UNIVERSITY OF WASHINGTON, BOTHELL

CTA PROPOSAL

B PHYS 311, INTRO TO ASTROPHYSICS

SEGUE 1: An Unevolved Fossil Galaxy from the Early Universe

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1 Topic Background

When studying the early universe scientists commonly seek out stars with low metal content. Locked inside these stars is information about the physical and chemical conditions that led to the formation of the star. The low metallicity of these stars, specifically low $[Fe/H]$ values and high $[\alpha/Fe]$ values, indicate that the stars were formed in the early universe. By comparing the quantity of α-elements, iron, and hydrogen we can map the timescales of nucleosynthesis to the timescales of different types of supernovae. The α-elements are carbon, oxygen, neon, magnesium, silicon, sulfur, argon, and calcium.

The earliest supernovae events in the universe were core-collapse supernovae of Massive stars. Massive stars produce large amounts of α-elements during their stellar evolution and core-collapse explosion. Massive stars have short lifetimes of less than 10 million years. Heavy metals, such as iron, appeared later in the astronomical timeline as a byproduct of Type Ia supernovae. Type Ia supernovae originate from binary star systems containing a white dwarf stars. These binary systems have much longer lifetimes, on the order of 10^8 years, before collapsing into a supernova. These substantially different timelines allow scientists to approximately date the relative timing of nucleosynthesis in early stars.

For decades scientists looked at low metal stars in the halo of the Milky Way to study the early universe. In the past decade efforts such as the Sloan Digital Sky Survey (SDSS) have uncovered a plethora of very dim dwarf spheroidal (dSph) galaxies and ultra faint dwarfs with total luminosities in the range of $10^5 L_\odot \lesssim L \lesssim 10^7 L_\odot$ and $L \lesssim 10^5 L_\odot$, respectively. Within this pool of dSph and ultra faint dwarf galaxies scientists discovered a small handful of ultra faint dwarf galaxies that showed extremely low $[Fe/H]$ values. In this small handful one galaxy, SEGUE 1 stood out from the rest. SEGUE 1 stood out since it's stars show increasing metallicity but do not exhibit decreasing $[\alpha/Fe]$ ratios. This would indicate that SEGUE 1 dates back to the very early universe predating Type Ia supernovae events.

2 Novelty

The authors of this paper made new spectrography measurements of 6 stars within SEGUE 1 focusing on the chemical enrichment process to better understand star formation in the very early universe.

3 Results, Discussion, and Future Work

4 References