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^{4}He+γ cross sections for astrophysical interest

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Roles of the neutrino-induced nuclear reactions of ^{4}He in supernova explosions and rapid process (r-process) of stellar nucleosynthesis are current issues in nuclear astrophysics. Recent theoretical studies of the supernova explosions suggest a critical role of the neutrino-inelastic scattering on ^{4}He in energy transport by outgoing shock wave. The neutrino-inelastic scattering on ^{4}He is considered to be also important for productions of ^{7}Li via r-process in neutrino-driven wind of supernovae. To study the roles of the neutrinos in supernova explosions, one needs information about response of ^{4}He nucleus to neutrino-inelastic scattering in the excitation energy range of 20$\sim$40 MeV, which corresponds to the energies of the neutrinos emitted from supernovae. Photonuclear reactions of ^{4}He in the giant dipole resonance (GDR) region is a unique tool to study the nuclear response of ^{4}He, since the electromagnetic transitions are direct analogs of the neutrino transitions by weak neutral current. However, there has been a large discrepancy between the existing data of the photonuclear reactions of ^{4}He in the GDR region. Therefore we have performed a new measurement of the photodisintegration cross sections of ^{4}He in the energy range from 21.8 to 29.8 MeV using laser-Compton backscattered photons and a time projection chamber containing ^{4}He gas as an active target. The obtained cross sections increase monotonically with energy up to 29.8 MeV, contrary to a recent calculation by the Lorentz integral transform method. Most recently, a coupled-channel calculation including the tensor force has been performed, and the calculated values are in excellent agreement with the present experimental ones. In this paper the present result will be compared to recent theoretical calculations, and its astrophysical implications will be discussed.