Spherical Infall Model in a Cosmological Background Density Field [A. Taruya, J. Soda]

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Abstract We discuss the influence of the cosmological background density field on the spherical infall model. The observation of the infalling flows is frequently compared with the prediction from the spherical infall model to determine the density parameter of the universe. Here, we consider the modified version of the spherical infall model. We derive the mean field equations from the Newtonian fluid equations, in which the influence of cosmological background inhomogeneity is incorporated into the averaged quantities as the backreaction. By calculating the averaged quantities explicitly, we analyze the averaged dynamics and find that the density fluctuations with the spectral index \( n < -1 \) make the infalling flows slow. It suggests that we underestimate the density parameter \( \Omega \) when using the simple spherical infall model. In the cases with the index \( n > -1 \), it turns out that the effect of background inhomogeneity could be negligible and the spherical infall model becomes useful for estimating the density parameter.