Isotopic Yields from the Reaction $^{20}\text{Ne} + \text{Au}$ Using the FAUST Detector Array

By studying projectile fragmentation reactions at intermediate energies it is possible to explore nuclear matter under various conditions. Looking at the charge distributions or isotopic yields from these reactions, it is possible to study the reaction dynamics of the multifragmentation events and this will lead to a better understanding of the processes involved [1].

The reaction under investigation is $^{20}\text{Ne} + \text{Au}$ at 32 MeV/nucleon. The reaction was performed at the Texas A&M University Cyclotron Institute using the FAUST detector array [2]. Projectile fragments were identified with an array of 68 Si/CsI telescopes that covered an angular range from approximately 2.3° to 33.60° with a solid angle coverage of 89.7%. Isotopic identification was possible for $Z=1$ to $Z=4$.

![](image1.png)

**Figure 1.** Alpha energy spectra as a function of angle.

The energy spectra for alpha particles are shown in figure 1. A transition in the spectra shape can be seen to take place over increasing angle. We see at more forward angles a strong peak at an energy close to the beam energy per nucleon. As the angle is increased this peaking subsides and the energy spectrum shows an exponential behavior.

Previously presented data in reference [3], which had no event selection, showed that the angular distribution of charged particles is flat for light fragments and forward peaked for the heavier fragments. The data has been filtered to accept only events with total summed fragment charge of 10 and a summed momentum in the beam direction. The momentum cut was determined by taking a projection of the $\Sigma Z_{\text{frag}}=10$ onto the summed momentum axis. A gaussian was fit to the distribution and the standard deviation determined. Two standard deviations about the peak were accepted as reconstructed events. Event selection also required a multiplicity of two for the event.

![](image2.png)

**Figure 2.** Charge distributions for both inclusive (for multiplicity $\geq 2$) and reconstructed events. There is a change to a bimodal distribution after the requirement of a reconstructed projectile.

Once this was performed, the majority of fragments were found to be $Z=1,2,6,8,$ and 9 and all showed a relatively flat distribution with angle. This hinted at a
bimodal distribution in the emitted charge for reconstructed events. A plot of counts vs.
charge is shown in figure 2. The top panel
shows the data with only a multiplicity two
or greater restriction. The Bottom panel
shows the same multiplicity requirement
with the added requirements of the Z
and momentum cuts. The change to a bimodal
distribution can clearly be seen.

The third plot shows the average
isospin as a function of charge. The open
and closed diamonds show the data for
inclusive and reconstructed events, respecti-
vely. The comparison of the inclusive to
reconstructed data show an enhancement of
the neutron poor fragments for Z=1 but a
suppression of neutron poor fragments for
Z=2-4.

![Graph](image)

**Figure 3.** Average isospin as a function of
charge. The open and closed diamonds show
the inclusive and reconstructed ratios, respec-
tively. Error bars on the data are smaller
than the symbols. The circles and squares
show the predictions based on the delta and
Q values, respectively.

The open and closed circles show
the prediction based upon the average iso-
spin using the mass excess for each isotope.
The open circle takes into account $^6\text{Be}$ while
the closed circle excludes the $^6\text{Be}$. The open
and closed squares show the average isospin
calculated from the Q values binary breakup
of $^{20}\text{Ne}$ resulting in the isotope of interest.
The four predictions lie very close to each
other with the greatest variation coming for
Z=4.

The comparison of the reconstructed
data to the predictions shows a strong en-
hancement of the neutron poor isotope of
hydrogen. The trend is reversed for the he-
lium and beryllium isotopes. The lithium
reconstructed data point agrees well with the
prediction.

A recent experiment has been per-
formed to study the projectile fragmentation
of isobaric nuclei. Three beams were utili-
ized for this purpose: $^{20}\text{F}$, $^{20}\text{Ne}$, and $^{20}\text{Na}$.
The first and the last are radioactive beams
and were produced online with the MARS
beam-line at the Cyclotron Institute. The
neon beam was also transported to the de-
tector via this beam-line. The data is cur-
rently being analyzed.

**References**


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