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GADGET: a novel ultra-cold neutron gaseous detector for the n2EDM project

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A new ultra-cold neutron (UCN) detector is required for the n2EDM experiment since the previous ^{6}Li-doped glass scintillator (NANOSC) model, used in the nEDM experiment, is constrained by its small size and high price (\textcolor{red}. Hence, the authors propose a novel detector (GADGET) composed of a chamber filled with ^{3}He and CF_4 gases, and three perpendicular photo-multiplier tubes coupled to it. In order to access the optimal gas pressures, two experiments, one at the Paul Scherrer Institute with a pulsed UCN beam, and the other at the Mainz's TRIGA reactor with constant UCN flux, were carried out. As a result, under conditions of 400 mbar for CF_4 and 25 mbar for ^{3}He, a relatively higher detection efficiency (twice the one of a Cascade detector) and a great background suppression (estimated in a 2\% of the total counts at PSI) were achieved. In addition, to further improve the light emission properties of GADGET, tests with new customized photo-multiplier tubes, thinner entrance foils and higher transmittance chamber windows are also discussed.

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