Proposal for Ar-40 beam time at JYU Physics department Cyclotron particle accelerator

Verneri ERONEN[a], Joonas LEHTO[a], Lauri LIPONEN[a] and Aaro RANTAKARI[a]

[a]Jyväskylän Lyseon Lukio, Jyväskylä, Finland

Introduction

Rutherford experiment once proved that atom has a nucleus, by firing alpha-particles towards a gold foil and observing how the particles spread out after impacting the foil. Electron capture decay was discovered with vanadium-48. Our experiment relies on both findings, by firing Argon-40 at to a Samarium-152 foil and generating Mercury-192. Mercury-192 decays by electron capture to Gold-192 and we also will observe the impacts of our Argon particles' Rutherford's scattering.

Experimental details

We use different kinds of detectors in our experiment. MARA stands for Mass Analyzing Recoil Apparatus. It is a vacuum mode recoil separator. Focal plane is a silicon detector. Then there is a gamma ray detector and JYU-tube. JYU-tube detects the scattering of the particles.

In our reaction Argon-40 is beamed towards the target which is made of Samarium-152. The reaction produces Mercury-192 whose state of matter is liquid. Thus, the platform which holds the target must act as a container. Once the target is beamed the resulted Mercury-192 begins to decay into Gold-192 through electron capture. The half-life of Mercury-192 is 4,85 hours so gold is being produced in a reasonable rate. As we have mentioned the gold is neither stable, so it begins to decay into stable Platinum-192 through both β+ and electron capture. The following figure summarizes all the reactions above.

The beamed Argon-40 reacts with the target (Samarium-152) and creates Mercury-192.

$$^{152}_{62}Sm +^{40}_{18} Ar \rightarrow^{192}_{80} Hg$$

The target contains now Mercury-192 which begins to decay into Gold-192 through electron capture.

$$^{192}_{80}Hg + e^{-} \rightarrow^{192}_{79} Au + \nu_e$$

Motivation

We've chosen a reliable reaction which guarantees us good statistics. Our experiment does not require much beamtime and only a couple of hours should be enough. We want to see how much gold we can produce. For example, our goal is to determine how long it takes for us to get enough gold to make a bracelet out of it. We can't actually make stable gold, but our experiment will still be illuminating. Our other motivation is winning. We really do want to win.