Nucleosynthesis in helium-enriched asymptotic giant branch models: Implications for Heavy Element Enrichment in Globular Clusters

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We investigate the effect of helium enrichment on the evolution and nucleosynthesis of asymptotic giant branch (AGB) stars with a metallicity of Z=0.0006 ([Fe/H] = −1.4). We calculate evolutionary sequences with the primordial helium abundance (Y = 0.24) and with helium-enriched compositions (Y = 0.30, 0.35, 0.40). Post-processing nucleosynthesis calculations are performed on each of the evolutionary sequences to determine the production of elements from hydrogen through to bismuth. Elemental surface abundance predictions and stellar yields are presented for each model. The models with enriched helium have shorter main sequence and AGB lifetimes, and enter the AGB with a more massive hydrogen exhausted core than the primordial helium model. The main consequences are 1) AGB models with enhanced helium will evolve more than twice as fast, giving them the chance to contribute sooner to the chemical evolution of the forming globular clusters, and 2) the stellar yields will be strongly reduced relative to their primordial helium counterparts. In the low-mass AGB models we find that an increase of $\Delta Y = 0.10$at a given mass decreases the yields of carbon by up to about 60%, of fluorine by up to 80%,and decreases the yields of the s-process elements barium and lanthanum by about 50%. While the yields of first s-process peak elements strontium, yttrium and zirconium decrease by up to 50%, the yields of rubidium either do not change or increase.