IDENTIFICATION OF ISOMERIC STATES 'SOUTH' OF ^{208}Pb VIA PROJECTILE FRAGMENTATION*

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Relativistic fragmentation of ^{208}Pb has been used to produce excited states in neutron-rich nuclei with $N \approx 126$. Spectroscopic information for a range of nuclei has been obtained through observing delayed γ-ray emissions from isomeric states. Preliminary results for ^{203,204}Pt nuclei are presented. For the first time, excited states have been observed in ^{203}Pt and ^{204}Pt. The yrast structure of ^{204}Pt up to spin-parity, $I^{\pi} = (10^{+})$ has been tentatively inferred from the internal decay of two isomeric states.

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1. Introduction

The Rare Isotopes Investigations at GSI (RISING) project has begun the Stopped Beam phase of experiments [1]; reported here are the first results from one of these measurements. Rare, exotic, neutron-rich nuclei in the vicinity of $N = 126$ were produced in the relativistic projectile fragmentation of a ^{208}Pb beam.

A number of $N \approx 126$ nuclei were produced during the fragmentation process. These present an ideal testing ground for the shell model, because of the limited number of valence nucleons involved in forming the low lying, yrast and near yrast excited states in these nuclei. The analysis of such states permits the extraction of information on the single-particle energies and residual shell-model interactions in this region.

2. Experimental details and results

The 1 GeV/nucleon ^{208}Pb beam, provided by the SIS-18 accelerator at GSI, was fragmented on a beryllium target (thickness 2.5 g/cm^2). The FRagment Separator (FRS) [2], operated in standard achromatic mode, was used to separate and identify the desired nuclei (see Fig 1). Once identified, nuclei were brought to a halt in a 7 mm plastic stopper. The delayed γ rays were detected over a 100 μs time range after implantation using the high efficiency RISING array [1], which, in its Stopped Beam configuration, surrounded the implantation target.

Delayed γ-ray spectra associated with ^{202,203,204}Pt are shown in Fig. 2. The observation of the previously identified isomeric state in ^{202}Pt [3] confirms the particle identification. Gamma rays belonging to ^{203}Pt and ^{204}Pt have been seen for the first time in this experiment. The ground state of ^{203}Pt was previously identified in projectile fragmentation at GSI [5], but the isomer in ^{203}Pt represents the first spectroscopic information on this $N = 125$ nucleus. Similarly, this is the first observation of excited states in ^{204}Pt; transitions from two isomeric states have been observed, with three γ rays (96, 1061, 1158 keV) originating from a shorter lived metastable state and two γ rays (872, 1123 keV) originating from a lower-lying, longer-lived isomer.

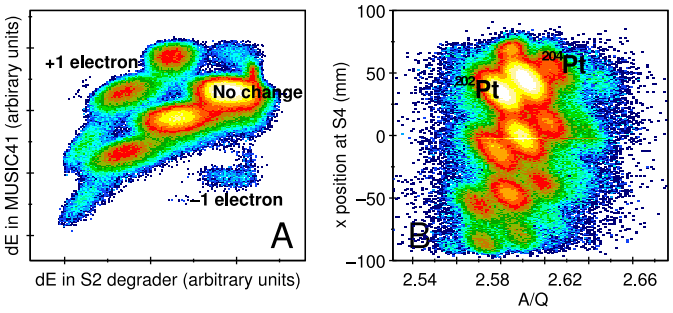

Fig. 1. Fragment identification. (A) Energy loss at the middle focal plane *versus* energy loss at the final focal plane. Charge state changes are distinguished here, allowing selection between nuclei that undergo no change, the loss of or gaining of an electron in the S2 achromatic degrader. (B) A/Q *versus* S4 position tangential to the beam direction. Only $\Delta Q = 0$ nuclei are plotted. Locations of the previously observed ^{202}Pt [3] and the newly identified ^{204}Pt nuclei are highlighted.

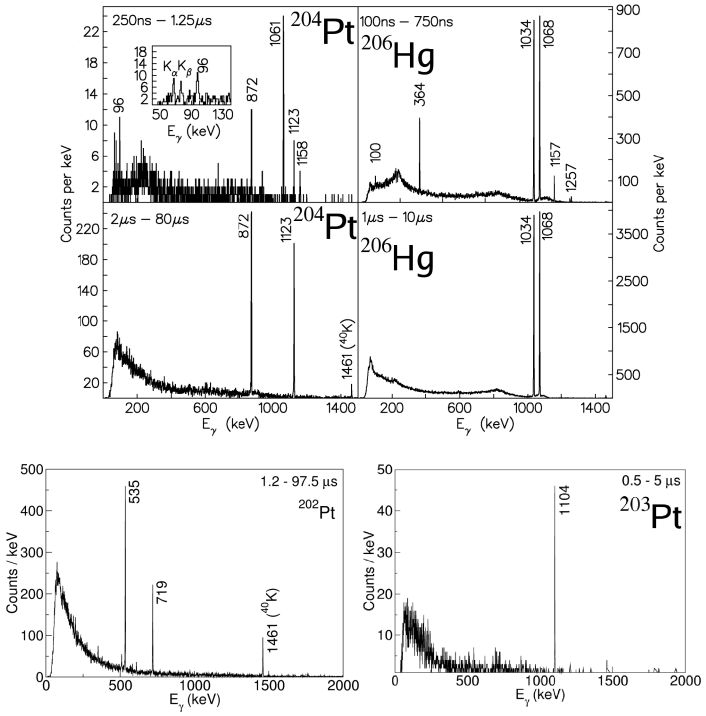

Fig. 2. Delayed γ-ray spectra associated with ^{202,203,204}Pt and ^{206}Hg. Note that the non-physical background suppression of low energy γ rays (up to ∼300 keV) is a result of data analysis techniques. Similar γ-ray spectra are observed for ^{206}Hg and ^{204}Pt, which exhibit 2-proton hole and 4-proton hole structures, respectively.

In producing ^{204}Pt four protons are removed from doubly closed shell ^{208}Pb. Like ^{206}Hg, ^{204}Pt has two isomeric states (see Fig. 2). The higher lying isomer in both cases is expected to be of a $(\pi_{h_{\frac{11}{2}}})^{-2}_{10^+}$ character [4]. This structure is associated with seniority two proton–hole states in the $Z = 82$ shell closure. A more detailed interpretation will be the subject of a future publication.

In conclusion, new spectroscopic information has been obtained on a range of heavy, neutron-rich nuclei, populated in relativistic energy projectile fragmentation. For the first time, excited states in $N = 125$ ^{203}Pt and the $N = 126$ ^{204}Pt have been presented, including the identification of three isomeric states.

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