Formation of the young massive stellar cluster westerlund 1 triggered by cloud-cloud collisions

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The formation of young massive stellar clusters remains a central question in star formation studies, given their crucial role in shaping the structure and evolution of galaxies. In recent years, cloud-cloud collisions have emerged as a promising mechanism for triggering high-mass star formation, supported by observations in both nearby galaxies and Galactic star-forming regions. In this study, we present new ^{12}CO(J = 3–2) observations of the most massive young stellar cluster in the Milky Way, Westerlund 1, using the Atacama Submillimeter Telescope Experiment at a resolution of 22" (Sano et al. 2026, ApJ, 1004, 12). We identify a cavity-like molecular structure with a radius of ~3.4 pc surrounding the cluster, consistent with infrared structures revealed by JWST. The cavity exhibits expanding gas motion with a velocity of ~5 km/s at $V_{\rm LSR}$ ~−32 km s^{-1}, corresponding to a dynamical timescale of ~0.7 Myr. Given the cluster age of ~3–5 Myr, this structure is naturally interpreted as a wind-blown bubble formed by stellar feedback from the cluster. In addition to the feedback-driven structure, we identify a complementary spatial distribution between molecular clouds at $V_{\rm LSR}$ ~−55 km s^{-1} and ~−32 km s^{-1}, connected by an intermediate-velocity component at $V_{\rm LSR}$ ~−44 km s^{-1}. These kinematic and spatial features indicate that the two clouds are physically associated and undergoing a cloud-cloud collision. We propose that this collision directly triggered the formation of the stellar cluster Westerlund 1. In this presentation, we will first briefly review the general observational and theoretical framework of the cloud-cloud collision scenario for massive star and cluster formation. We will then apply this framework to the case of Westerlund 1, discussing the evidence for cloud-cloud collision and its role in the formation of this system.