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STRUCTURAL YIELDS AND ASPECTS OF ISOMER IN DEEP-INELASTIC COLLISIONS

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Structural yields and features in the meta-stable states of nuclei from the projectile like fragments of 8.36 MeV ^{76}Ge in ^{198}Pt target are reported. The dynamic features of deep inelastic collisions (DICs) are studied by dissipation energy versus transfer of nucleons. We have studied the yields as a function of excitation levels. The structural appears do not depend on the excitation energy of isomers persuaded in the DICs. This is in dissimilarity to the protuberant physical landscapes establishing in population yield of isotopes which disappear with Gaussian distribution.

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INTRODUCTION

Study of the isomer-yield of neutron rich nuclei is very important since such systems study the implication on astrophysical problems like the solar abundance etc. as well as the method in approaching neutron rich systems. Understanding nuclei far from stability is crucial for resolving important questions in nuclear astrophysics. For example, it is through the reactions and decays of exotic neutron rich nuclei that most heavy elements were synthesized in the astrophysical r-process. The perceived site of the r-process in supernova explosion intimately connects the associated neutrino physics to the possessions of nuclei faraway from stability. A detailed understanding of this synthesis and the environments where it happens critically depends on knowing the structure, shapes and binding energies of nuclei far stability [1, 2].

Nuclear construction manifest themself in various landscapes, which are extensively examined, e.g. in ground-state assets similar half-life, binding energy, shape and radius. Methodical measurements of the whole nuclear response yield of reaction have been a vital instrument in the education of neutron rich nuclei. The nuclear assembly was established in the manufacture yields in fragmentation and deep inelastic responses, which can be fairly fierce and are predictable to present a huge quantity of excitation energy in the nucleus [3-5].

Deep-inelastic reactions (DICs) occur individually in crashes between two multifaceted nuclei comprising significant statistics of nucleons. It is known that usually neutron rich nuclei are not created through fusion and proton rich nuclei are created by fusion reactions. Neutron rich nuclei might be formed through fragmentation or fission reactions. DICs are an efficient means to observe neutron rich nuclei. DIC has excellent advantage for provide verities combination of the projectile-target that creates neutron rich nuclei offered for γ-ray measurement. In the current mini review report, I present on the creation yields from the reactions of ^{76}G (635 MeV) and ^{198}Pt. The γ-ray of outgoing nuclei was recognized with the excellent equipment isomer-scope [3-7], and their yields were deduced. Islands of isomers were observed around ^{68}Ni [6-8]. We have demonstrated the study of complex isomers yield phenomena revealed with excitation energy and dynamic features of the ^{76}Ge (635 MeV) + ^{198}Pt deep-inelastic reactions.

1. METHODOLOGY

The experiments for measuring in-beam γ-rays spectroscopy from meta-stable states of nuclei were performed at the Japan Atomic Energy Agency (JAEA) Tokai-mura, Ibaraki using tandem and booster equipment [5]. A 0.957 enhanced ^{198}Pt target, and $4.3\cdot10^{-3}$ gm/cm^2 thick, was blasted with typically beams 4 nA of ^{76}Ge (635 MeV). The output signal of tandem booster was measured by an isomer-scope [6]. The projectile like fragments (PLFs) were detected by an annular type of Si detector located 55 mm away from the target. The Si detector covers the scattering angles 21…35° along the beam direction. The Si detector measured the energy of PLFs and gives the timing evidence for PLF-γ happenstance events. Five Germanium detectors were used around the Si detector to measure γ-rays from PLFs. The efficiency of Ge detector is 0.30. To get the delay time of PLF-γ coincidence a TPHC/SCA (time to pulse height converter and Single Channel Analyzer) was used between Ge and Si detector. The twitch and stopover signal of TPHC was detected by Germanium and Silicon detector respectively. The time range of TPHC was 2 μs. The high-quality PLFs-γ coincidence data were recorded during the bombardment of the ^{198}Pt target with ^{76}Ge beam to extract the spectroscopic information on isomers. The details of the experiments are presented in ref. [6, 7].

2. RESULTS AND DISCUSSION

2.1. POPULATION OF YIELD ISOMERS

We identified 25 meta-stable states of lifetime ns-μs in ^{76}Ge (635 MeV) + ^{198}Pt deep-inelastic collisions [3-7]. The relative production yields for selected nuclei were estimated from γ-γ data as well as single γ-ray data by correction efficiency and branching ratio. Fig. 1 shows the yield for individual nuclei produced in ^{76}Ge (635 MeV) + ^{198}Pt DICs. The sequence along the vertical indicates the yields of populated projectile fragments from ^{61}Fe to ^{90}Zr isomer. The relative yields of metastable states of nuclei are normalized to the yield of ^{70}Ga to 100 and the corresponding yields are indicated with a bar for respective projectile like fragments. We have observed that the distribution of population yields for the isomers; do not fit by a Gaussian function. The maximum yield is 100(4) for ^{70}Ga, but there is no co-relation between yields with population fragments of both sides of the isomers of ^{70}Ga. The production cross sections of the observed fragments reveal a complex structure. For examples the yields of ^{68}Ga, ^{69}Cu, ^{71}Cu, and ^{72}As are very small even those are exited near to maximum yield ^{70}Ga. The population yield of isomers largely deviated from Gaussian distribution which is controversial to prominent structural features found in isotope.

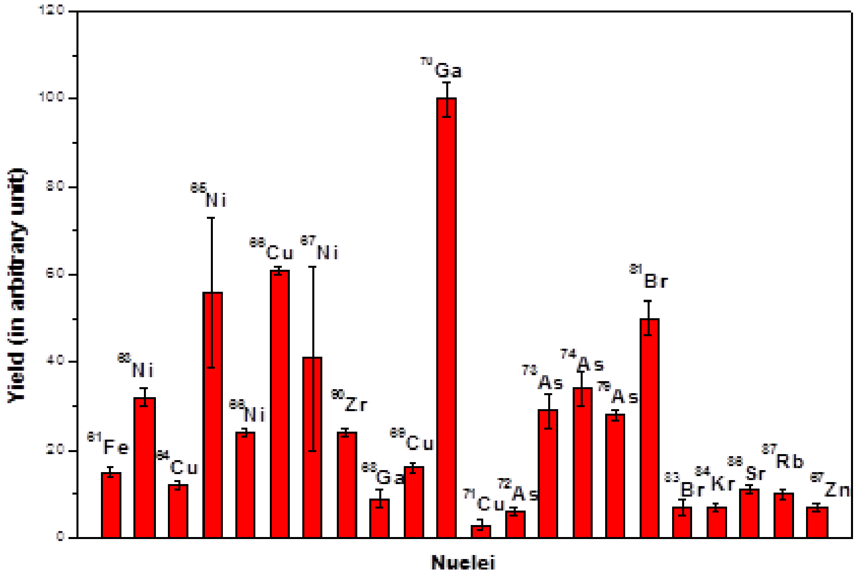

Fig. 1. Population yield of isomers plotted as a function of nuclei

2.2. YIELD DEPENDENCE ON EXCITATION LEVELS

We have observed the isomeric yields dependence on excitation levels are shown in Fig. 2. The points with error bar along y axis indicate yields corresponding to the populated isomers. Enhanced production yield of isomer are observed at lower excitation level. Most of those are found at below 1500 MeV. Usually in case of γ-rays transition, side feeding γ-rays is less at higher level compare to lower level. Therefore yields at lower excitation are reasonable strong. For examples the relative yield of isomers are indicated in the bracket: ^{70}Ga (100), ^{81}Br (50), ^{65}Ni (56), ^{66}Cu (41) etc. But yields of some isomers are weaker at lower level. This is not surprising, because maximum prominent structures of the observed yields of the reaction were replicated by means of well-established but somewhat diagram explanations of pairing in binding energies and level densities. Moreover we measured isomers only not prompt events, therefore the structure seems to be insensitive to the excitation energy.

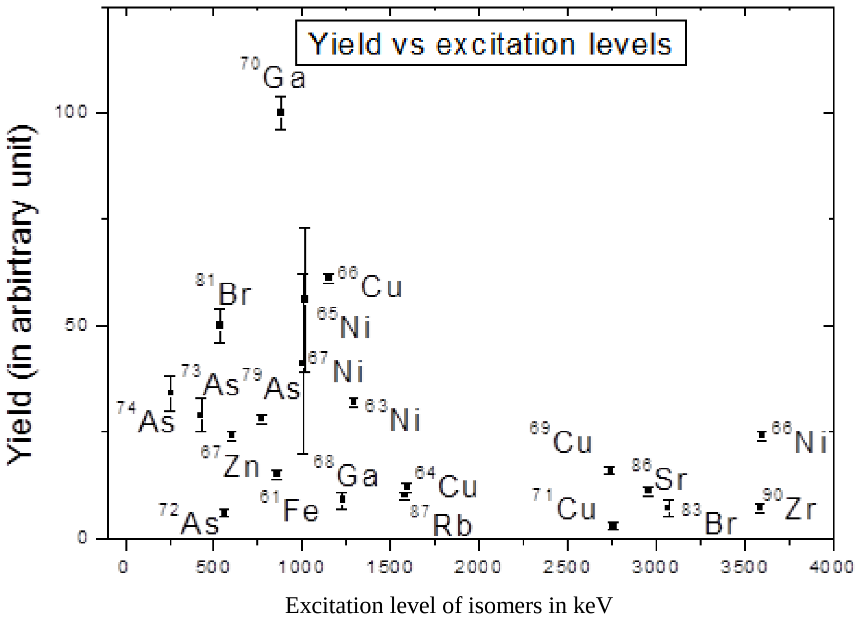

Fig. 2. Yields dependence on excitation levels

2.3. DISSIPATION ENERGY AND TRANSFER OF NUCLEONS

One of the significance chapters of deep-inelastic collisions (DIC) is correlation between transfers of nucleons with energy dissipation of the fragments. In DIC the full dissipation of dynamic energy grosses place and a comparatively prolonged DNS is produced. All through this one lifetime have the DNS achieves to go a substantial angle, and DIC yields are released in the district of negative angles. The creation energy is measured by the departure of Coulomb barriers. Multi-nucleon transmission may happen in DIC involving DNS creation. The transfer of a significant number of protons and neutron requires lengthy interaction between the projectile and target.

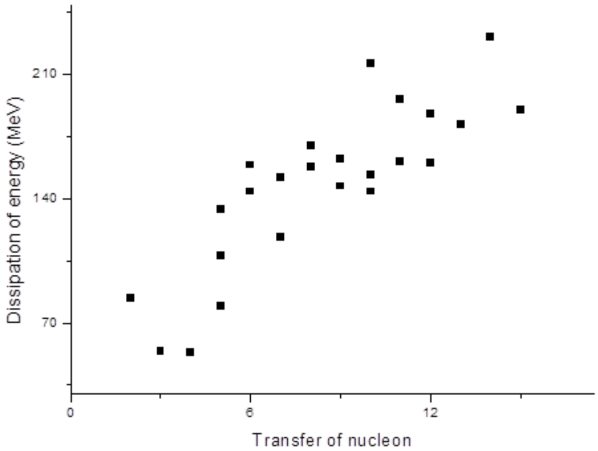

Fig. 3. Dissipation energy versus transfer of nucleons

It indicates the dynamic features of deep-inelastic collisions. In DIC, a great number of exit channel are exposed, and many isotopes are produced as response of products. When the projectile incidence on a target in DICs, a large amount of energy dissipate due to friction between projectile and target and at the same time large number of nucleons exchange between projectile and target. It is important to investigate the dependence of the dynamic features of fragments energies as well as transfer of nucleons. Fig. 3 shows dissipation energy as a function of transfer of nucleons. The figure shows that when the dissipation energy is increased, the transfer nucleon is also increased. The information is a consequence of high nuclear viscidness that demonstrates themself in the situation of nuclear relative motion with a huge overlay of nuclear exteriors and a small compressibility of soaked nuclear substance. Great nuclear friction clues to the intense dissipation of moving energy which removals into excitation of the arrangement. The angular momentum of the DNS spreads a considerable value, the rotational energy of the DNS product energy is waged by DNS distortion. On lesser nuclei, the character of the revolving energy nevertheless rises abruptly.

CONCLUSIONS

We have demonstrated the complex structural yields of isomer produced in projectile ^{76}Ge incident on target ^{198}Pt. The yields of overall isomers are largely deviated from Gaussian shape. The yields dependence of isomers on excitation levels was investigated. The dissipation energy as a function of transfer of nucleons is increased in deep-inelastic collisions.

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СТРУКТУРНІ ВИХОДИ І АСПЕКТИ ІЗОМЕРУ ПРИ ГЛИБОКОНЕПРУЖНИХ ЗІТКНЕННЯХ

I. Hossain

Приведені структурні виходи і особливості в метастабільних станах ядер снарядоподібних фрагментів ^{76}Ge з енергією 8,36 МеВ у ^{198}Pt-мишени. Динамічні особливості глибоконепружних зіткнень (ГНЗ) досліджуються по залежності енергії дисипації від перенесення нуклонів. Вивчені виходи залежно від рівнів збудження. Структурні прояви не залежать від енергії збудження ізомерів, що знаходяться в ГНЗ. Це не схоже на фізичні опуклості, що встановлюють у популяції вихід ізотопів, які зникають з розподілом Гауса.

СТРУКТУРНЫЕ ВЫХОДЫ И АСПЕКТЫ ИЗОМЕРА ПРИ ГЛУБОКОНЕУПРУГИХ СТОЛКНОВЕНИЯХ

I. Hossain

Приведены структурные выходы и особенности в метастабильных состояниях ядер снарядоподобных фрагментов ^{76}Ge с энергией 8,36 МэВ в ^{198}Pt-мишени. Динамические особенности глубоконеупругих столкновений (ГНС) исследуются по зависимости энергии диссипации от переноса нуклонов. Изучены выходы в зависимости от уровней возбуждения. Структурные проявления не зависят от энергии возбуждения изомеров, находящихся в ГНС. Это не похоже на физические выступы, устанавливающие в популяции выход изотопов, которые исчезают с гауссовым распределением.