SPIN-ORIENTED PROJECTILE FRAGMENTS: THE FIRST APPLICATION TO \( g \)-FACTOR MEASUREMENTS

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Ejectile nuclei in the fragmentation of intermediate-energy heavy-ion projectiles were found to be largely spin polarized. The observed polarization as a function of the outgoing momentum was nicely explained by a simple kinematical argument based on the participant-spectator model of projectile fragmentation. The measurements extended to cover several different targets, incident energies, exit channels, and emission angles revealed that substantial polarization shows up widely in projectile fragmentation reactions. Furthermore, this polarization exhibits an interesting behavior which may be interpreted as a manifestation of a gradual change in the deflection angle from positive to negative values as the energy increases and/or the target-Z decreases. The present polarization results also suggest various applications of spin polarized radioactive beams. As the first example of such an application, we present a recent result on the \( g \)-factor measurements on neutron-rich nuclei.

1. INTRODUCTION

The technique of nuclear orientation has been applied to a wide range of nuclei extending to those far from stability, and has made numerous important contributions in nuclear physics, condensed matter physics, and fundamental interaction studies. Recently the field of nuclear physics has made remarkable progress benefiting from a new method of isotope production which uses the projectile fragmentation reaction induced by high- and intermediate-energy heavy-ion beams. This type of reaction shows remarkable characteristics which are useful as a means to produce nuclei far from stability. The cross sections for isotope production in the reaction reach large values even in the region of nuclei which are otherwise almost impossible to study. The productivity is enhanced by the fact that a thick target can be used at these energies. Furthermore, the products are emitted from the target in sharply focused angular and velocity ranges.

In this report we discuss the spin polarization of such nuclei which have become accessible by use of the projectile fragmentation reaction. One might think of several methods to obtain polarized unstable nuclei, but they suffer from various limitations. For example the tilted foil technique has been applied but the magnitude of polarization so far attained for the projectile fragments are not large. The inherent difficulty here comes from the conflict between the low energy character of the atomic phenomenon on which the technique is based and the high energy character of the reaction used to produce the isotopes. The most straightforward method of polarization is to use the reaction process itself. Whether the projectile fragmentation itself can produce spin polarized nuclei or not, is thus an intriguing question.

At first glance at models proposed to describe the projectile fragmentation reaction /1-3/, however, the situation looks rather pessimistic: these models are commonly based on the assumption that what one observes as a projectile fragment is the "spectator" portion of the projectile...
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