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Can single massive stars be LGRB progenitors?

In this talk, we will discuss the origins of Long-duration Gamma-Ray Bursts (LGRBs). Typically associated with Type-Ic Supernovae, LGRBs are linked to massive stars. However, it remains unclear whether the progenitors are in binary systems or are effectively single stars. Our emphasis will be on single-star pathways. Our emphasis will be on single-star pathways. Specifically, we will explore which mass ranges, metallicities, and rotation rates favor LGRB production. The metallicity evolution of these stars, in connection to observed LGRB metallicity evolution, is not well understood, making it difficult to conclude if single stars are the major LGRB production channel irrespective of metallicities. Additionally, the evolutionary paths of massive stars ($M > 10\ M_\odot$) remain substantially uncertain. These stars begin their lives as main sequence O stars, but depending on their masses, rotation rates, and metallicities, they can pass through a wide range of evolutionary states. This leads to various possible surface compositions, spectral classifications, and end products, such as core-collapse SN, Pair-Instability SN (PISN), Pulsational Pair-Instability SN (PPISN), and Black Holes. We will present models of massive stars within a mass range of 10–150 MSun, with a mass resolution of ΔM = 10 MSun, and rotation rates (v/v_crit) from 0 to 0.6, with a velocity resolution of Δ(v/v_crit) = 0.1. We will discuss the possible metallicity and rotation rate distributions from our models that may be favorable for producing LGRB candidates, considering observed LGRB rates and their metallicity evolution. Our primary focus will be on exploring whether Chemically Homogeneous Evolution (CHE) could be a major channel for LGRB production.

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