COSMIC EXPANSION IN INHOMOGENEOUS COSMOLOGIES AND THE
FORMATION OF LOCAL-GROUP LIKE SYSTEMS

Abstract
by
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In this dissertation, we explore two outstanding questions in the formation
and evolution of the large-scale structure. One question is that general relativistic
corrections to the expansion rate of the universe arise when the Einstein equations
are averaged over a spatial volume in a locally inhomogeneous cosmology. It has
been suggested that they may contribute to the observed cosmic acceleration. In
this dissertation, we propose a new scheme that utilizes numerical simulations
to make a realistic estimate of the magnitude of these corrections for general in-
homogeneities in (3+1) spacetime. We then quantitatively calculate the volume
averaged expansion rate using N-body large-scale structure simulations and com-
pare it with the expansion rate in a standard FRW cosmology. We find that
in the weak gravitational field limit, the converged corrections are slightly larger
than the previous claimed $10^{-5}$ upper limit, but not large enough nor even of the
correct sign to drive the current cosmic acceleration. Nevertheless, the question
of whether the cumulative effect can significantly change the expansion history of
the universe needs to be further investigated with strong-field relativity.

As a second part of this dissertation, we have also studied the formation and
evolution of Local-Group like poor galactic clusters. We analyze the star forma-
tion rate and examine the development of streaming flows toward the dominant
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galaxies of dwarf spheroidal protogalactic halos moving along the filamentary like structures in such a system. We show that this flow may impact the kinematics and star formation history in the halo and intergalactic medium.