Student's presentation

Calculation of correction factors for neutron capture cross section measurements

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Introduction

- The average capture cross sections, $<\sigma_a>$, at an average neutron spectrum energy can be measured relative to the standard capture cross section of ^{197}Au by activation method:

$$<\sigma_a>=\frac{C^x f(\lambda,t)^x f_c^x I_\gamma^{Au} \varepsilon_\gamma^{Au} N^{Au} <\sigma_a>^{Au}}{C^{Au} f(\lambda,t)^{Au} f_c^{Au} I_\gamma^x \varepsilon_\gamma^x N^x}$$

$$f(\lambda,t)=\frac{\lambda}{(1-\exp(-\lambda t_1))\exp(-\lambda t_2)(1-\exp(-\lambda t_3))}$$

f_c: correction factors

- **Correction factors must be introduced to take into account:**

  - **Multi-scattering of neutron in sample**

  - **Self-shielding effect**
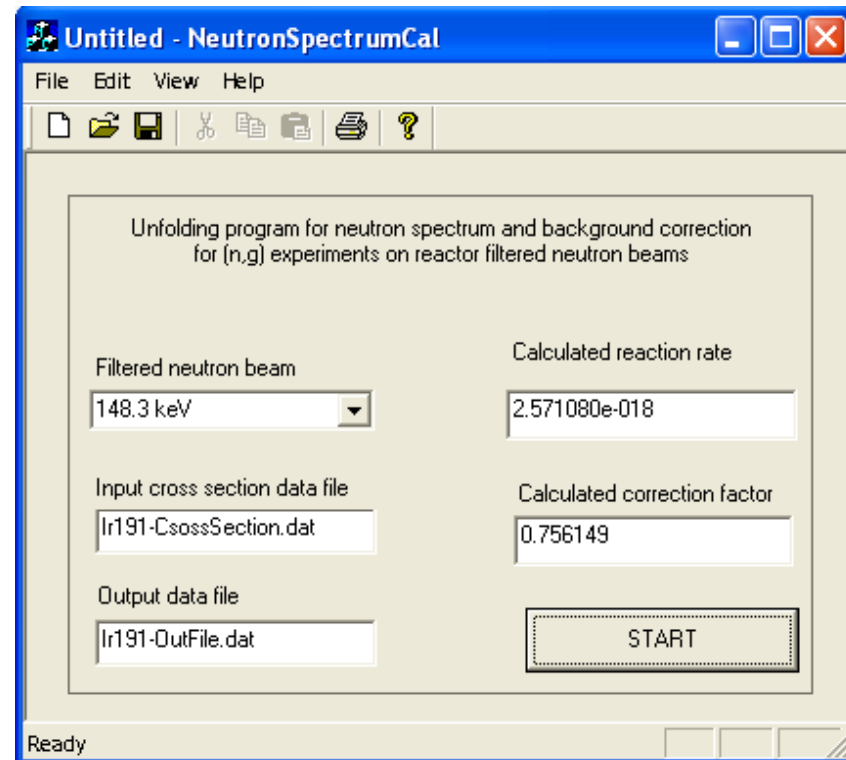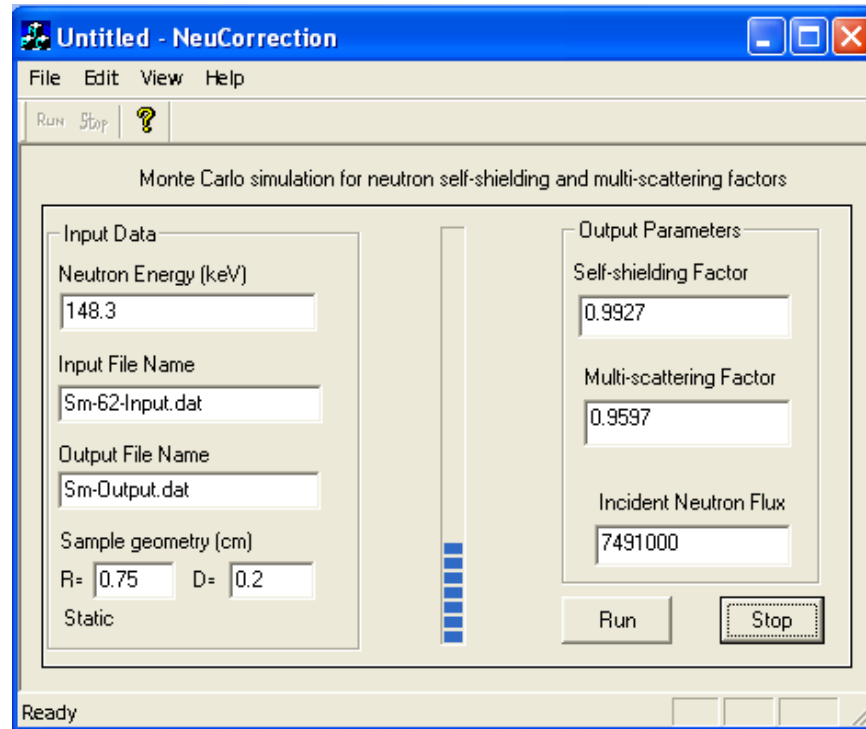
    Monte Carlo simulation

  - **Resonance capture with neutrons in low energy background region**
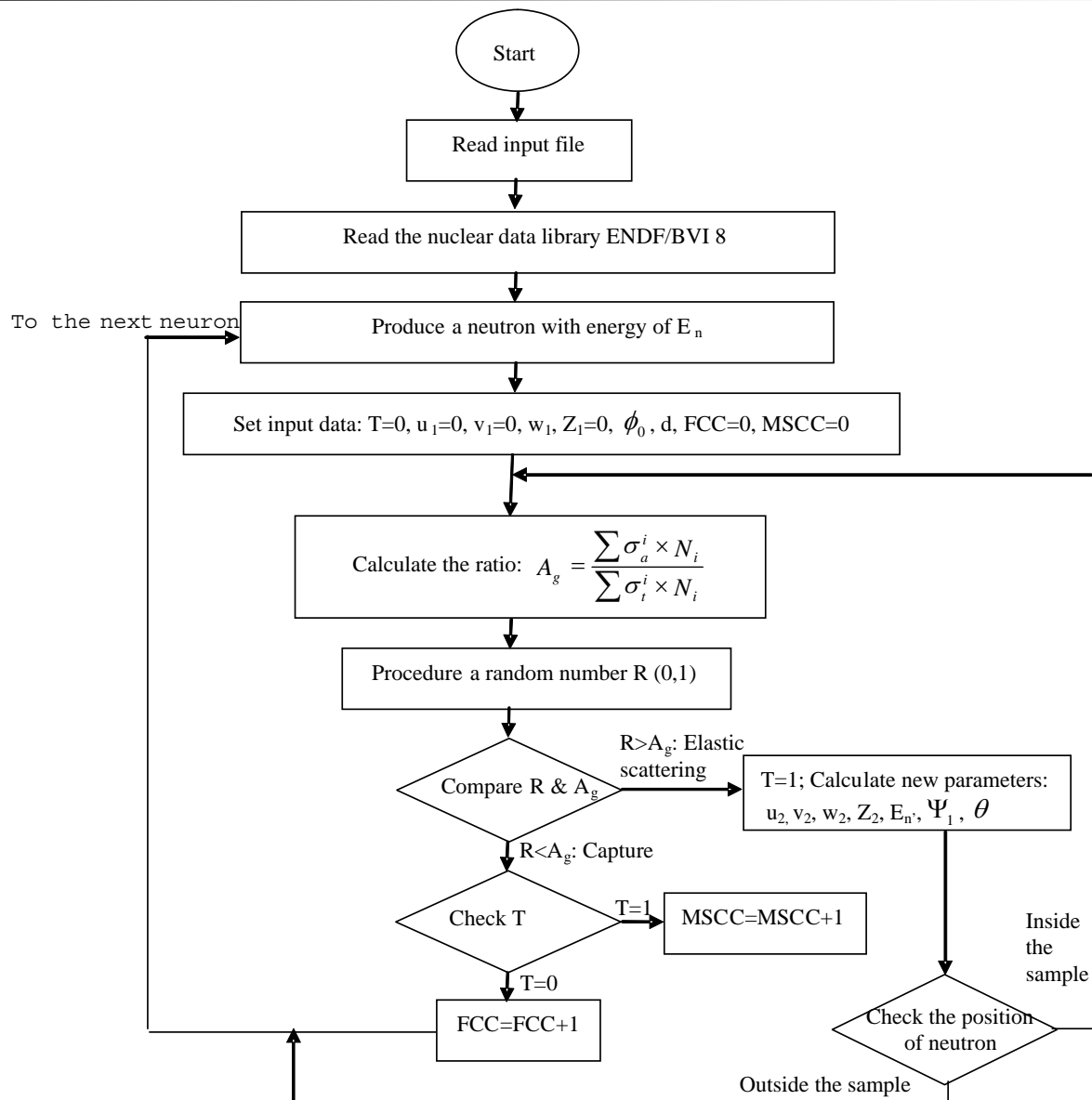
    Exactly estimation of neutron spectrum
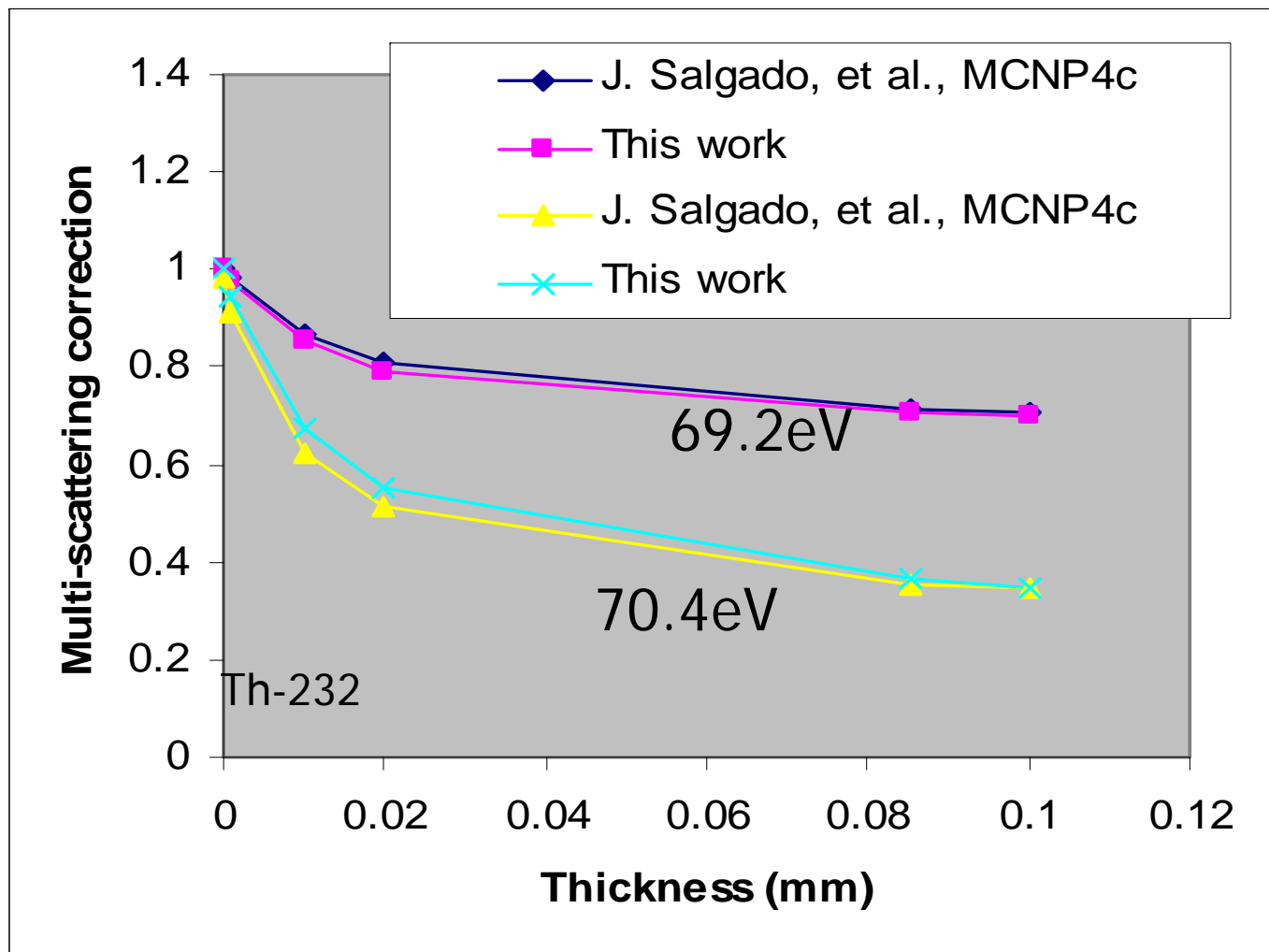
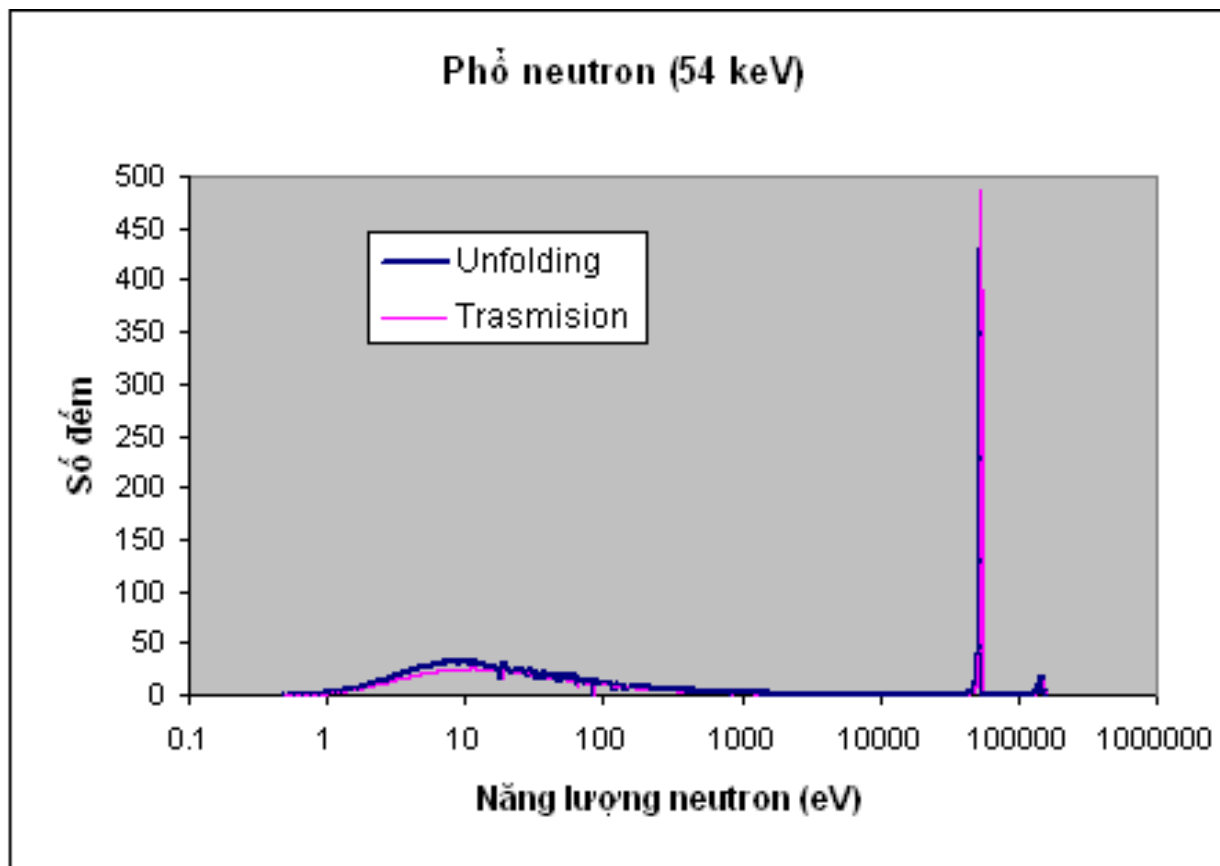   (unfolding method)

Computer programs

Computer programs

Start

Read input file

Read the nuclear data library ENDF/BVI 8

To the next neuron

Produce a neutron with energy of E_n

Set input data: T=0, u_1=0, v_1=0, w_1, Z_1=0, ϕ_0, d, FCC=0, MSCC=0

Calculate the ratio: $A_g = \dfrac{\sum \sigma_a^i \times N_i}{\sum \sigma_t^i \times N_i}$

Procedure a random number R (0,1)

Compare R & A_g

R>A_g: Elastic scattering

T=1; Calculate new parameters: u_2, v_2, w_2, Z_2, $E_{n'}$, Ψ_1, θ

R<A_g: Capture

Check T

T=1

MSCC=MSCC+1

Inside the sample

T=0

FCC=FCC+1

Check the position of neutron

Outside the sample
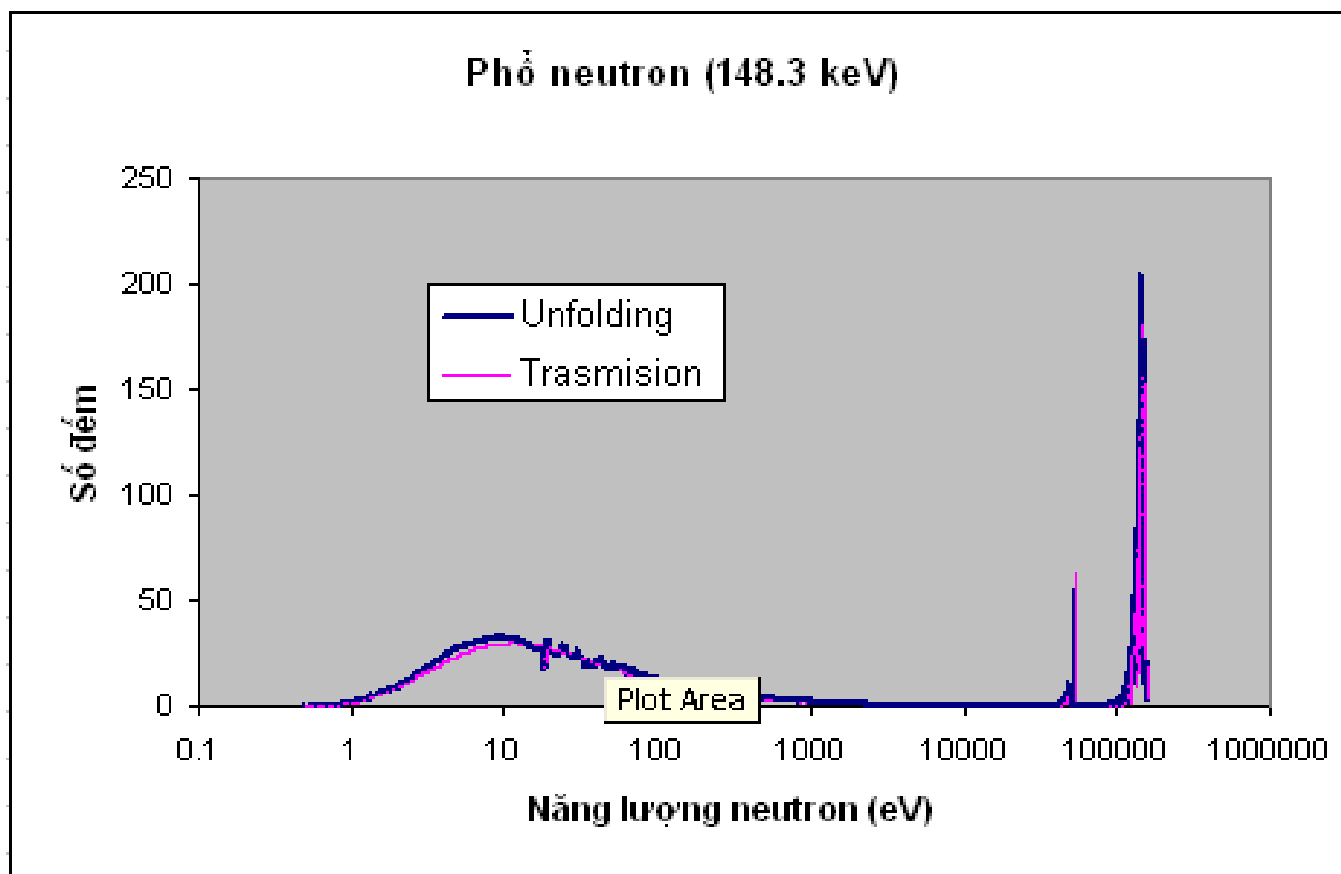
Computer programs

Computer programs

Unfolding neutron spectrum of 54keV filtered neutron beam at Dalat Reactor

Computer programs

Unfolding neutron spectrum of 148.3keV filtered neutron beam at Dalat Reactor

Computer programs

In a neutron activation experiment, the reaction rate will be measured indirectly, by detection of emitted decay gamma rays from the product nucleus:

$$R = N\int_{0}^{\infty}\sigma(E)\phi(E)dE = N\left[\int_{E1}^{E2}\sigma(E)\phi_{P}(E)dE + \int_{0}^{\infty}\sigma(E)\phi_{LB}(E)dE\right]$$

Can be Measured by using a HPGe Detector

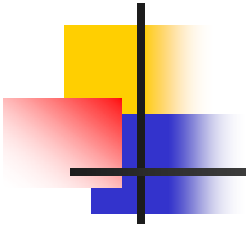The first term of the reaction rate accounts for the effect of neutrons in the primary region of spectrum.

The second term accounts for the effect of neutron in background region.

Experimental results

Results of measured capture cross section for some nuclei

Nucleus	54keV		148.3keV	
	This work	ENDF	This work	ENDF
Sm-152	0.34501	0.3438	0. 25832	0. 25030
Sm-154	0.1521	0.21999	0.0841	0.08496
La-139	0.02207	0.02819	0.00991	0.01422
Ir-191	1.01333	1.006	0.54797	0.6282
Ir-193	0.63721	0.6349	0.3719	0.3726
Nd-146	0.0883	0.09919	0.0642	0.72845
Nd-148	0.1189	0.11058	0.0936	0.84968

Thank you for your attention!