

Primary Study of Detector Response Function Development for MCNP Use

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Agenda

- Project description
- Experiments and MC simulation
- Discussion and conclusion
- Future work

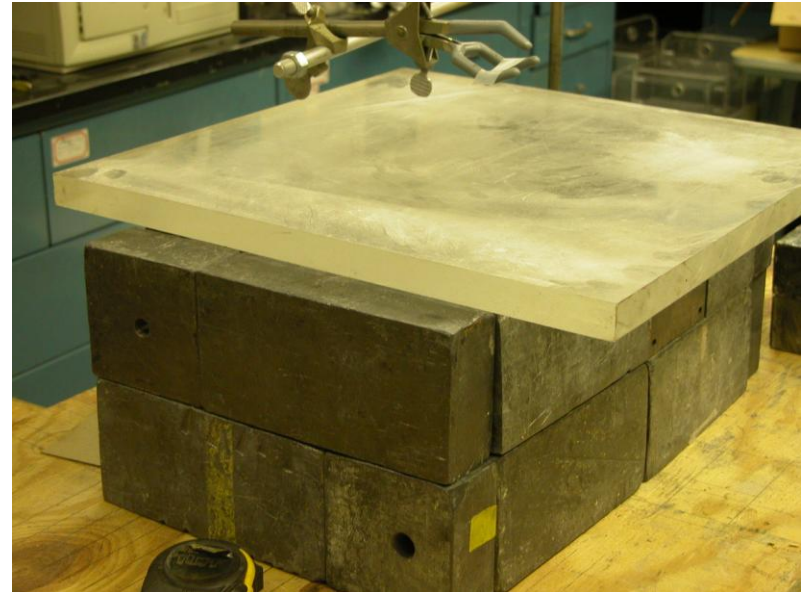
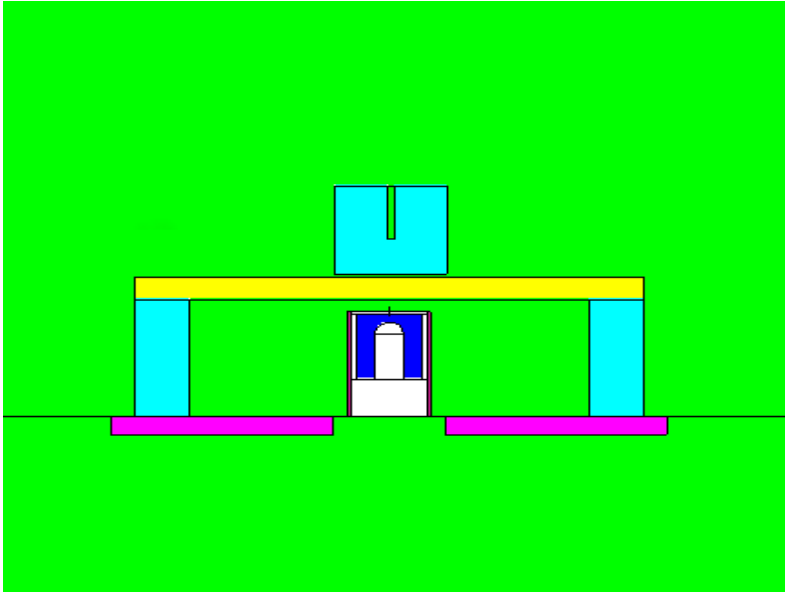


Project description

- ❑ Purpose: to improve the accuracy of calculated gamma-ray spectra
- ❑ Approach
 - Record the particles current flux over the surface of detector
 - The current flux is convolute with the pre-calculated DRF to get the pulse-height gamma-ray spectrum. ($H(E) = \int C(E) * R(E) dE$)
 - The calculated spectra are compared to the experimental spectra



Problem setup

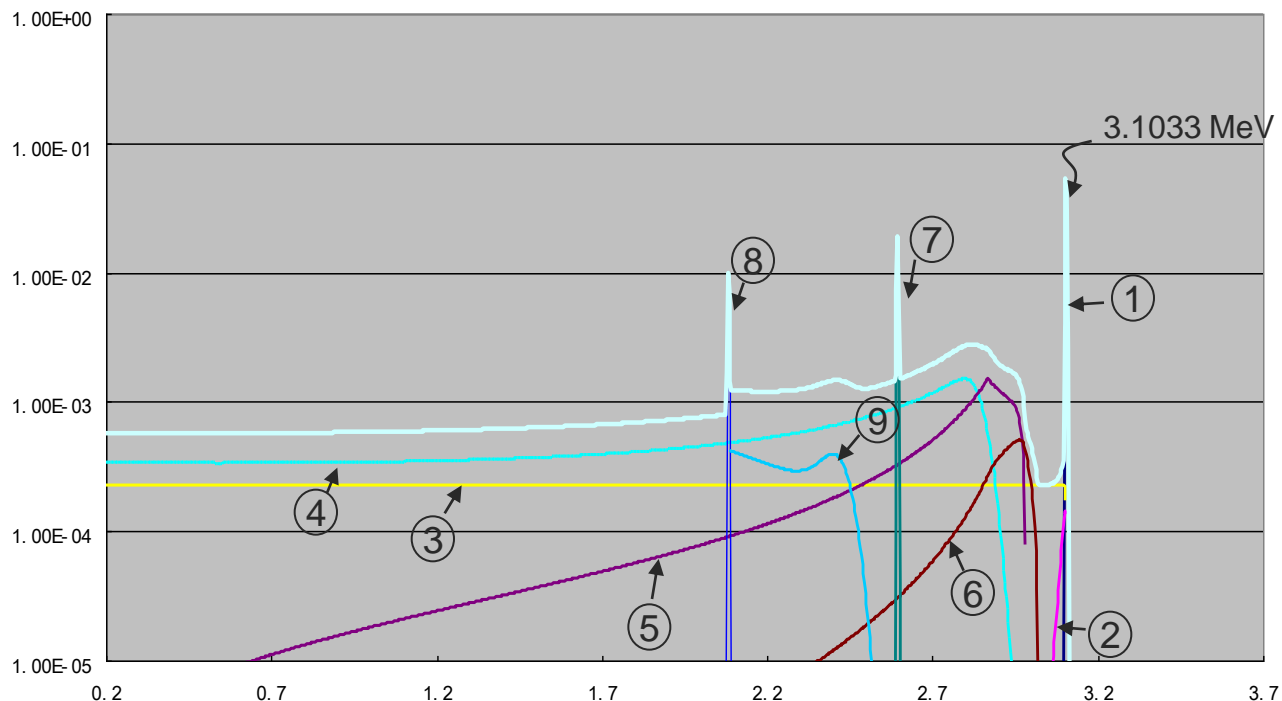


Experiment treatment

- Cs-137, $E_{\gamma}=0.661$ MeV
- Co-60, $E_{\gamma}=1.173, 1.332$ MeV
- ^{252}Cf spontaneous fission source
- Attenuation slab
 - Aluminum
 - Pyrex
 - magnesium



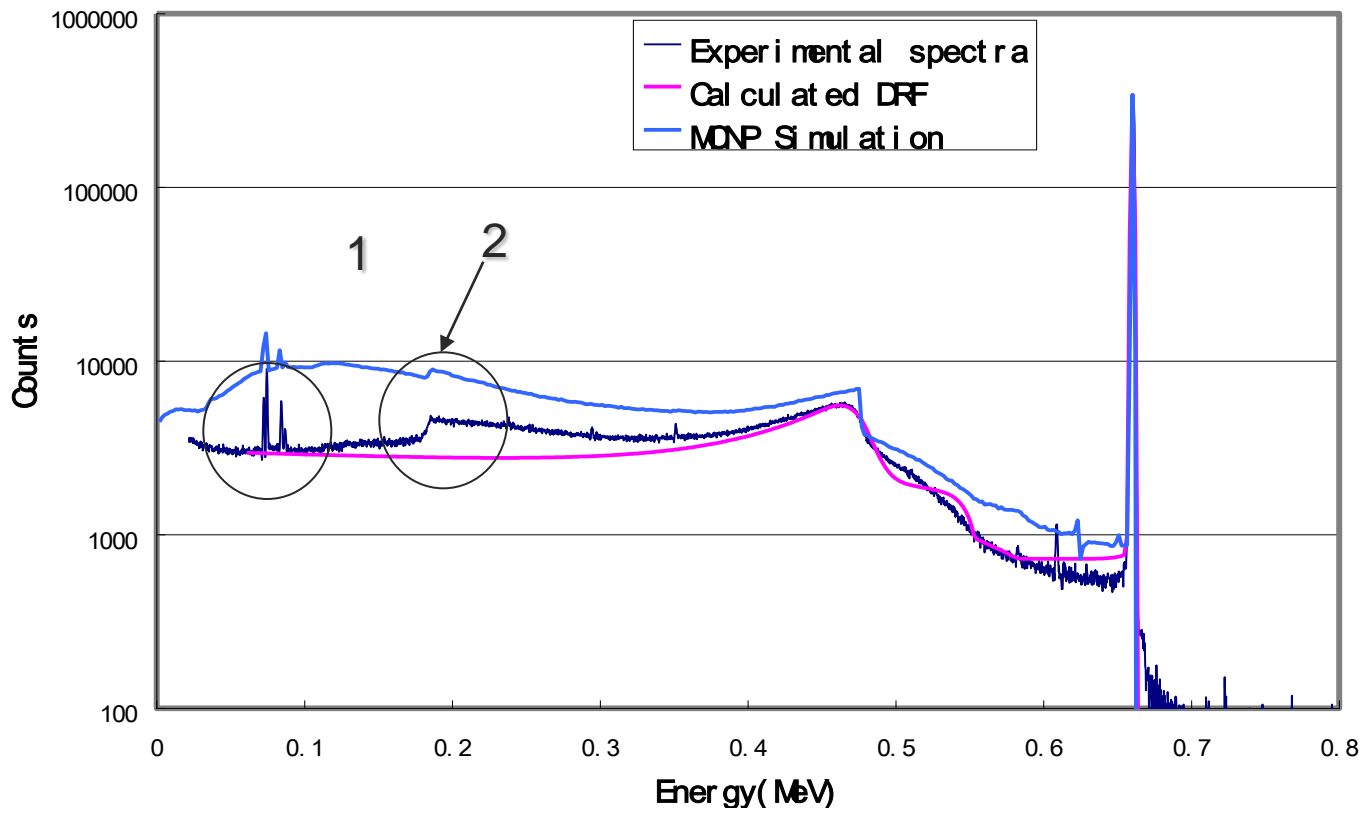
DRF of Germanium detector



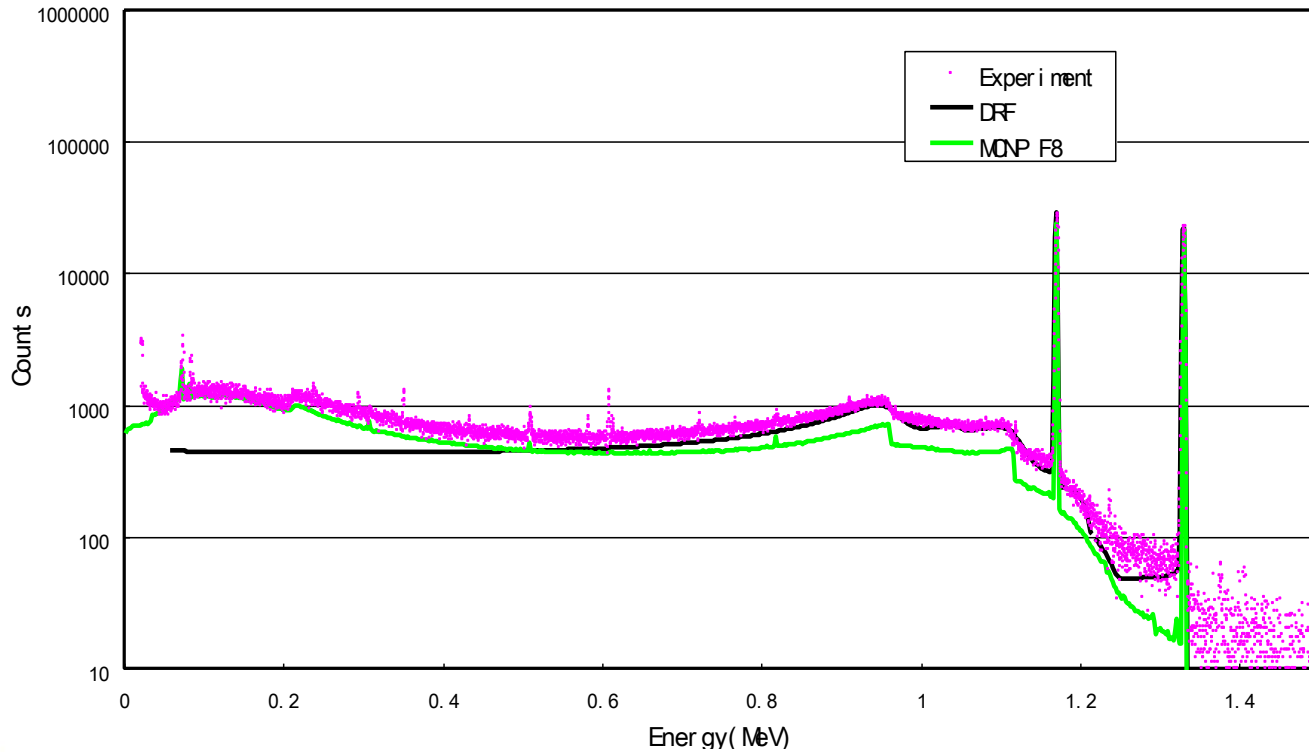
1- Full energy peak; 2- Exponential tail on the left side of full energy peak; 3- Flat continuum; 4- Single scatter Compton continuum; 5,6- Multiple scattering Compton continuum; 7- Single escape peak; 8- Double escape peak; 9- Single and multiple scatter Compton continuum of annihilation photon

DRF

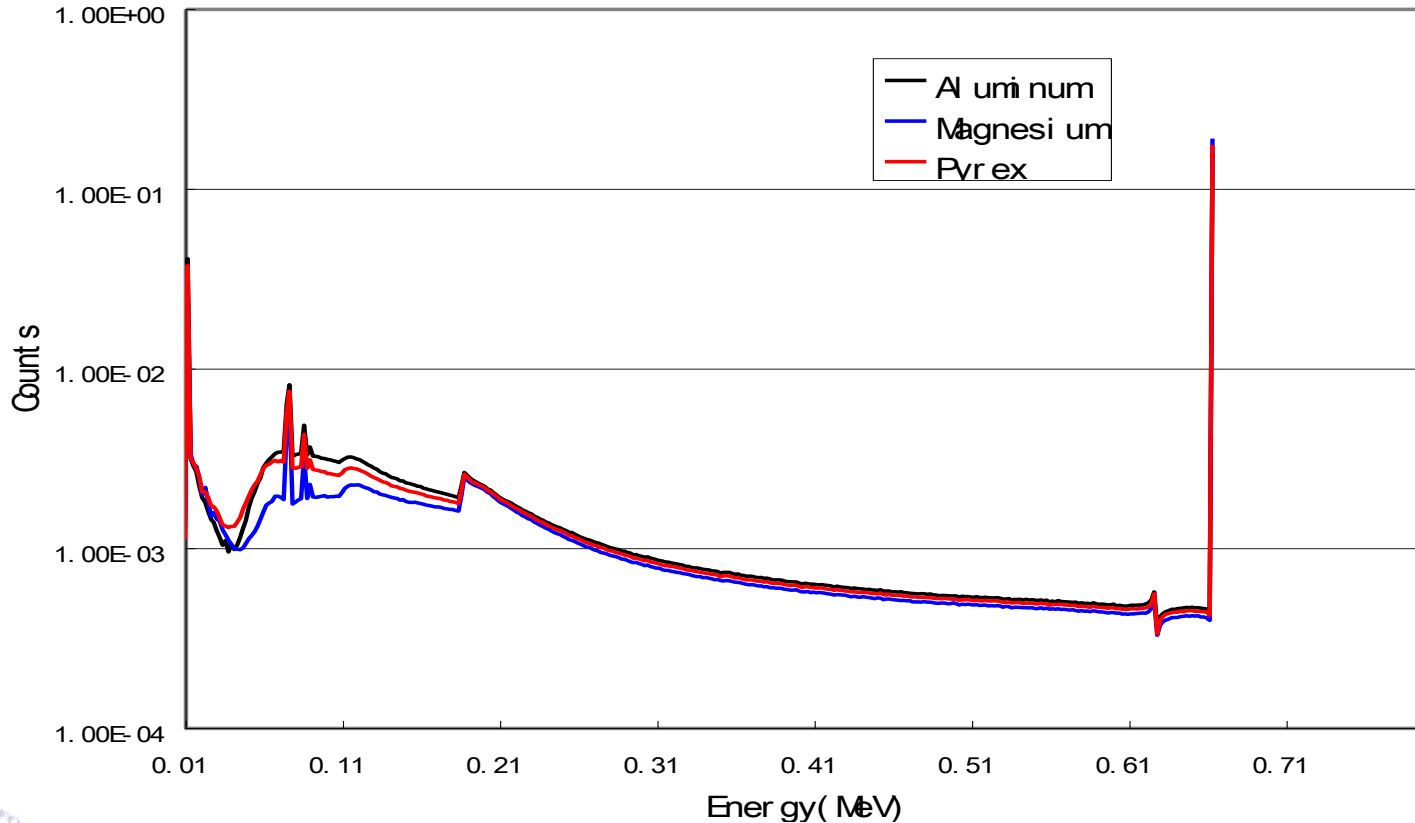
□ Cs-137



C0-60



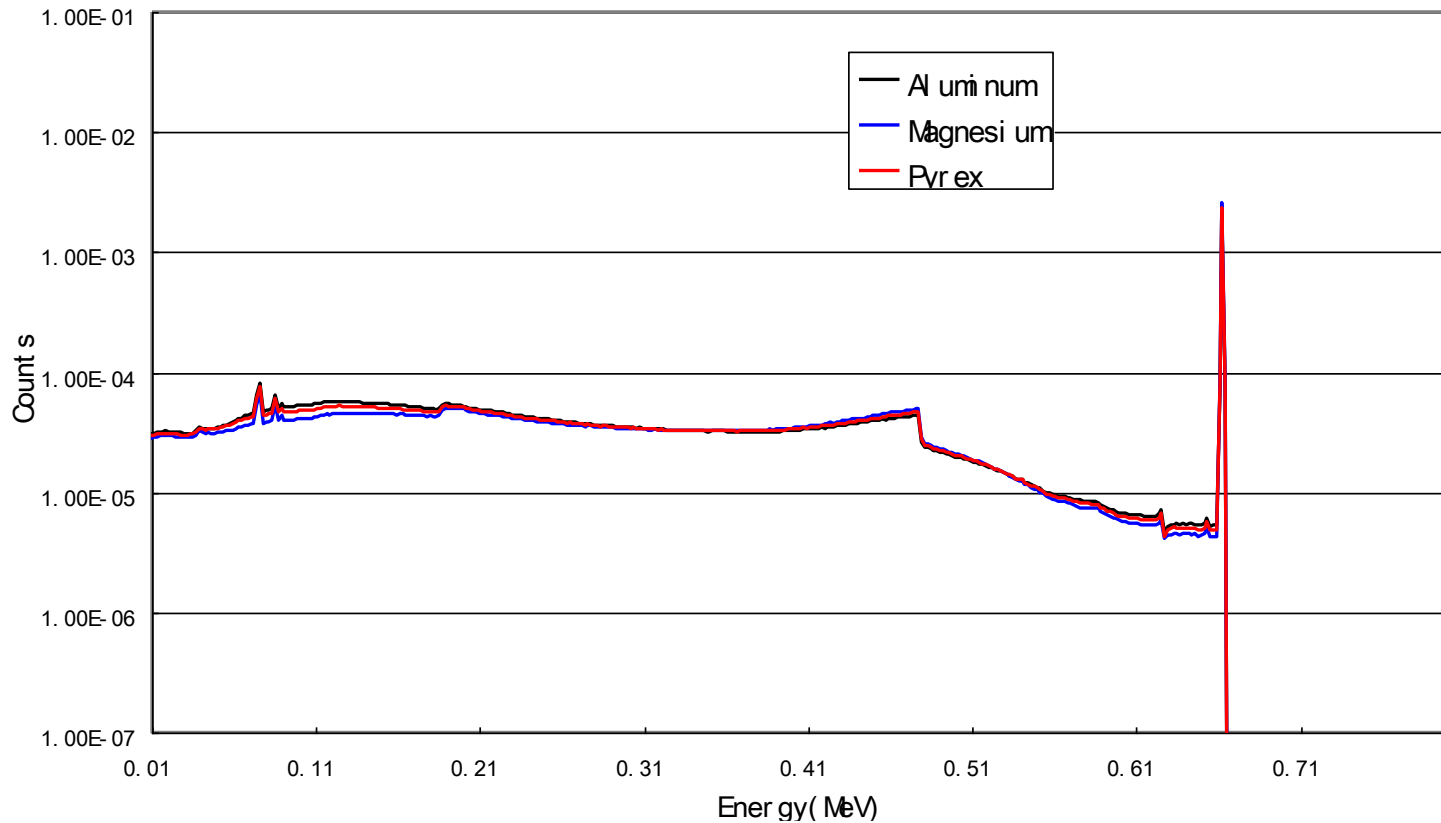
Photon transmission



MCNP surface current tally



Photon transmission

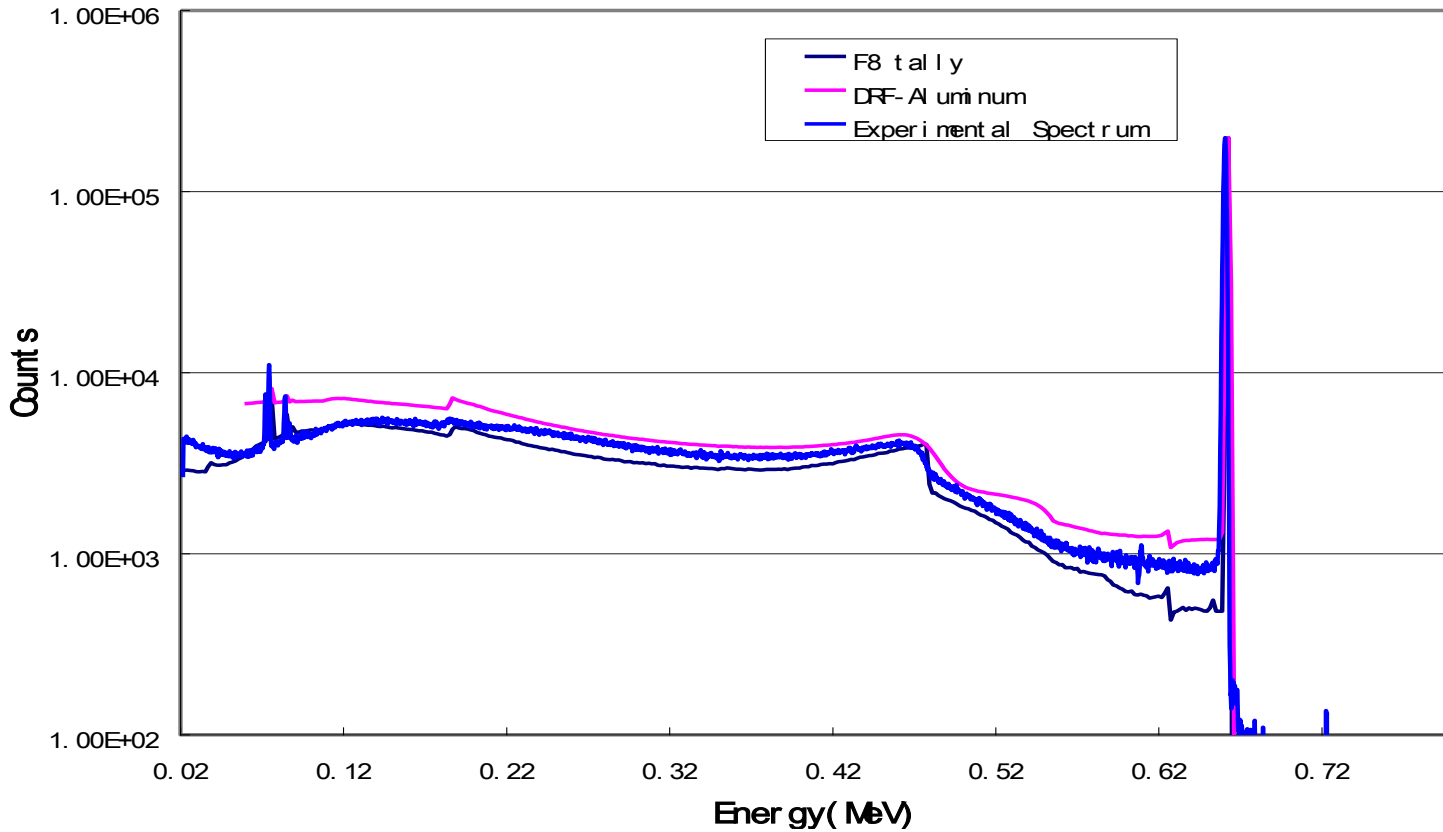


MCNP pulse-height tally

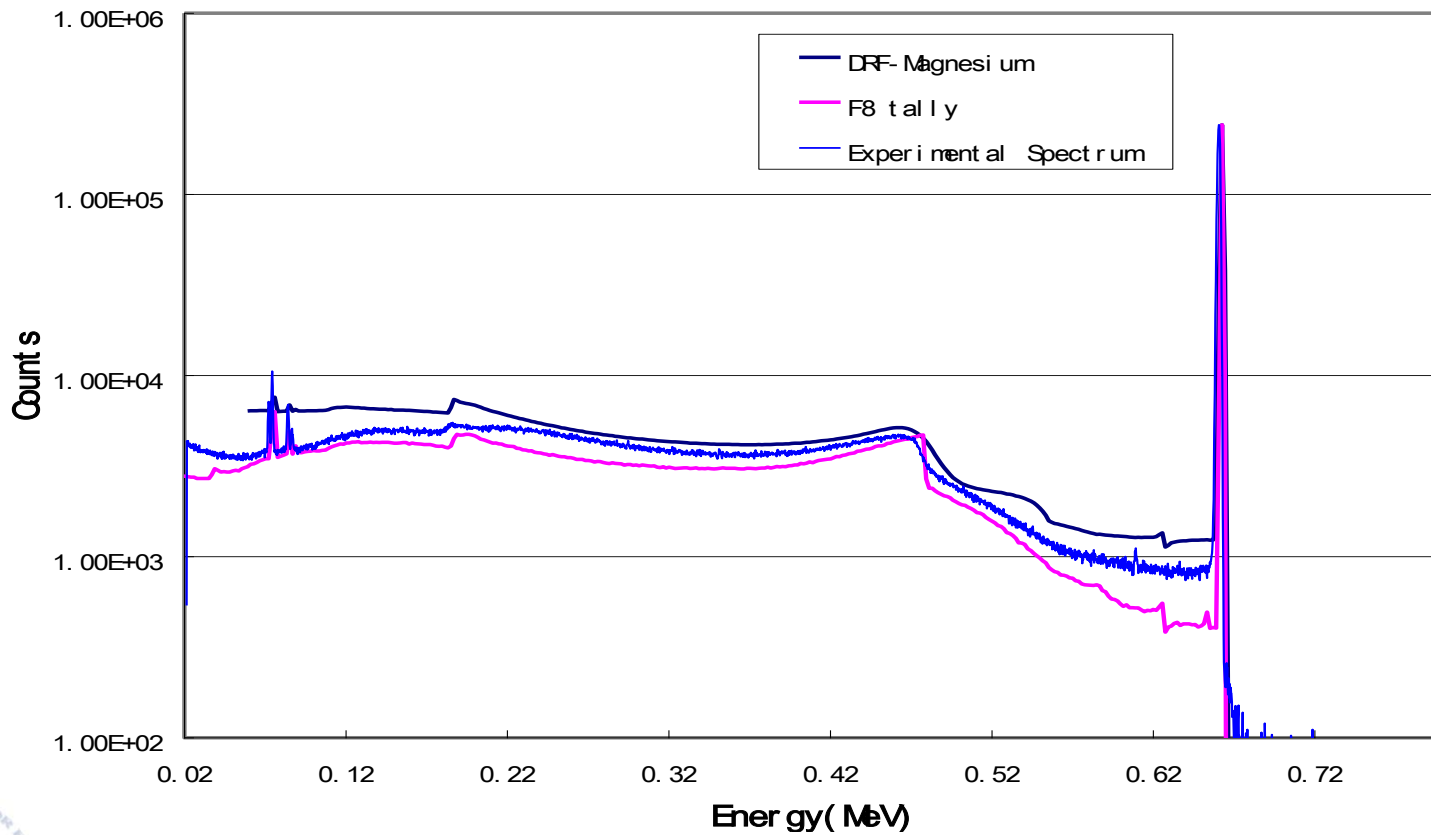
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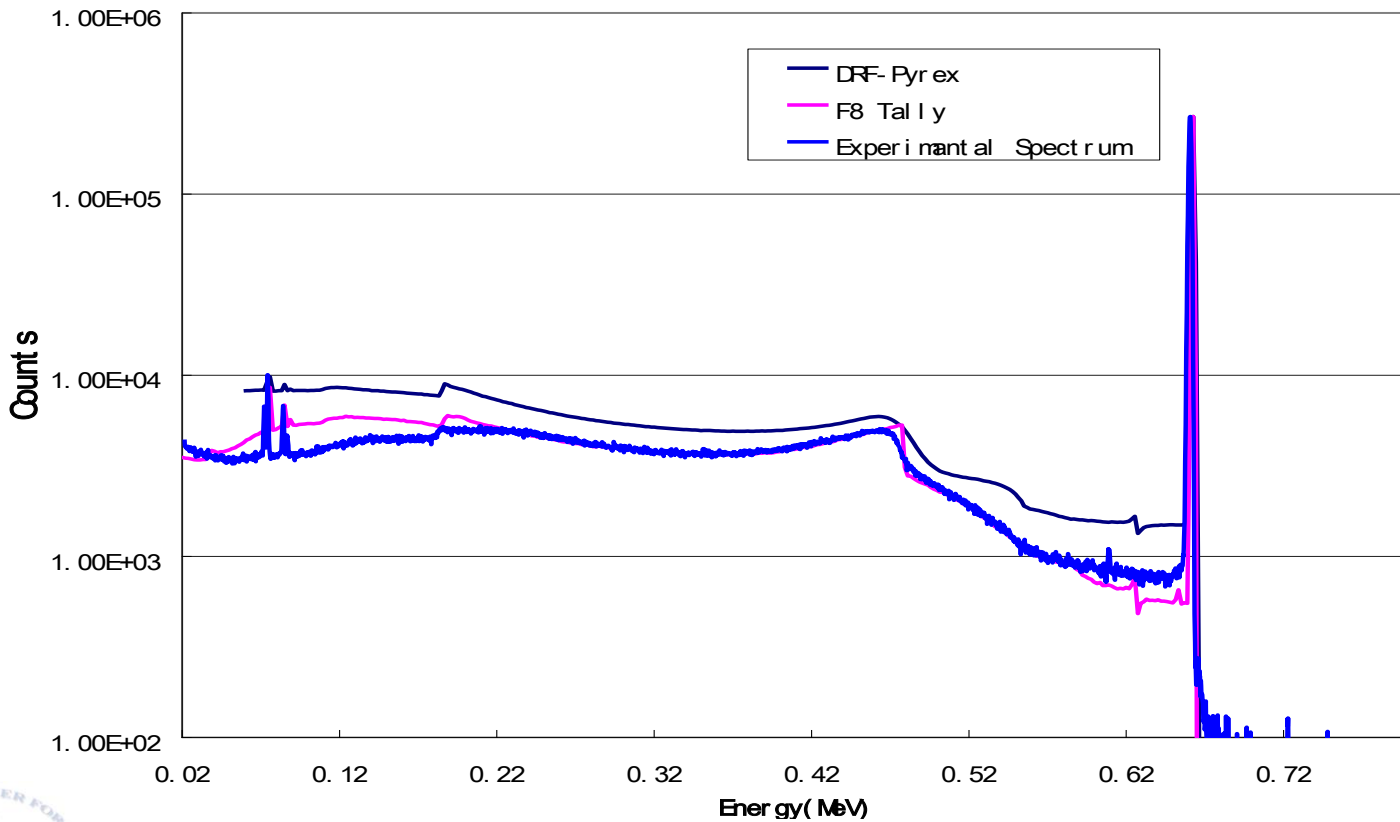
Aluminum



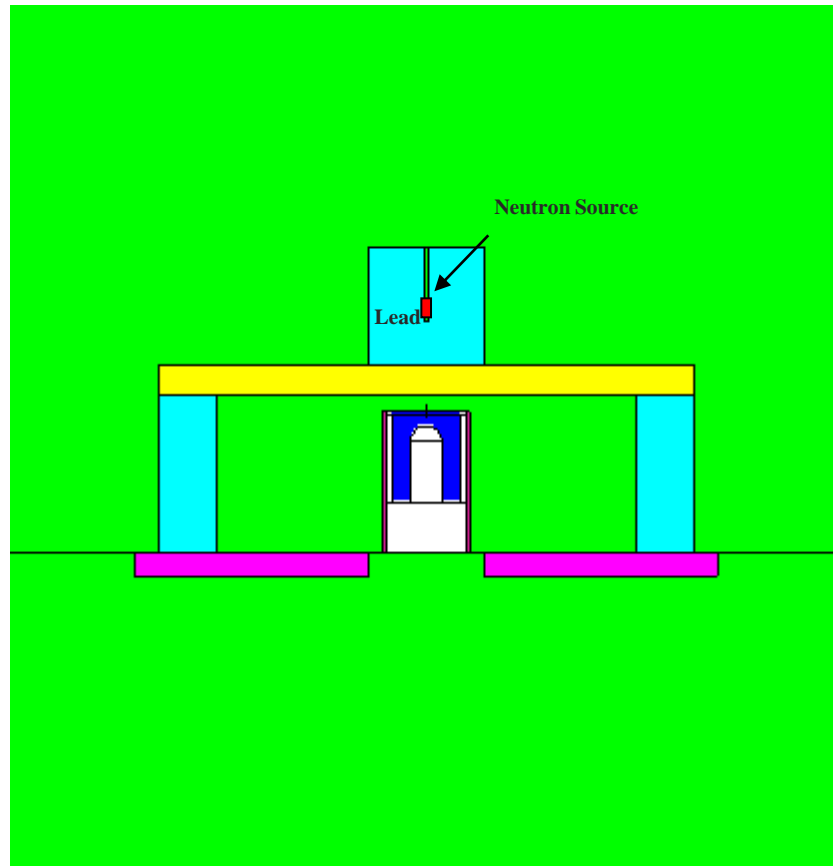
Magnesium



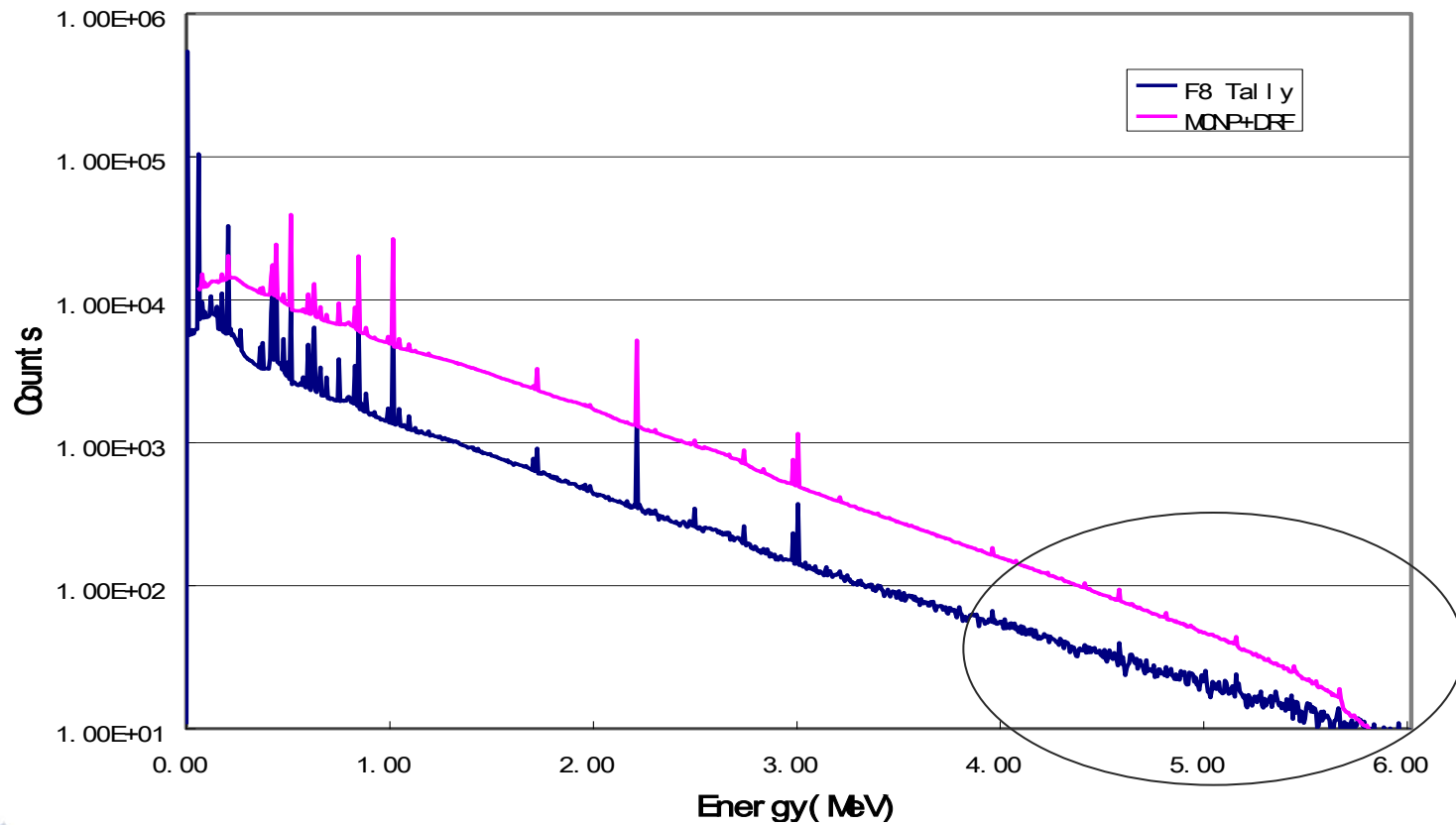
Pyrex



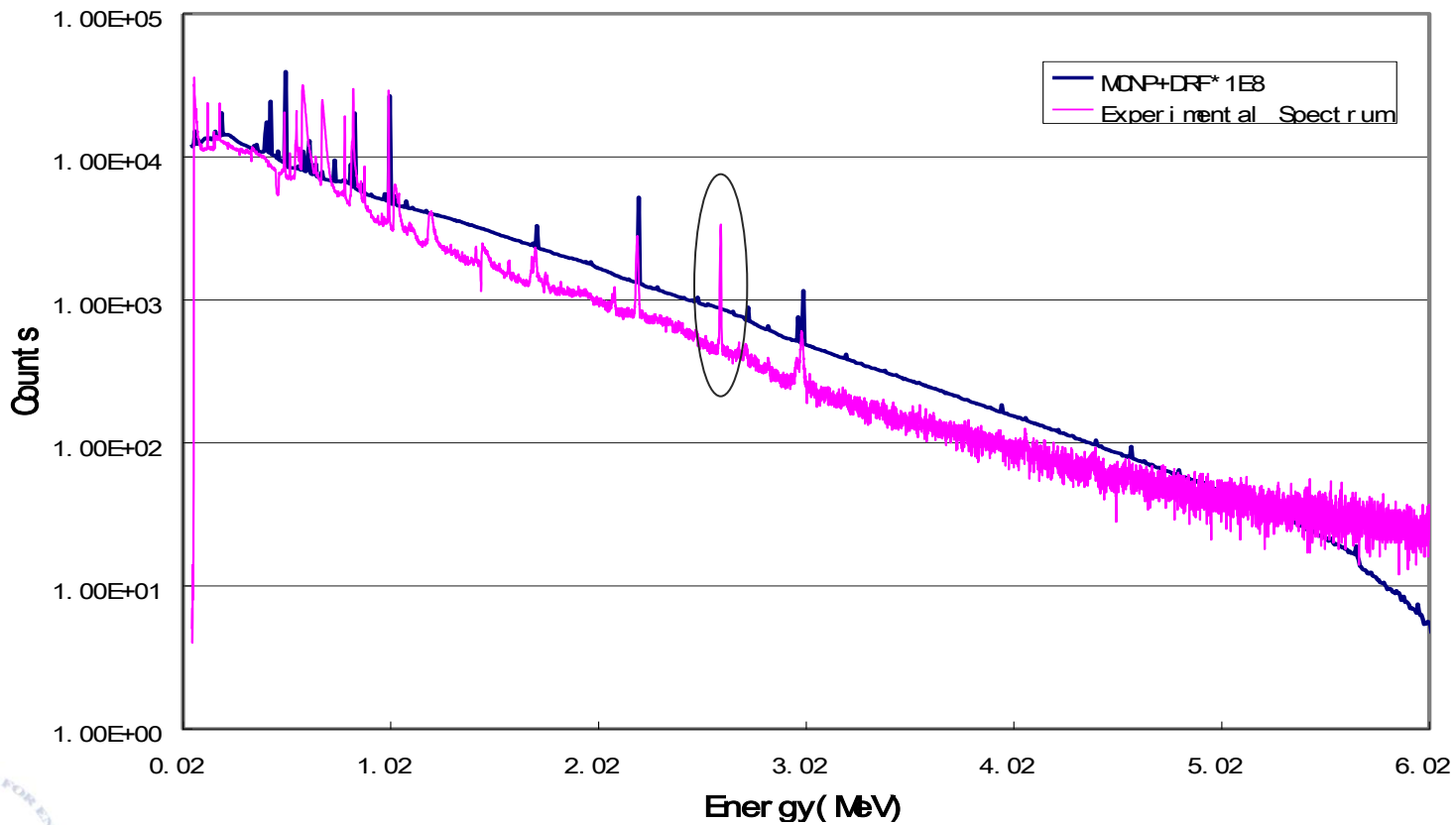
Neutron transmission



Aluminum

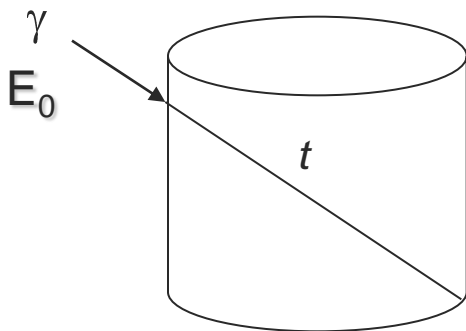


Experiment v.s. F1+DRF



Discussion and Conclusion

- F1+DRF can repeat the pulse – height spectrum correctly but need some small correction
- Detection efficiency should be considered



$$\text{F8 } R = E_0 * D(E)$$

$$\text{F1 } R = E_0$$

Correction F1

$$R = E_0 * (1 - e^{-\Sigma_t(E_0)t})$$

Future work

- DRF simulation
- Detector detection efficiency
- Well-shielded lead cave

