High-resolution Spectroscopy for Photo-absorption Cross Sections using HHS and LCP

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Fine structures in photonuclear reactions are important quantities for the investigation of the innovative applications of photonuclear reactions because the photonuclear cross sections of some special states are expected to have huge values that are comparable to the photo-atomic cross sections. However, very little is known about the fine structures neither experimentally nor theoretically.

Nuclear photoabsorption (NPA) spectroscopic method is an ideal tool to investigate photonuclear reactions. The measurement gives the cross section of the total photonuclear reaction that is the sum of all the at-induced reaction channels. The NaI scintillation spectrometer, LD_2/TOF spectrometer or the magnetic spectrometer has been applied for the photon absorption measurements.[1,2,3] However, the energy resolving power of these spectrometers were about a few percent, and were not enough to investigate fine structures in photonuclear reactions.

Recent progress on Ge detector fabrication technologies makes it possible to develop a high-resolution high-energy photon spectrometer (HHS)[4] (Fig. 1) with an excellent energy resolution of about 0.1% for high-energy photons, typically 10-30 MeV, with which NPA method can achieve a high resolution. As a result the fine structure in photonuclear reaction can be studied up to about 30 MeV.

The beam of laser Compton photon (LCP)[5] is now strong enough to be used in NPA experiments. The use of LCP overcomes the inherent disadvantage of the use of bremsstrahlung, that is, its high background, especially at the low energy side. The low energy tail of the LCP beam is cut off with a collimator since the energy of LCP is determined by LCP's scattering angle.

The experimental technique of NPA using HHS and LCP has been developed for several years,[6] and recently the energy resolving power of 0.1% has been successfully demonstrated.[7] The progress of the new spectroscopic method was briefly reviewed.

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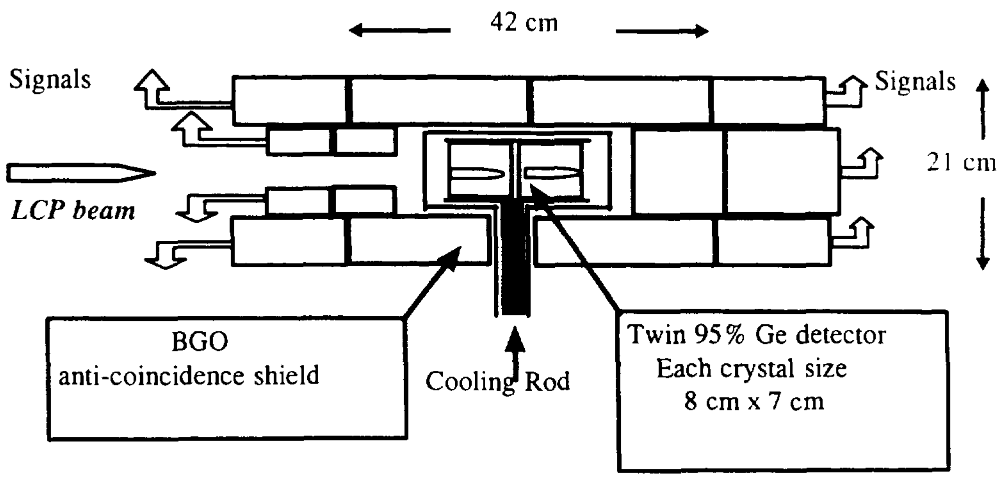

Fig. 1 A schematic representation of the High-energy Photon Spectrometer.

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