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The radial velocity profile of the filament galaxies in the vicinity of the Virgo cluster as a test of gravity

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The radial velocities of the galaxies in the vicinity of a massive cluster shows deviation from the pure Hubble flow due to their gravitational interaction with the cluster. According to a recent study of Falco et al. with a high-resolution N-body simulation based on General Relativity (GR), the radial velocity profile of the galaxies located at distances larger than three times the virial radius of a neighbour cluster has a universal shape and could be reconstructed from direct observables provided that the galaxies are distributed along one dimensional filament. Analyzing the narrow filamentary structure identified by Kim et al. in the vicinity of the Virgo cluster from the NASA-Sloan-Atlas catalog, we reconstruct the radial velocity profile of the Virgo filament galaxies and compare it with the universal formula derived by Falco et al. It is found that unless the virial mass of the Virgo cluster exceeds 1015h−1M⊠ the universal formula fails to describe the reconstructed radial velocity profile whose peculiar velocity term turns out to decrease much less rapidly. Speculating that the disagreement between the GR prediction and the observed radial velocity profile of the Virgo filament galaxies may be due to the presence of unscreened fifth force, we suggest the radial velocity profile of the filament galaxies around the clusters as a powerful test of gravity on the cosmological scale.

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