Discussion of the $^{52}Cr(n,n'\gamma)$ Experiment of Mihailescu et al.

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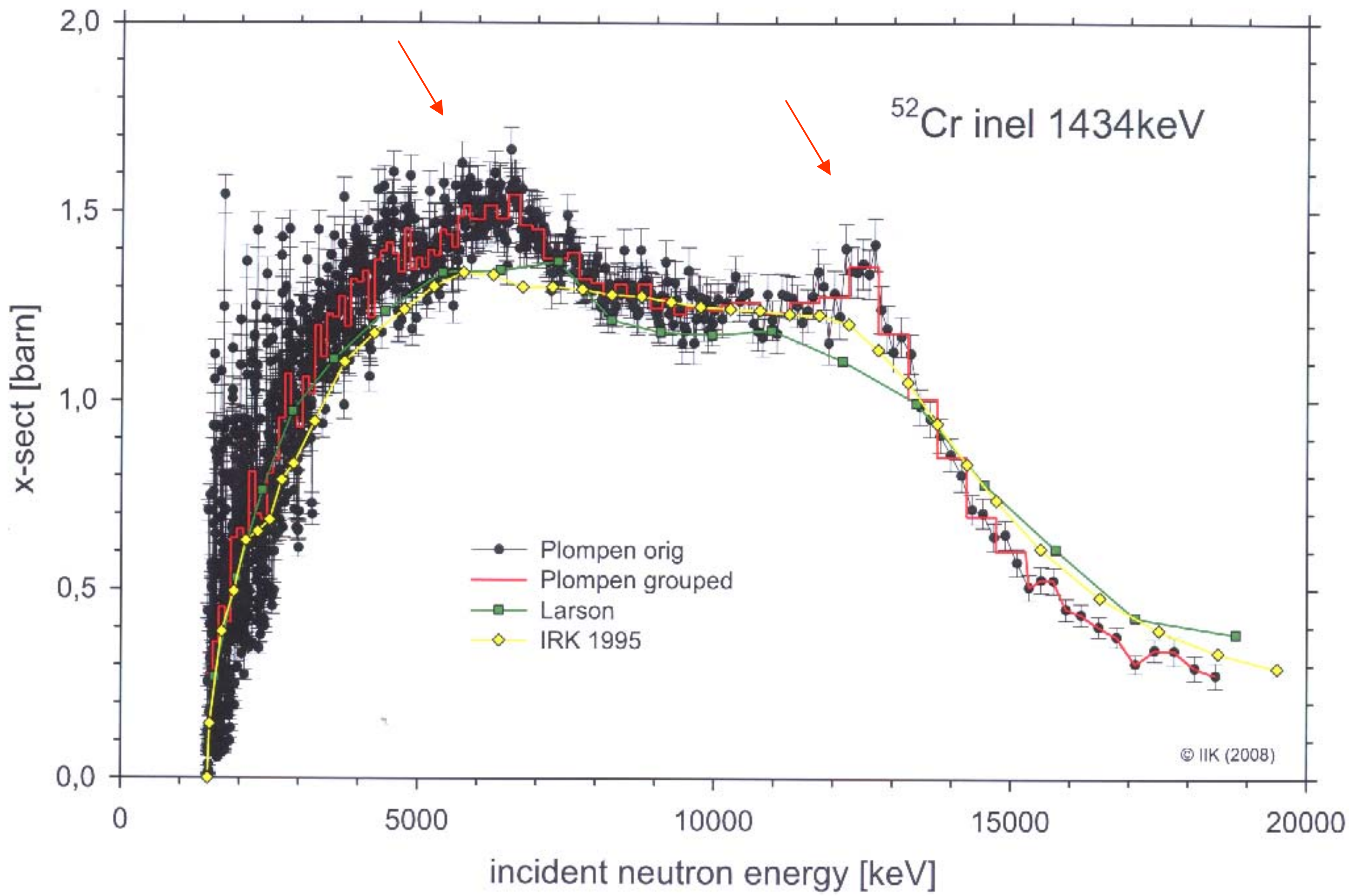
Status of the Experiment at the 2008 Consultants' Meeting



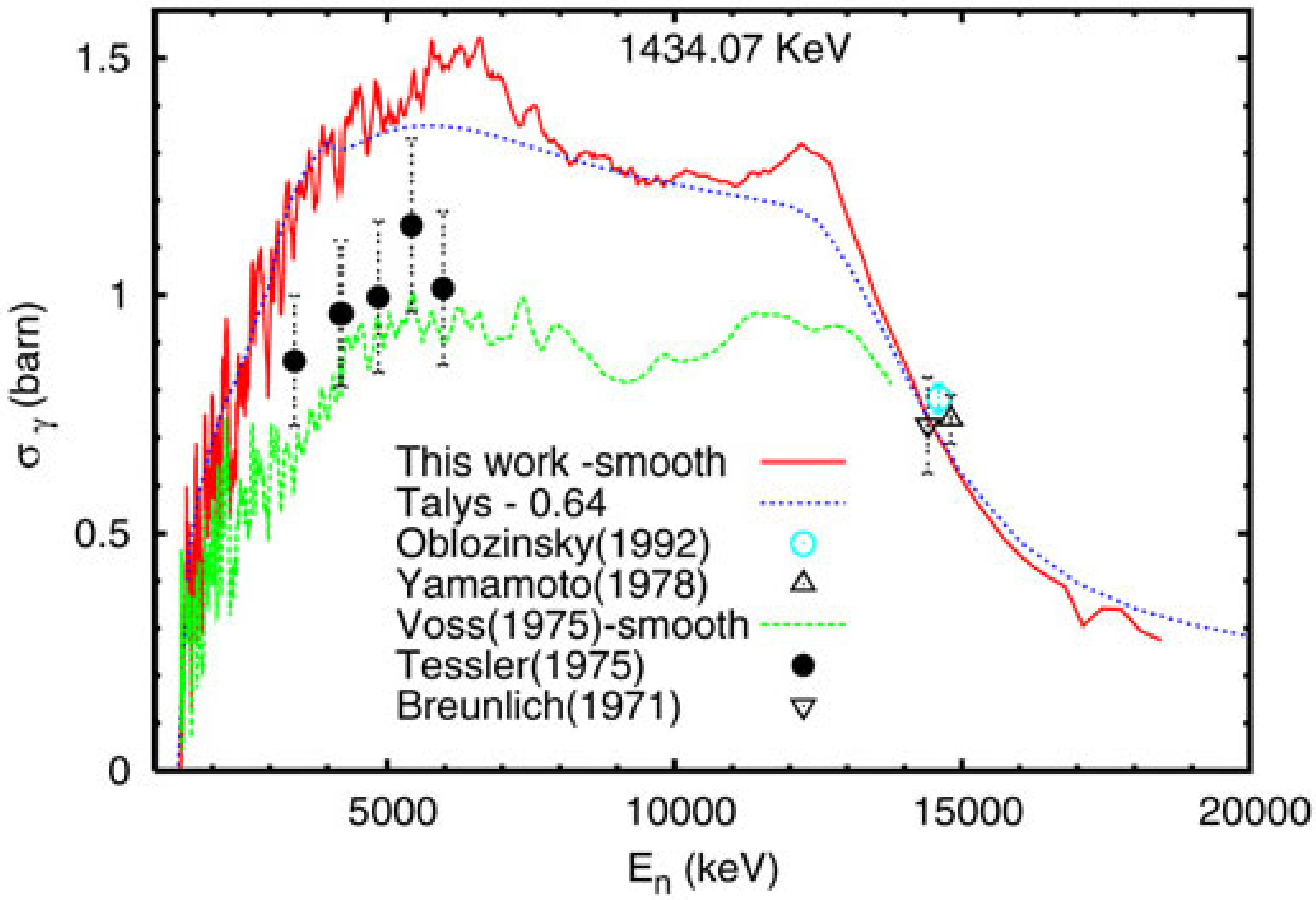
Experimental Results

- The Mihailescu (Plompen) experiment is described in Nucl. Phys. A786 1 (2007).

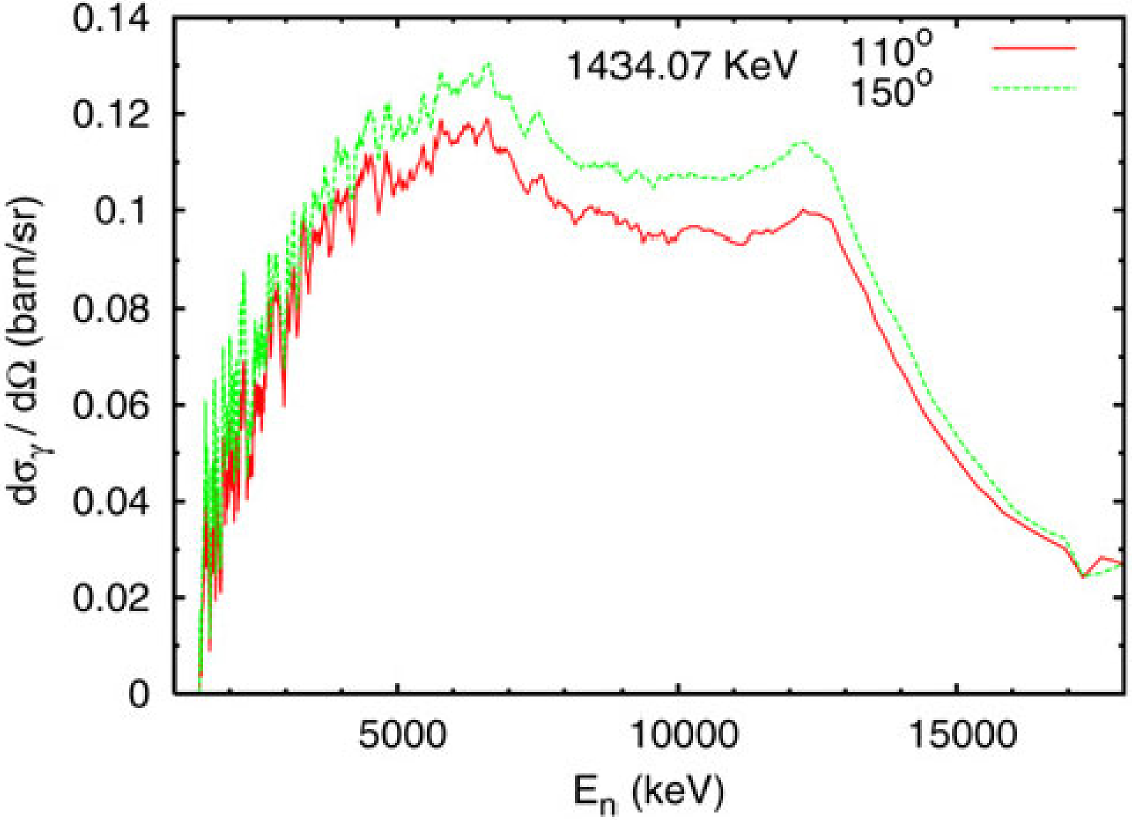
- Very important is the facility paper, NIM A531 375 (2004), where the experimental setup is given. In that paper the ^{52}Cr(n,n'γ) cross section for the 1434 keV line is given and that is the same data shown in the Nucl. Phys. Paper.

- The cross section they obtain also disagrees with TALYS calculations near 6 MeV and near 13 MeV. The TALYS results are in reasonable agreement with the IRK evaluation and the Larson experiment.

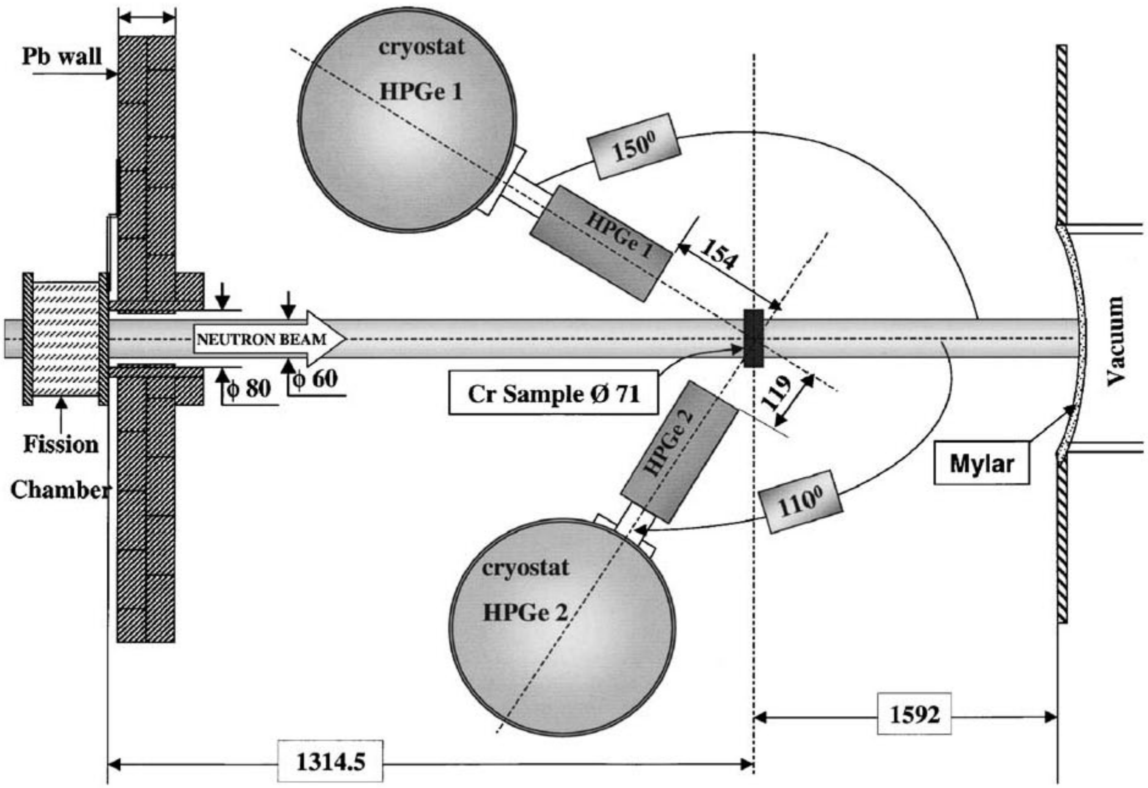
Comparison of Measurements and an Evaluation of the $^{52}Cr(n,n'\gamma)$ Cross Section for the 1434 keV gamma-ray. "This Work" is Mihailescu et al.



Comparison of the ^{52}Cr(n,n'γ) Differential Cross Section Measured by Mihailescu et al. at 110 degrees with that at 150 degrees for the 1434 keV gamma-ray.



Experimental Setup showing the Fission Chamber and the Germanium Detectors at 110 degrees and 150 degrees



Configuration of the detectors in Gelina flight path number 3 at the 200 m measurement station. The germanium detectors are placed at 150° and at 110° with respect to the beam axis. The fission chamber for the fluence normalization and a lead shielding wall are shown as well. Dimensions in mm.

Fission Chamber Details

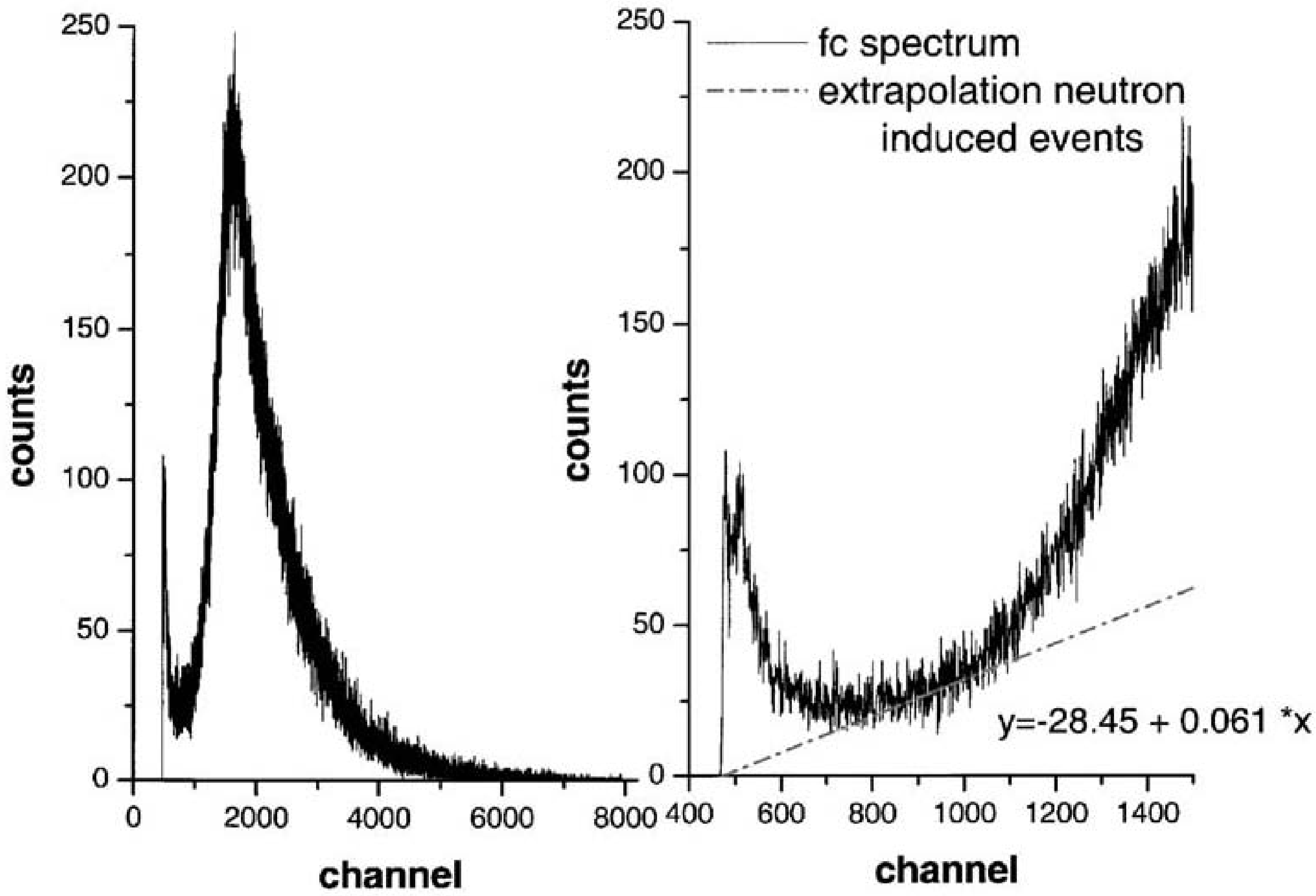
•The fission chamber used in this experiment had rather thick deposits, about 375 μg/cm^2

•This leads to poor pulse height distributions and rather large corrections for events for which the energy of a fragment is so low that it does not exceed the bias set on the recording electronics. The extrapolation to zero pulse height that was used in this experiment is a concern for this experiment

•Also a separate correction, that was not made, should be made for events for which the fragments are lost in the deposit and backing. The foil orientation they used (back to back) is worse at high neutron energies. At those energies it is best to have them oriented so the momentum carries the fragments into the counting gas. The correction for this by Gary Carlson is well established (NIM 119 97 (1974)).

In a discussion with Arjan Plompen, Ron Nelson and Allan Carlson at ND2010, Plompen agreed to look into the fission chamber efficiency calculations. He recently indicated their data should come down substantially. He plans to have the data analysis completed for the WINS Workshop in December.

Fission Chamber Pulse Height Distribution



The Angle Integrated $^{52}Cr(n,n'\gamma)$ Gamma Production Cross Section

$$\sigma(E_k) = 2\pi \sum_{i=1}^{2} w_i \frac{d\sigma}{d\Omega}(\theta_i, E_k) = \frac{t_U}{t_s} \frac{A_s}{A_U} \frac{\epsilon_{\mathrm{FC}}\, \sigma_U(E_k)}{Y_{\mathrm{FC}}(E_k)} \frac{1}{c_{\mathrm{msc}}(E_k)} \left(\frac{1}{2} \sum_{i=1}^{2} w_i \frac{Y_i(E_k)}{\epsilon_i} \right).$$

Here E_k is the neutron energy for bin k, $d\sigma/d\Omega(\theta_i, E_k)$ is the differential gamma-production cross-section, θ_i is the detector angle, $i = 1, 2$ identifies the detector, s stands for sample, U for "^{235}U", t is the material thickness and A is the atomic mass. ϵ_{FC} is the fission chamber efficiency and ϵ_i is the efficiency of the HPGe detector for the gamma ray of interest. σ_U is the ^{235}U(n, F) standard cross-section obtained from Ref. [39]. $Y_i(E_k)$ is the yield of the gamma-ray of interest, $Y_{\mathrm{FC}}(E_k)$ is the fission chamber yield, and $c_{\mathrm{msc}}(E_k)$ is the multiple scattering and neutron attenuation coefficient that is calculated with MCNP [40].

Conclusion

We can expect improvements in the quality of the Mihailescu et al. results.