MEASUREMENT OF THE HALF-LIFE OF ^{60}FE FOR STELLAR AND EARLY SOLAR SYSTEM MODELS USING THE DIRECT DECAY OF ^{60m}CO AND ACCELERATOR MASS SPECTROMETRY

Abstract

by

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Radioisotopes, produced in stars and ejected through core collapse supernovae (SNe), are important for constraining stellar and early Solar System (ESS) models. The presence of these isotopes (specifically ^{60}Fe) can identify progenitors of SNe, give evidence for nearby SNe, and can be used as a chronometer for ESS events. The ^{60}Fe half-life, which has been in dispute in recent years, can impact calculations for the timing of ESS events, the distance to nearby SNe, and the brightness of individual, non-steady state ^{60}Fe γ ray sources in the Galaxy. To measure such a long half-life, one needs to simultaneously determine the number of atoms in, and the activity of, an ^{60}Fe sample. We have undertaken a half-life measurement at the University of Notre Dame. This thesis gives results of both an activity measurement and an Accelerator Mass Spectrometry (AMS) measurement on an ^{60}Fe sample. This is the first time that the AMS technique is coupled with the direct isomeric day of ^{60}Co instead of the ground state decay of ^{60}Co. The resulting half-life from this work is (2.294 $\pm$ 0.269) million years, agreeing with the most recent measurement of (2.50 $\pm$ 0.12) million years, published in 2015. This is substantially longer than the previously accepted value of (1.49 $\pm$ 0.27) million years published in 1984.