

Design of γ - γ fast timing setup VENTURE-2.0 with CeBr₃ detectors

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ABSTRACT: The design of the γ - γ fast timing array VENTURE-2.0 is presented as an upgradation of the VENTURE array existing at Variable Energy Cyclotron Centre (VECC), Kolkata. The development will give rise to the possibility of exotic nuclear structure studies in terms of shapes, spin and isospin using γ - γ fast timing spectroscopy. The new array is aimed at measuring nuclear level lifetimes from few nanoseconds down to about few picoseconds in nuclei produced with low cross section. Nine different sizes of CeBr₃ detectors with crystal dimension (diameter (ϕ) \times thickness (t)) varying between 1 in and 2 in were considered as the possible components of the array. The Monte Carlo and electronic circuit simulations have been performed to estimate full-energy peak (FEP) detection efficiency and time resolution for these nine different sizes of detectors. The simulation was experimentally verified using available 1 in \times 1 in CeBr₃ crystals coupled to R9779 PMTs. The design of VENTURE-2.0 has been finalized to result in the best time precision of the setup that can be achieved through optimising the detection efficiency, time resolution and number of detectors in the setup. It is observed that detectors having higher surface area (ϕ 2 in.) but lower thickness (t 1 in.) is the most appropriate one for the development of VENTURE-2.0.

KEYWORDS: Detector modelling and simulations I (interaction of radiation with matter, interaction of photons with matter, interaction of hadrons with matter, etc); Gamma detectors (scintillators, CZT, HPGe, HgI etc); Timing detectors

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