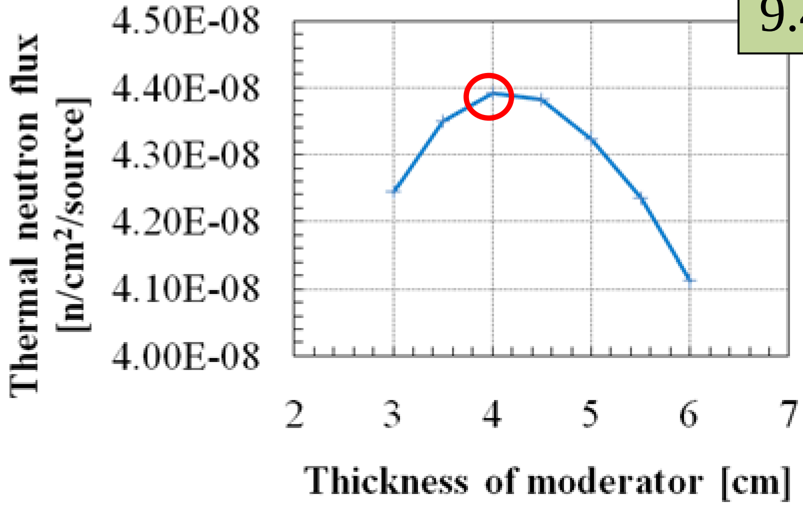


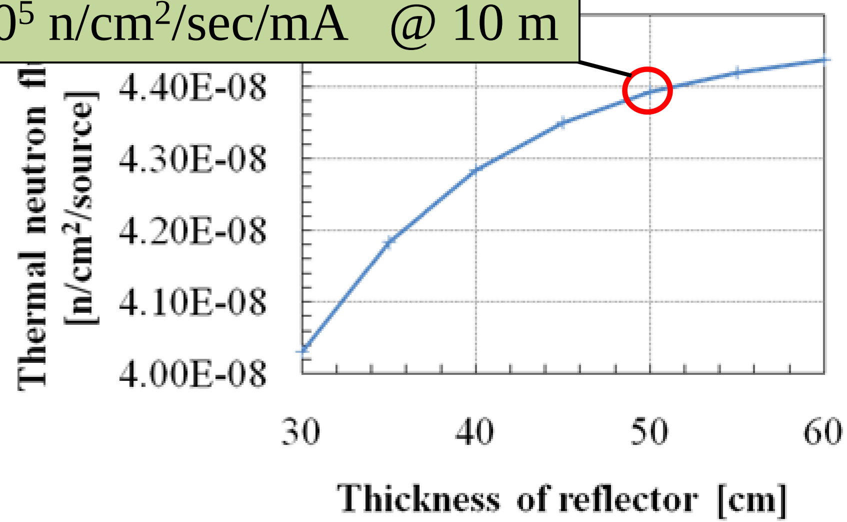
Time-and area-integrated intensity

Time-integrated intensity normalized by L/D
(Divided by area of moderator surface to compare at the same L/D)

Optimal area of moderator surface is 10x10 cm^2

9.43×10^5 n/cm²/sec/mA @ 10 m





Optimal thickness of moderator is 4 cm

Optimal thickness of reflector is 50 cm

Thank you for your attention!

I’ll talk about the details in poster session.