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Passage Through the Carina Spiral Arm as the Origin of Major Star Forming Complexes in the Solar Neighborhood

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Thanks to the high precision of stellar parallaxes and proper motions made possible by the European Space Agency Gaia mission, combined with dramatic increases in the number of stars with measured radial velocities, it has recently become possible to identify stellar clusters and measure their full three-dimensional positions and velocities with unprecedented accuracy. Using the positions, velocities, and ages from the recently published catalog of stellar clusters from Hunt & Reffert (2023), supplemented by radial velocities from APOGEE, GALAH, and other surveys, Swiggum et al (2024) have recently shown that at least 57% of 272 young (<70 Myr) clusters within one kiloparsec of the Sun originated in three distinct star forming complexes. Each complex had an estimated gas mass of 1-2 million solar masses that started to form stars 30 to 45 Megayears ago. Here we present evidence that this burst of star formation in the solar neighborhood was triggered by the passage of the Sun through the Carina spiral arm of the Milky Way Galaxy. Using parallax-based distance to a set of young clusters and YSO groups, combined with radial velocities and proper motions, we provide a new map of the near and far side of the Carina Arm and investigate the non-circular motions in this arm, possibly due to spiral arm streaming. We then compare the position of the Carina spiral arm now to the location of the solar neighborhood star “burst” 45 million years ago to measure the pattern speed of the Carina arm. The inferred gas masses, stellar masses, and kinematics of the solar neighborhood clusters 45 million years ago are also shown to be comparable to the properties of the gas and clusters properties seen in the current Carina Arm. Further observational test of this hypothesis are proposed.