Investigation of isoscalar and isovector dipole excitations in ^{20}O

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The electric dipole excitation is one of the most basic properties of atomic nuclei. Neutron-rich nuclei are predicted to have exotic electric dipole excitations owing to their small neutron separation energy and excess neutrons. One example of such excitations in neutron-rich nuclei is the low-energy dipole excitations found at excitation energies less than 10 MeV. Recent experimental studies on stable nuclei revealed that some low-energy dipole excitations show specific isospin character[1] called isospin splitting. In order to study the isospin properties of low-energy dipole excitations in neutron-rich oxygen isotopes, we performed an experiment at RIBF and measured the dipole resonances of the neutron-rich nucleus ^{20}O. The beam was produced via projectile fragmentation of a 345-MeV/nucleon ^{48}Ca beam on ^{9}Be target with a thickness of 2.8 g/cm^2. Two secondary targets, a 5-g/cm^2-thick gold target for coulomb excitation and a 300 mg/cm^2 thick liquid helium target for inelastic α-particle scattering, were used to obtain the isovector and isoscaler dipole strengths independently. The γ rays from the excited beam particles were detected with large volume $LaBr_3$ crystals from INFN Milano[2] in combination with DALI2[3]. A preliminary doppler-corrected γ-ray spectrum of the $\alpha(^{20}O,^{20}O\gamma)$ reaction is shown in Fig. 1 (a), and the spectrum of $Au(^{20}O,^{20}O\gamma)$ reaction is shown in Fig. 1 (b). Preliminary fits are presented by red solid lines, and two 1^- states are identified. A clear difference is observed between the two spectra. This suggests that the Coulomb excitation and inelastic α-particle scattering have different sensitivities to the isospin and are actually effective to determine the isovector and isoscalar strength. Further analysis using the distorted-wave Born approximation is in progress to determine the isovector and isoscalar strengths of the observed low-energy dipole excitations.

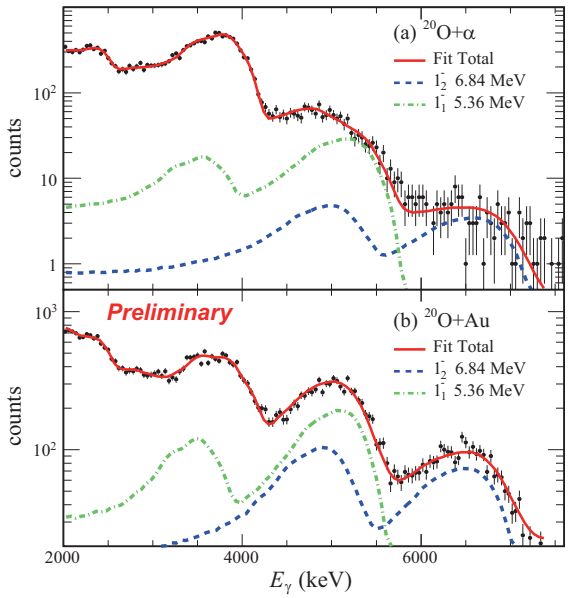

Fig. 1. Preliminary fits of Doppler-corrected γ ray spectra: ^{20}O+α (top panel) and ^{20}O+Au (bottom panel).

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