Radiogenic Neutron Generator

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Motivation

- Radiogenic neutrons play important role in the background budget for dark matter searches and neutrino experiments.
- The generation of radiogenic neutrons is not implemented in the main simulation tools such as GEANT4, FLUKA.
- The calculation codes in terms of radiogenic neutron yield are either limited by accessibility or incomplete functionality.

GEANT4 Situation

- Low energy neutron propagation in media are well coded in GEANT4(NeutronHP). However, the generation of (a, n) and spontaneous fission neutron is not implemented.
- We don't know when this feather will be available in GEANT4. Before that, we have to calculate the neuron yield then apply the energy spectrum as input to track the neutron propagation in detector system.

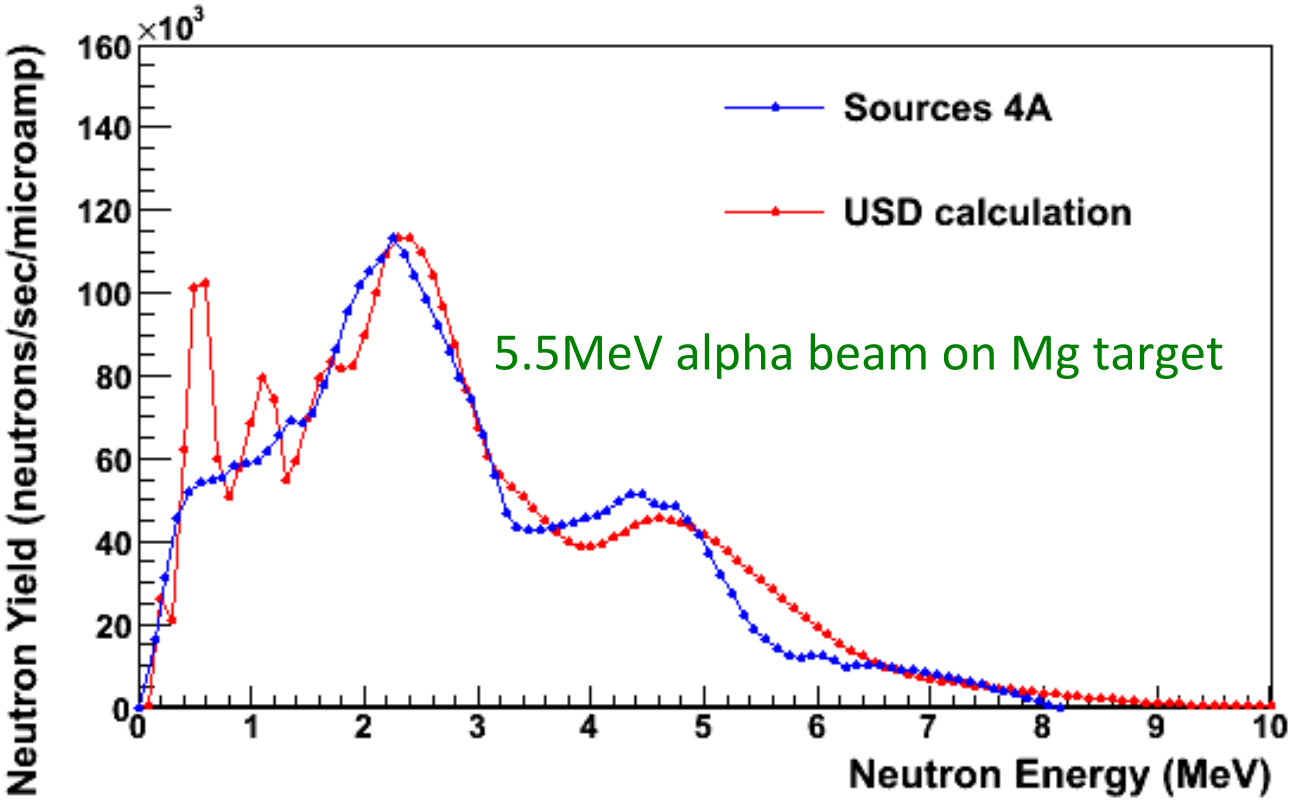
Neutron Yield Calculation Tools

Tools	Pros	Cons
SOURCES	1. (a,n) and fission neuron rates and spectra in: homogeneous media, multiple-interface as well as beam alpha. 2. Using EMPIRE and experimental data library. 3. Rich input sources and target.	1. Limit of accessibility. 2. Restricted use of modification and update(not an open source).
USD Web Database	1. (a,n) neutron rates and spectra in homogeneous media. 2. Using TENDL data library. 3. User friendly. Free of use.	1. Limited source of input. 2. The code cannot be downloaded and personalized.

SOURCES: Tomasello et al., NIMA 595(2008)431.
USD website: http://neutronyield.usd.edu NIMA 606 (2009) 651

Comparison of Calculated Results

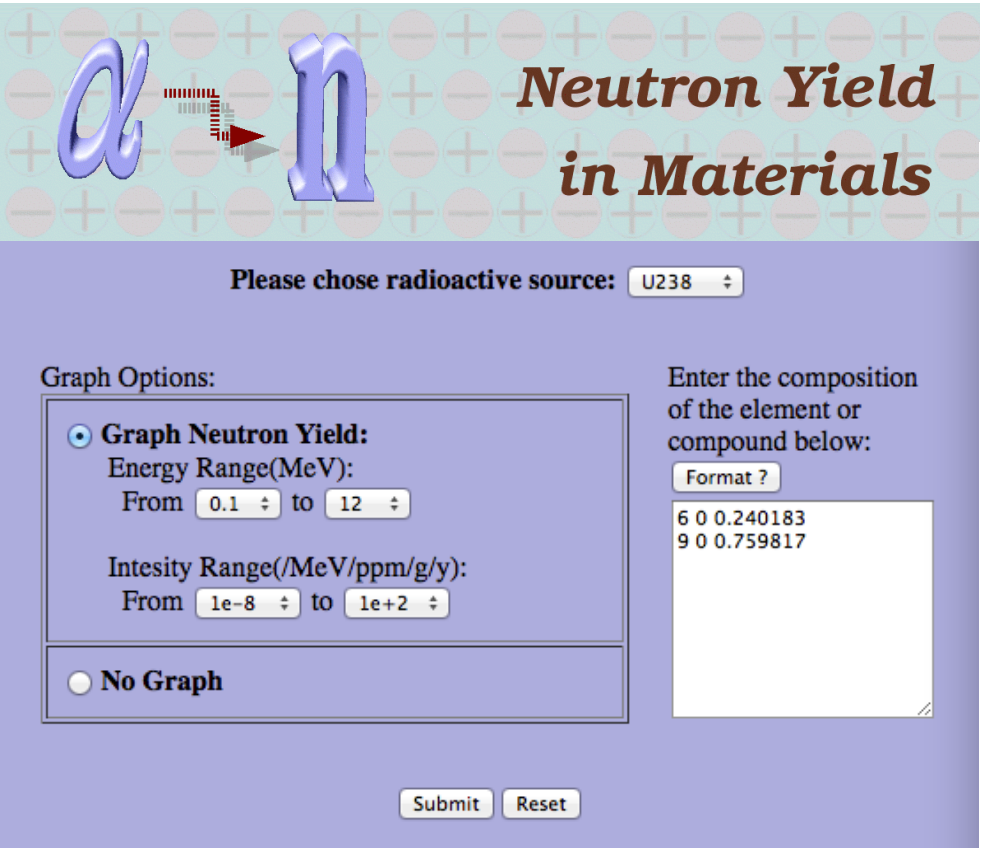
- Calculation of (a, n) neutron yield comparison between USD web database and SOURCES code. A general agreement within a factor a 2 is found (more comparison: http://www.physics.smu.edu/cooley/aarm/webpage.html)

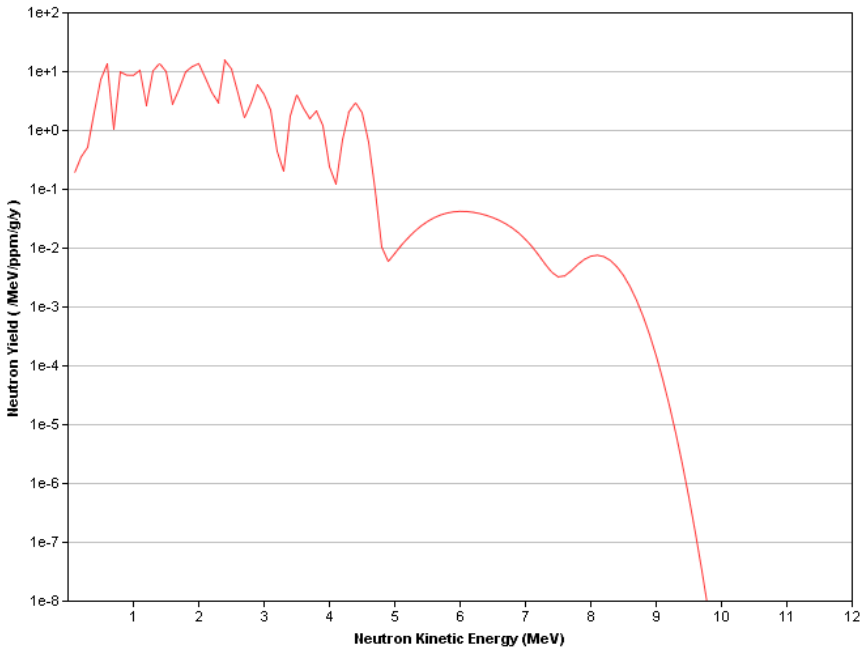


New Tool – Radiogenic Neutron Generator

1. A development of USD web database.
2. Framework is based on C++ and GNU software. Free of using, downloading and improving.
3. Support both single alpha source, radioactive decay chain or fission decay as input.
4. Neutron rates and energy spectrum from (a, n) and fission neutron yield.
5. Evaluated cross section data libraries and validated energy spectrum.

Current USD Web Database

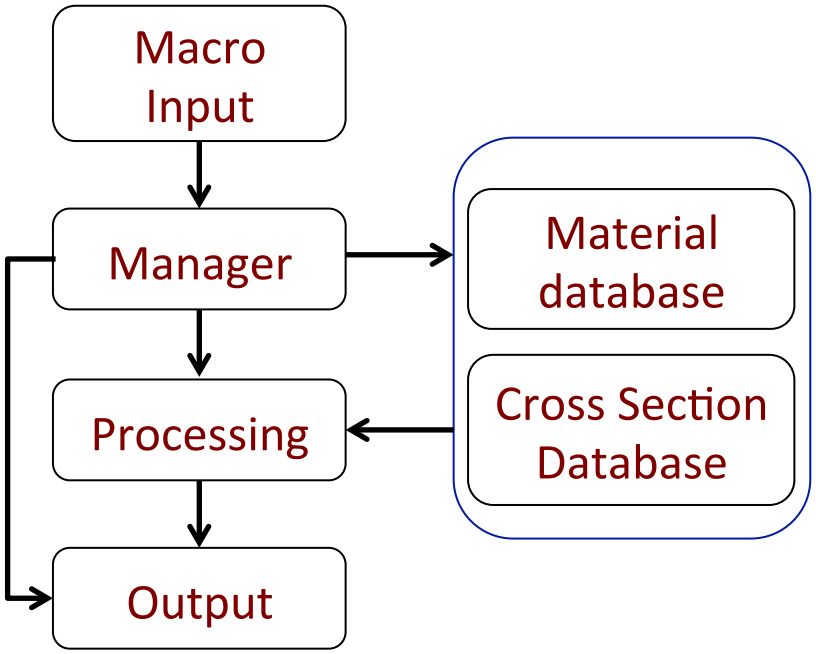




Input

Output

Flowchart of RNG



- Input: a) Decay chain; b)single alpha; c) beam alpha; d) fission.
- Target materials: a) single element; b) compound.
- Evaluated Database: EMPIRE, TENDL , ENDF.
- Output: a) total rates; b) energy spectrum.

Summary

- A multi-functional radiogenic neutron generator is needed by the community.
- Based on current USD web database, RNG software is proposed for for further development.
- The goal of RNG is provide a free software which is dedicated in simulating radiogenic neutron yield with evaluated database and validated energy spectrum.
- Funding and manpower are needed.