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Formation and Evolution of Milky Way Galaxy: Abundance trends of stable and short-lived nuclides

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To understand the formation and evolution of Milky Way galaxy, Galactic Chemical Evolution (GCE) simulations are performed using N-body Monte Carlo technique. Our GCE models predict the elemental abundance gradients of C, N, O, Mg, Si, Ca, Ti, Fe, and Zn using the revised solar abundance of value 0.0143. The galaxy is radially divided into eight annular rings of 2 kpc width each at a distance of 2-18 kpc from the center of the galaxy. We ran models using three infall and two infall accretion models to gradually form halo, thick disc and thin disc. An ensemble of stars in the mass range 0.1-100 M⊠ is formed and evolved over the galactic time scale. The process of star formation is mainly controlled by Star Formation Rate (SFR) and Initial Mass function (IMF). The nucleosynthetic yields ejected from stars of various generations enrich the Interstellar gas. Further, next generation of stars form out of enriched gas with higher metallicity. The predicted normalized abundance gradients are compared with the observational data from various sources. The effect of radial gas mixing and gas inflows on the predicted abundance gradients is also explored in these simulations.
In these models the formation of solar system takes place ˜ 4.56 Gyr ago in the fourth annular ring from the galactic center. At that instant, the values for metallicity and [Fe/H] are assumed to be ˜0.0143 and 0 respectively. In the present work, three infall GCE model is further developed to explain the abundance trends of Short lived radio nuclides (SLRs), 26Al, 36Cl, 41Ca, 53Mn and 60Fe in the galaxy and solar neighbourhood. The homogeneous GCE models predict the abundance trends of SLRs for the entire galaxy. In addition, heterogeneous GCE simulation are performed by dividing the solar annular ring into independent grids of size in the range of 0.1-1 kpc2 to consider the homogenization of stellar ejecta in localized region. In case of heterogeneous models the formation of various stellar clusters/associations are simulated in the solar annular ring ˜4.56 Gyr ago. The birth of solar system is likely to occur within one of these stellar clusters. In these simulations, mainly massive stars in the clusters contribute SLRs in the early solar system. This contribution is scaled by parameterizing the homogenization spatial scale in a specific grid to obtain the canonical values of SLRs, 26Al, 36Cl, 41Ca, 53Mn and 60Fe observed in the early solar system.

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