University of Crete
Department of Physics

FORTH
INSTITUTE OF ASTROPHYSICS

Joint Physics & IA/FORTH Colloquium

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From cosmic expansion dipoles to missing baryons: exploring the mysteries of the Universe with galaxy clusters

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ABSTRACT

Abstract: Galaxy clusters, the largest relaxed structures in the Universe, are excellent probes of the most crucial cosmological questions, from the (non-)uniformity of cosmic expansion to unveiling the location of hidden baryonic gas in large cosmic filaments. In the past, we have used scaling laws between multiwavelength galaxy cluster properties to robustly detect a directional variation in the local expansion rate (Hubble constant) at 800 Mpc scales. This apparent anisotropy could be attributed to a large 900 km/s coherent flow motion (bulk flow) of galaxy clusters extending to 500 Mpc. Both of these scenarios strongly challenge the validity of LCDM in the local Universe. New X-ray data of >8,000 newly discovered clusters by eROSITA independently confirm the existence of this cosmological anomaly, while future data from Euclid will shed more light on this cosmic mystery. To better understand these findings, we need to map the mass distribution in our cosmic neighborhood accurately. However, a significant fraction of the cosmic baryons remains undetected, while they are believed to reside in cosmic filaments in the form of the warm-hot intergalactic medium (WHIM). The latter is especially challenging to detect observationally. In our latest work, we report the first-ever spectroscopic discovery of a 7 Mpc "pure" cosmic filament via its X-ray emission in the Shapley supercluster. We constrain the filament gas temperature and baryon overdensity to be ~1 keV and ~40, respectively, which constitutes the least dense filament ever detected in X-rays. Finally, using X-ray, weak lensing, and millimeter data, we also reveal a very distant galaxy cluster merger with a hot, dense gas bridge connecting the two systems, suggesting that filaments may have had a non-negligible contribution to the mass distribution of the earlier Universe as well.