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Further Development of Manganese-53 AMS Nuclear Science Laboratory at the University of Notre Dame

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^{53}Mn is a rare, radioactive isotope with a half-life of 3.74 million years which has astrophysical applications as an early solar system chronometer and as a test of nucleosynthesis models of supernovae and asymptotic giant branch (AGB) stars. In addition, ^{53}Mn has geological applications in determining the exposure and burial age of ferromanganese minerals. To fully exploit the capabilities of ^{53}Mn as a chronometer, a sensitivity to the ^{53}Mn/^{55}Mn ratio of 1×10^{-13} is necessary. Due to this low ratio, and interference from the naturally abundant ^{53}Cr isobar, Accelerator Mass Spectrometry (AMS) is the only technique sensitive enough to make these isotopic ratio measurements. However, 3×10^{-13} is the detection limit among active facilities[1]. At the University of Notre Dame's Nuclear Science Laboratory (NSL), work is ongoing to develop ^{53}Mn AMS capability using a 10 MV FN tandem accelerator and a Browne–Buechner Spectrograph operated as a gas-filled magnet. During previous experiments, meteoric samples with ^{53}Mn/^{55}Mn ratios between 10^{-10} and 10^{-8} were measured. This presentation discusses the results of varying the experimental parameters on the detection limit.
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1) Wallner, A., Fifield, L. K., Froehlich, M. B., Koll, D., Leckenby, G., Martschini, M., Pavetich, S., Tims, S. G., Schumann, D., & Slavkovská, Z. (2023). Accelerator mass spectrometry with ANU's 14 million Volt Accelerator. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 534, 48–53. https://doi.org/10.1016/j.nimb.2022.10.021

Student Submission

Yes

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