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The chemodynamical properties of the Galactic bulge

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We present a chemodynamical analysis of a large sample across the whole disk selected from Gaia-XP-spectra-derived dataset. When dividing the sample into a subsequent of annuluses, a universal chemodynamical trend exists from the disk to the bulge in the row normalized density map in the azimuthal velocity V_ϕ and metallicity [M/H] space is found, that is, a V-shaped structure stacked with a vertical band shows up in all radial bins, which are considered to refledt the thin, thick disk and the Splash respectively. The median behaviour of the universal trend exhibits a regulated transition with radius all the way into the inner Galaxy, thus implying a disk origiin for the majority of bulge stars. Further split the bulge population in the V_ϕ and [M/H] plane into 5x5 grids and study the kinematical properties of those divided populations, we found a well defined boundary that separates the bulge stars into relatively hot and cold groups, the populations in the cold groups all show the V_R butterfly pattern in the x-y plane and cylindrical rotation that are strong evidence of bar, while all the populations in the hot group does not show butterfly pattern but some of them still exhibit cylindrical rotation, which implies that the cylindrical rotation is not an unique feature of bar that used to be thought as unique in literature. We perform a N-body simulation with an initially non-rotating spherical structured placed, which turns out to be that this non-rotating component would be spun up in a cylindrical way by the later formed bar that is disk-originated, and the spherical structure do not involved in the bar formation since it does not exhibit the V_R butterfly pattern, which explains the phenomenon seen in observation.

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