

## DEVELOPMENT OF AN INTENSE, PULSED SOURCE OF COMBINED CHARACTERISTIC-GAMMA-RAYS AND NEUTRONS TO INDUCE FISSION\*

R.J. Commisso, J.W. Schumer, J.P. Apruzese, R.J. Allen, G. Cooperstein, D.D. Hinshelwood, S.L. Jackson, D. Mosher,<sup>a</sup>  
D.P. Murphy, P.F. Ottinger, D.G. Phipps, S.B. Swanekamp,<sup>a</sup>  
B.V. Weber, and F.C. Young,<sup>a</sup>

*Plasma Physics Division, Naval Research Laboratory  
Washington, DC 20375 USA*

A. Hunt, M. Gagliardi, and H. Seipel  
*Idaho Accelerator Center, Idaho State University  
Pocatello, ID 83201 USA*

The detection of fissile material by passive and active techniques is an area of intense interest. Many active approaches detect the products of fission induced by photon and/or neutron irradiation.<sup>1</sup> One such approach has focused on using intense, pulsed, beam-target interactions to produce an irradiation source of 6.13-, 6.92-, and 7.13-MeV characteristic gamma rays from the  $^{19}\text{F}(p,\alpha\gamma)^{16}\text{O}$  reaction.<sup>2,3</sup> Initially, work at NRL utilized the Gamble-II, 3- $\Omega$ , water-line generator with a pinch-reflex ion diode that accelerates ions to 2 MeV at  $\sim 0.5$ -TW peak ion power.<sup>3</sup> This pulsed source also simultaneously produces neutrons from: (1) a collective ion-acceleration mechanism associated with the diode and (2) the reactions resulting from the isotopic abundance of deuterons in the ion beam, e.g.,  $^{12}\text{C}(d,n)^{13}\text{N}$  and  $^{19}\text{F}(d,n)^{20}\text{Ne}$ . In this presentation, we review progress toward characterizing a similar mixed source using the Mercury inductive voltage adder operated in positive polarity producing  $\sim 4$ -MeV<sup>4</sup> ion energy and  $\sim 0.3$ -TW peak ion power. An array of diagnostics is used to determine the number of gamma rays and neutrons produced by the source, including a shielded scintillator-photomultiplier for the gamma-ray time history and a rhodium-activation counter to measure the total number of neutrons produced. In addition, the gamma and neutron source strengths are inferred from delayed neutrons that result from fissions in depleted uranium and that are measured using  $^3\text{He}$  and  $^6\text{Li}$  neutron detectors.

1. See manuscripts in *Nucl. Instr. and Meth. in Phys. Res. B*, vol. 261, pp. 268-378, 2007.
2. B. J. Micklich, et al. *Nucl. Instr. and Meth. in Phys. Res. A*, vol. 505, pp. 466-469, 2003.
3. J.W. Schumer, et al., Proc. 2007 IEEE Nuc. Sci, Symp. and Med. Imag. Conf. (Honolulu, HI, 2007), p. 1026.
4. P.F. Ottinger, et al., this conference.

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<sup>a</sup> L-3 Communications, Titan Group, Reston, VA