Stellar Alchemy and Light: 3D Mergers and the Next Frontier in Radiative Transfer Simulations

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ABSTRACT

We delve into the physics of stellar mergers and their observable signatures in this talk, presenting a unified study that spans the life cycle of transient astrophysical phenomena. Using the Octo-Tiger code, we simulate the merger of a $16M_\odot$ star with a $4M_\odot$ companion, a process suggesting a genesis of Betelgeuse-like stars, characterized by significant mass ejections and rapid rotation. To translate the outcomes of such stellar catastrophes into observable features, we introduce a new generation of radiation transport simulations. Our new code, SuperLite, leverages advanced Monte Carlo techniques to model the radiative transport of high-velocity outflows, producing synthetic spectra for comparison with various transient events, including Types Ia, IIP, and II\textsubscript{n} supernovae. This synergistic approach elucidates the interplay between violent stellar processes and their luminous fingerprints, enhancing our comprehension of the transient universe's spectacles.