



Iranian Journal of Physics Research, Vol. 23, No. 1, 2023  
DOI: 10.47176/ijpr.23.1.31667

## The bulk flow in $\ddot{\Lambda}$ CDM and XCDM and the Hubble constant and $\sigma_8$ tensions

P Sheikhsari and Sh Baghram

Faculty of Physics, Sharif University of Technology, Tehran, Iran

E-mail: baghram@sharif.edu

(Received 26 March 2023 ; in final form 11 April 2023)

---

### Abstract

The standard model of cosmology,  $\Lambda$ CDM, has been successful in describing many observations. With the improvement of the number and the accuracy of observations, some inconsistencies among key cosmological parameters of the model have emerged. Many alternative models are proposed to alleviate these tensions. On the other hand, some observations of peculiar velocity show higher values than expected in a  $\Lambda$ CDM universe which may contradict the cosmological principle. In this work, we used linear perturbation theory to measure bulk flow and  $f\sigma_8$  parameter in two alternative cosmological models  $\ddot{\Lambda}$ CDM and XCDM. We compared measured bulk flows with the  $\Lambda$ CDM predictions and some observations. We did a  $\chi^2$  analysis to see which model is preferred by data. We find that  $\ddot{\Lambda}$ CDM model predicts higher bulk flows and is more consistent with observational data but does not reduce  $\sigma_8$  tension. Bulk flows measured in the XCDM model are lower compared to  $\Lambda$ CDM. However, this model can reconcile  $\sigma_8$  tension.

**Keywords:** structure formation, cosmological perturbation theory, bulk flow, cosmological tensions

---

For full article, refer to the Persian section