I. HIGH-PRECISION AND HIGH-SENSITIVITY EXPERIMENTS

The powerful and sensitive techniques of nuclear physics can be turned to many fields. Frequently, important results can emerge. This is the case using the Advanced Photon Source at Argonne to investigate, and debunk, claims for "enhanced" decay from hafnium isomers. The ability to reliably perform such measurements remains at the heart of our program.

i.1. Search for X-Ray Induced Decay of the 31-y Isomer of ^{178}Hf

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In recent years considerable attention has focused on the published claims[1] that the 31-year isomer of ^{178}Hf can be "triggered" by subjecting it to x-rays. This possibility has been widely publicized in the media (Hf-powered aircraft,[2] and Hf-based explosives)[3] and DARPA has explored the possibility of large-scale production of the isomer. We carried out an experiment to confirm the published claims using the intense x-ray beams of the Advanced Photon Source. In the last year, the refined final analysis of these results was completed and a final paper was published.[4] This refined analysis was necessary because the original results,[1] where an enhanced decay rate was reported in the 20 - 40 keV x-ray region, was followed by reports of triggering, first at lower x-ray energies around 10 keV,[5] and by reports of new gamma-ray lines in the decay.[6] No evidence of triggering was found in any of these regions – with limits some 4 - 5 orders of magnitude below the published claims. Limits were set both for prompt triggering and for triggering that would populate a lower, 4-s, isomer as is shown in Fig. I-91. No new line was seen at a level lower than the reported value by over two orders of magnitude. This work has now been published.

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[1]C. B. Collins *et al*., Phys. Rev. Lett. **82**, 695 (1999).
[2]Popular Mechanics, May 2004, p. 98.
[3]New Scientist, August 16, 2003, p. 4.
[4] I. Ahmad *et al*., Phys. Rev. C **71** 024311 (2005).
[5]C. B. Collins *et al*., Laser Phys. **14**, 154-165 (2004).
[6]C. B. Collins *et al*., Hyperfine Int. **135**, 51 (2001).

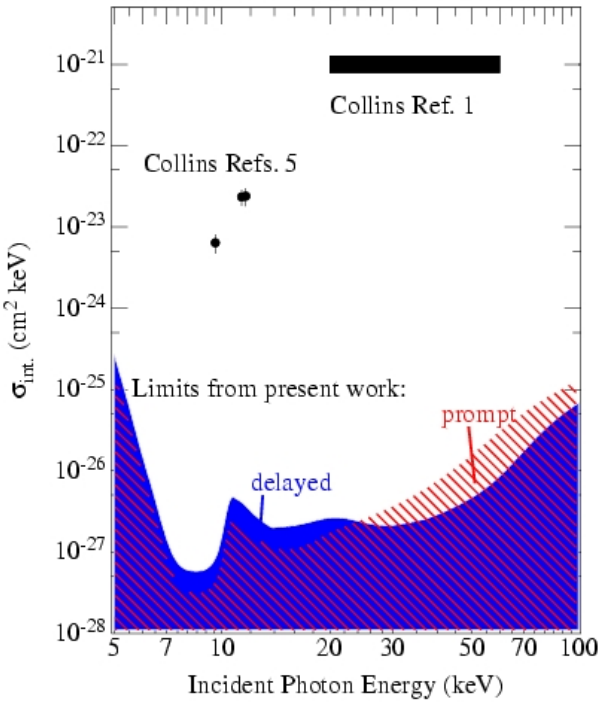

Fig. I-91. Limiting Cross sections (99% confidence limit, including systematic errors) for cross sections for enhancing the decay of the Hf isomer by x-rays. The area above the hatched regions is excluded for prompt or delayed signals, as indicated in the figure. The values corresponding to the reported levels from Refs. 1 and 5 are indicated in the figure.