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Magnetic Braking and Damping of Differential Rotation in Massive Stars LUNAN SUN, MILTON RUIZ, STUART SHAPIRO, University of Illinois at Urbana-Champaign — Fragmentation of highly differentially rotating massive stars that undergo collapse has been suggested as a possible channel for binary black hole formation. Such a scenario could explain the formation of the new population of massive black holes detected by the LIGO/VIRGO gravitational wave laser interferometers. We probe that scenario by performing general relativistic magnetohydrodynamic simulations of differentially rotating massive stars supported by thermal radiation pressure plus a gas pressure perturbation. The stars are initially threaded by a dynamically weak, poloidal magnetic field confined to the stellar interior. We find that magnetic braking and turbulent viscous damping via magnetic winding and the magnetorotational instability in the bulk of the star redistribute angular momentum, damp differential rotation and induce the formation of a massive and nearly uniformly rotating inner core surrounded by a Keplerian envelope. The core + disk configuration evolves on a secular timescale and remains in quasi-stationary equilibrium until the termination of our simulations. Our results suggest that the high degree of differential rotation required for $m = 2$ seed density perturbations to trigger gas fragmentation and binary black hole formation.

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