

Nuclear resonant scattering by the nuclei with high transition energy

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The nuclei which have been excited by the synchrotron radiation so far are restricted to ^{57}Fe , ^{169}Tm , ^{119}Sn , ^{83}Kr , ^{181}Ta , ^{151}Eu and ^{161}Dy whose transition energies are below 26 keV and they are excited to the first excited state in any case. More than 30 kinds of Mössbauer nuclei exist when the excited energies are allowed up to 80 keV. The nuclear resonant scattering with high transition energies will be studied in the large synchrotron facilities whose electron beam energies are so high that they produce high X-ray flux at the higher X-ray energy.

The cascade decay of ^{161}Dy from third excited state via first one excited by the synchrotron radiation whose energy was 75 keV has been observed for the first time. The scheme of cascade decay is shown in Fig. 1. The sample was $^{161}\text{Dy}_2\text{O}_3$ and before the sample the Al absorber was arranged to eliminate the first harmonics from the Si 111 monochromator and APD detector was used as shown in Fig. 2. The peak profile of the time delayed photon after the prompt pulse can be obtained when the X-ray energy through the monochromator coincides with the third transition energy of ^{161}Dy . The possibility that it was excited to the first excited state

whose energy is 26 keV was denied by the delayed count rates dependence by the Al absorber thickness. Time spectra were measured on the condition that the incident X-ray was on resonance and off resonance as shown in Fig. 3. It showed the decay profile with its half life time of 33 nsec.

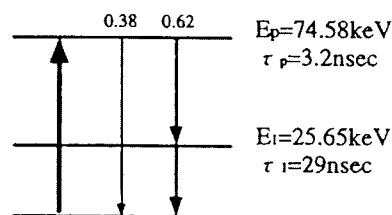


Fig. 1 The energy state of ^{161}Dy .

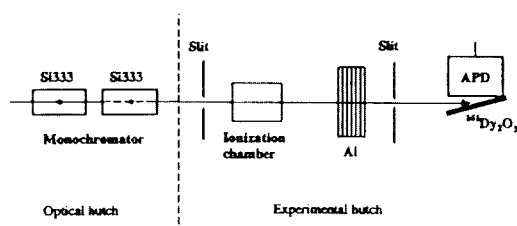


Fig. 2 The experimental setup of cascade decay of ^{161}Dy excited by SR.

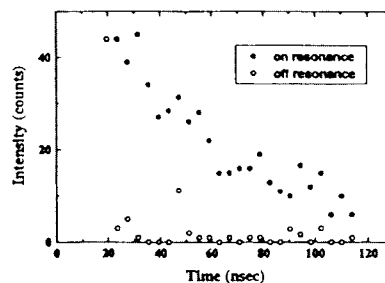


Fig. 3 Time spectra of the cascade decay.