Development of a Spectrometer for Multiple Prompt Gamma-Ray Measurement to Identify Nuclear Levels*

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Neutron capture cross sections have been measured for light-water reactor safety, radiation shielding, calculation of nuclear fuel cycle, and so on. These data have been well accumulated. In recent years, however, it has become insufficient for realizing new technologies such as new reactor concepts, nuclear transmutation, and so on. Because these technologies have to have high stability and safety, new neutron capture cross sections and higher accuracy are needed.

To measure neutron capture cross sections with gamma-ray detection, there are two typical methods. One is measurements of decay gamma rays from activated sample and the other is measurements of prompt gamma-ray. The former method can be used only if nuclide produced is radioactive and have relatively long half-life. On the other hand, the latter method can be used for almost all nuclides because nuclides produced emit prompt gamma-ray. There are a few ways to determine neutron capture cross section in prompt gamma-ray measurements. Among all, identification of ground-state transition gamma rays is a powerful method. Accuracy of this method strongly depends on completeness of excited level structures that are connected to the ground-state. However, such information is insufficient in almost all nuclides.

Therefore, to determine the level structure below the neutron capture state, we developed a gamma-ray spectrometer for prompt gamma-ray measurements. We will report on its efficiency and S/N ratio performance, i.e. abilities of determination of new levels, and show an example of nuclear level determination at the conference.

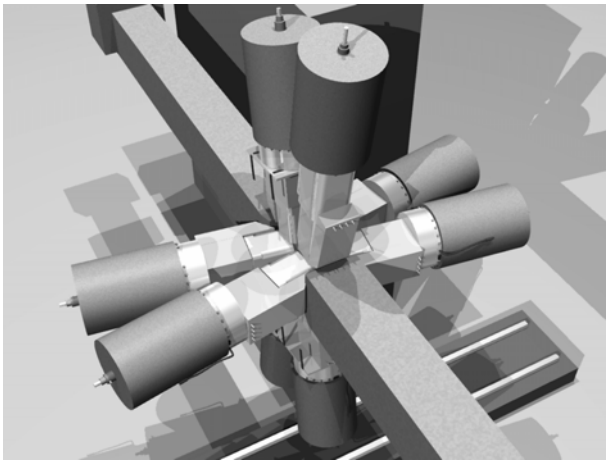

Figure 1: A schematic view of the spectrometer.

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