

Hubble Space Telescope near-ultraviolet spectroscopy of bright CEMP-s Stars

The metallicity of stars can be a rough indicator of their age, since the Universe became increasingly more abundant in heavy elements over time. Thus, the investigation of very old metal-poor stars in our Milky Way can shed light on the formation of the galaxy and on the evolution of the elements in our Universe in general. A subtype of metal-poor stars have an enhancement of carbon, so-called carbon enhanced metal-poor (CEMP) stars, and can be found in the halo of our galaxy. In particular, CEMP-s stars exhibit neutron-capture over-abundances consistent with the slow neutron-capture process, and are believed to be enriched in a binary system by a so-called asymptotic giant-branch (AGB) star companion, a very bright red giant. The great majority of abundance studies for CEMP stars have been restricted to spectroscopy in the optical region so far, because samples of C-enhanced stars that are sufficiently bright to be observed from space at high spectral resolution in the near-ultraviolet (NUV) are extremely limited.

This study [1] was the first to determine chemical abundances for two CEMP-s stars (HD196944 and HD201626) with the Space Telescope Imaging Spectrograph (STIS) on board of the Hubble Space Telescope (HST). Abundances or upper limits were obtained for a number of elements that are challenging or impossible to obtain from ground-based studies, but are nevertheless important for constraining detailed predictions of their production by AGB stars. These elements include: carbon, nitrogen, oxygen, titanium, chromium, manganese, nickel, germanium, zirconium, niobium, molybdenum, cadmium, lutetium, hafnium, osmium, platinum, gold, and lead.

A comparison of the derived chemical abundance patterns for the 2 CEMP-s stars with low-metallicity AGB models is important to constrain the main features of the binary system evolution, such as mass, metallicity, and initial chemical composition. For both observed CEMP-s stars, the best-fitting models for the masses of the binary system components (AGB star and CEMP-s star) are consistent with current scenarios for the formation and evolution of CEMP-s stars. The models indicate a mass composition of $M_{\text{AGB}}=0.90M_{\odot}$ and $M_{\text{CEMP}}=0.86M_{\odot}$ for HD196944 and $M_{\text{AGB}}=0.90M_{\odot}$ and $M_{\text{CEMP}}=0.76M_{\odot}$ for HD201626, where M_{\odot} represents the Solar mass. Further HST/STIS spectroscopy of CEMP stars and additional chemical abundances will place more constraints on theoretical models for AGB evolution.



The Hubble Space Telescope, Image Credit: NASA

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[1] V.M. Placco et al., *Hubble space telescope near-ultraviolet spectroscopy of bright CEMP-s stars*, *The Astrophysical Journal* **812**, 109 (2015)