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Maximizing the Detection of Coincidence Gamma-Rays E.G. BITTLE, D.M. HERRICK, S.J. PADALINO, SUNY Geneseo, S.L. STEPHENSON COLLABORATION[1] — For measurements of high areal density in ICF implosions, a tertiary neutron diagnostic using the activation of 12C is under development. The 12C(n,2n)11C reaction occurs as a result of interactions of 12C with high energy tertiary neutrons. The consequent 11C isotope decays to 11B, emitting a positron which results in the production of two back-to-back 511 keV gamma rays upon annihilation. The coincidence detection of the two gamma rays is achieved by placing the activated 12C between a pair of NaI(Tl) scintillation detectors. The dimensions of the 12C sample influence the amount of neutron activation and the efficiency of gamma-gamma detection. To aid in the selection of appropriate 12C dimensions, the efficiency of a gamma-gamma detection system was empirically determined. A 22Na positron source was placed between two 3in x 3in NaI(Tl) detectors. The gamma-gamma detection data was collected, with and without graphite between the source and the detectors, and compared to Monte Carlo MCNPx calculations. The efficiency is found to be directly related to the intrinsic efficiency of NaI(Tl) for the detection of 511 keV gamma rays, the solid angle coverage of the detectors, the reduction in solid angle due to positron annihilation location, and gamma ray absorption in graphite. Funded in part by the US Department of Energy and the Laboratory for Laser Energetics.

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