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Chemically-Homogeneous Evolution: Impacts on Stellar Populations and Compact Binary Mergers

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Compact binary mergers mark the final stage of a complex journey that begins with massive star binaries. Within the isolated channel, binaries undergo intricate processes, including mass transfer and tidal interactions, ultimately giving rise to neutron stars or black holes. Notably, chemically-homogeneous evolution, prevalent in metal-poor binary systems, significantly influences this process by triggering rapid spin increases and subsequent changes in stellar properties.

In my talk, I will present the effects of chemically-homogeneous evolution both on observable stellar populations and the detectability of compact binary mergers using gravitational wave interferometers. My population-synthesis simulations reveal how chemically-homogeneous evolution alters the ratio of red supergiants to Wolf-Rayet stars, dramatically affecting stellar populations potentially observable through electromagnetic observations. Notably, Wolf-Rayet stars produced by chemically-homogeneous evolution are, on average, more massive, more numerous, and more luminous than Wolf-Rayet produced either via single or common binary evolution. The effects of chemically-homogeneous evolution are eventually inherited by the compact objects produced by these stellar progenitors: neutron star production is suppressed in favor of black holes, leading to an increased ratio of binaries composed of neutron stars and black holes or massive black holes. Conversely, chemically-homogeneous evolution strongly suppresses the production of compact binary mergers. These findings emphasize the intricate interplay between chemically-homogeneous evolution, stellar populations, and compact binary mergers.

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