ALL-OPTICAL THREE-DIMENSIONAL ELECTRON MOMENTUM IMAGING

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To achieve an efficient 3-D imaging detection of electrons/ions in coincidence, a conventional 2D imaging detector (MCP/phosphor screen) and a fast frame camera are used in the 3D velocity map imaging (VMI) technique[1, 2] . However, it is still difficult to obtain two separate TOF events for two electrons using a conventional MCP detector coupled with a photomultiplier tube (PMT). This is because the phosphor screen is usually made of P47 phosphor which has longer decay time and thus not good to achieve high temporal resolution. Furthermore, due to the very short time separation interval between two electrons, it is imperative to use different phosphor/scintillator for improved 3D electron momentum imaging. Herein, we demonstrate that a scintillator screen coated with poly-para-phenylene laser dye (Exalite 404) can be used to achieve a greatly improved TOF resolution, which is sufficienct for 3D electron imaging.. A silicon photomultiplier tube (si-PMT) is also adopted to suppress the ringing in electric signals, typically associated with MCP pick-off.. The shorter emission lifetime of the poly-paraphenylene dye compared to the conventional P47 phosphor helps achieve an unprecedented dead time (0.48 ns). This has greatly enhanced the multi-hit capability of the 3D VMI technique in detecting two or more electrons in coincidence.