Light proton drip-line nuclei studied using a secondary-fragmentation reaction at GSI.

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A recent experiment at the GSI laboratory used the secondary-fragmentation technique to populate light nuclei approaching the proton drip-line. The experiment focussed on the first observation of the yrast structure of the $T_z = -3/2$ nucleus ^{53}Ni so that the Coulomb energy differences between it and its $T_z = 3/2$ mirror partner ^{53}Mn could be studied. The study of such exotic neutron deficient nuclei has proved extremely difficult using fusion-evaporation reactions with stable beams and targets. This experiment utilised a double fragmentation reaction at high energy and velocity to produce the nuclei of interest. Gamma decays from the secondary fragments were measured in the RISING detectors and the fragments identified down-stream in a Si (ΔE) and CsI scintillator (E) detector combination. Using a primary beam of ^{58}Ni, beam fragments of ^{55}Ni and ^{55}Co were selected for secondary fragmentation. With this technique the exotic nuclei of interest are produced with appreciable cross sections and with reasonable angular momenta. Online spectra for selected ^{54}Ni nuclei clearly showed $4_1^+ \rightarrow 2_1^+$ and $2_1^+ \rightarrow 0_1^+$ transitions.

The double-fragmentation reaction populated states not only in ^{53}Ni but in a whole range of nuclei all the way down to isotopes of carbon. The production intensity of these nuclei will provide a stringent test of the EPAX fragmentation calculations for this mass region and information on the ability to produce proton-rich nuclei using this reaction method. The complicated experimental setup with the numerous detection systems recording data on three separate streams coupled with the fact that the fragments of interest are traveling at approximately 50% of the speed of light has meant new and careful analysis techniques have had to be employed. A brief discussion of the experimental setup and data analysis will be presented along with results to date.