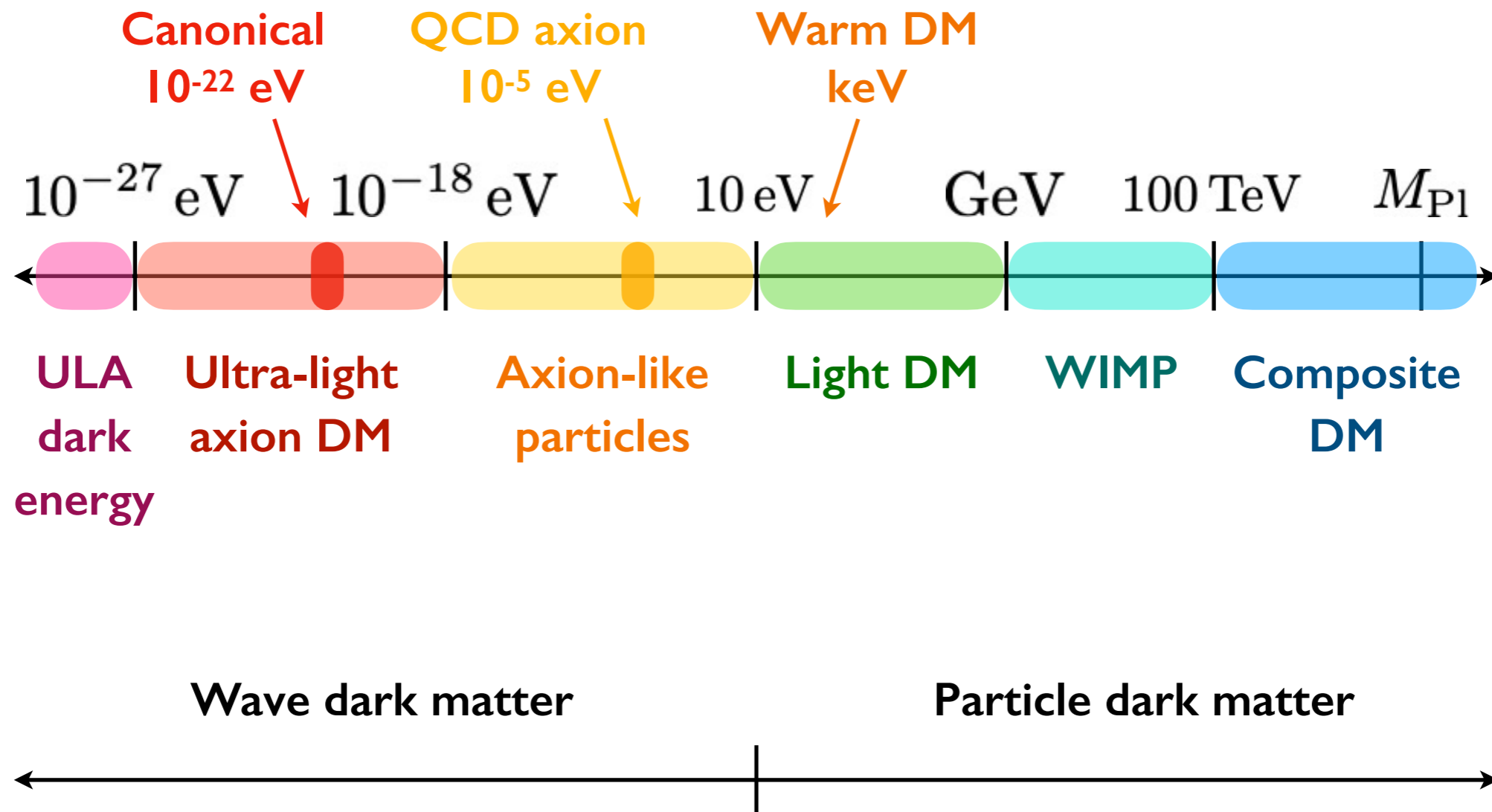
A visualization of the cosmic web, showing a complex network of blue filaments and nodes against a dark background. The filaments represent the large-scale structure of the universe, with nodes indicating regions of high density.

**IDENTIFYING
THE FUNDAMENTAL NATURE OF DARK MATTER
IN THE COSMIC LARGE-SCALE STRUCTURE**

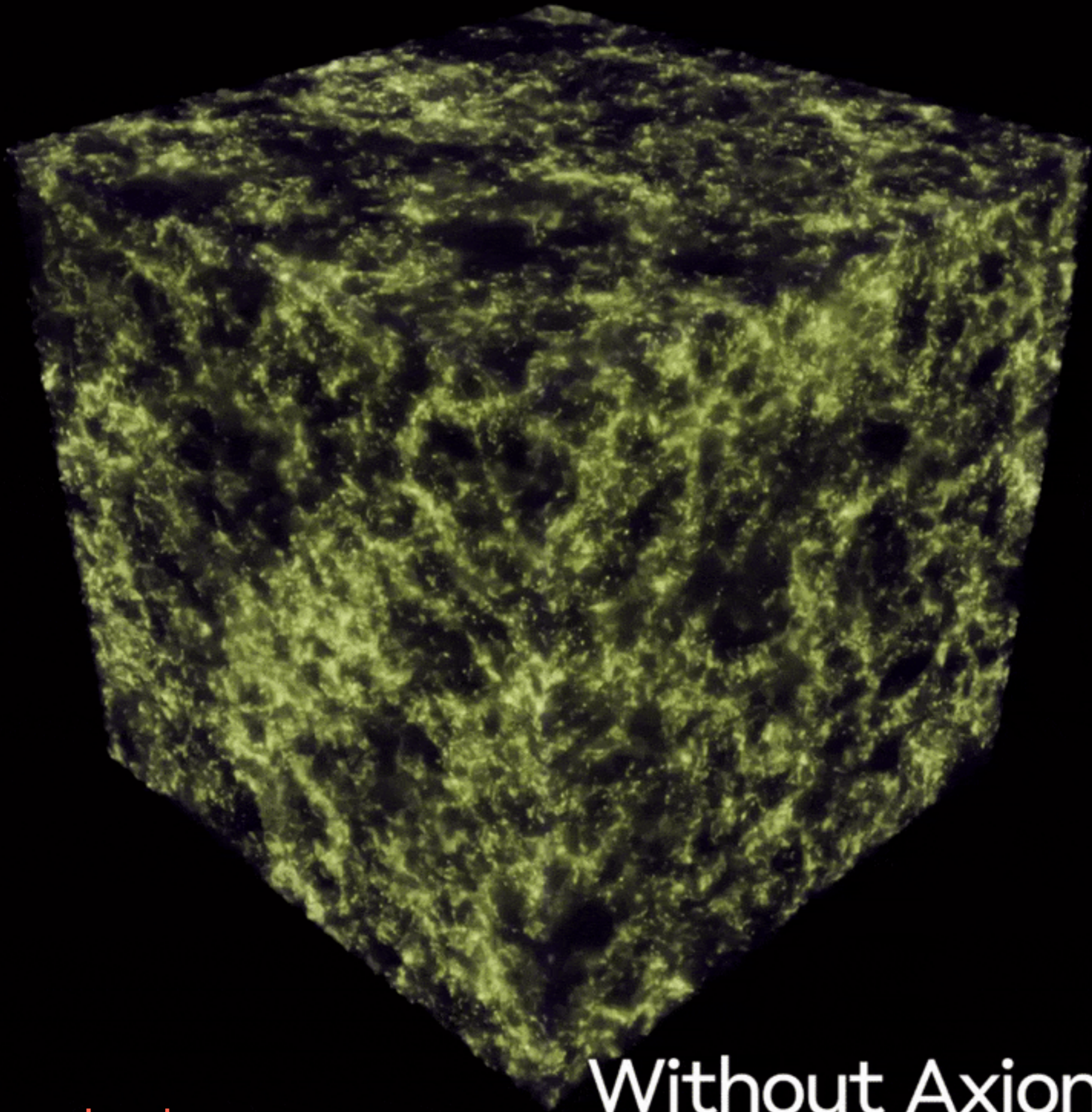
Keir K. Rogers

*Dunlap Fellow, Dunlap Institute for Astronomy & Astrophysics,
University of Toronto*

Beyond the WIMP: dark matter model space



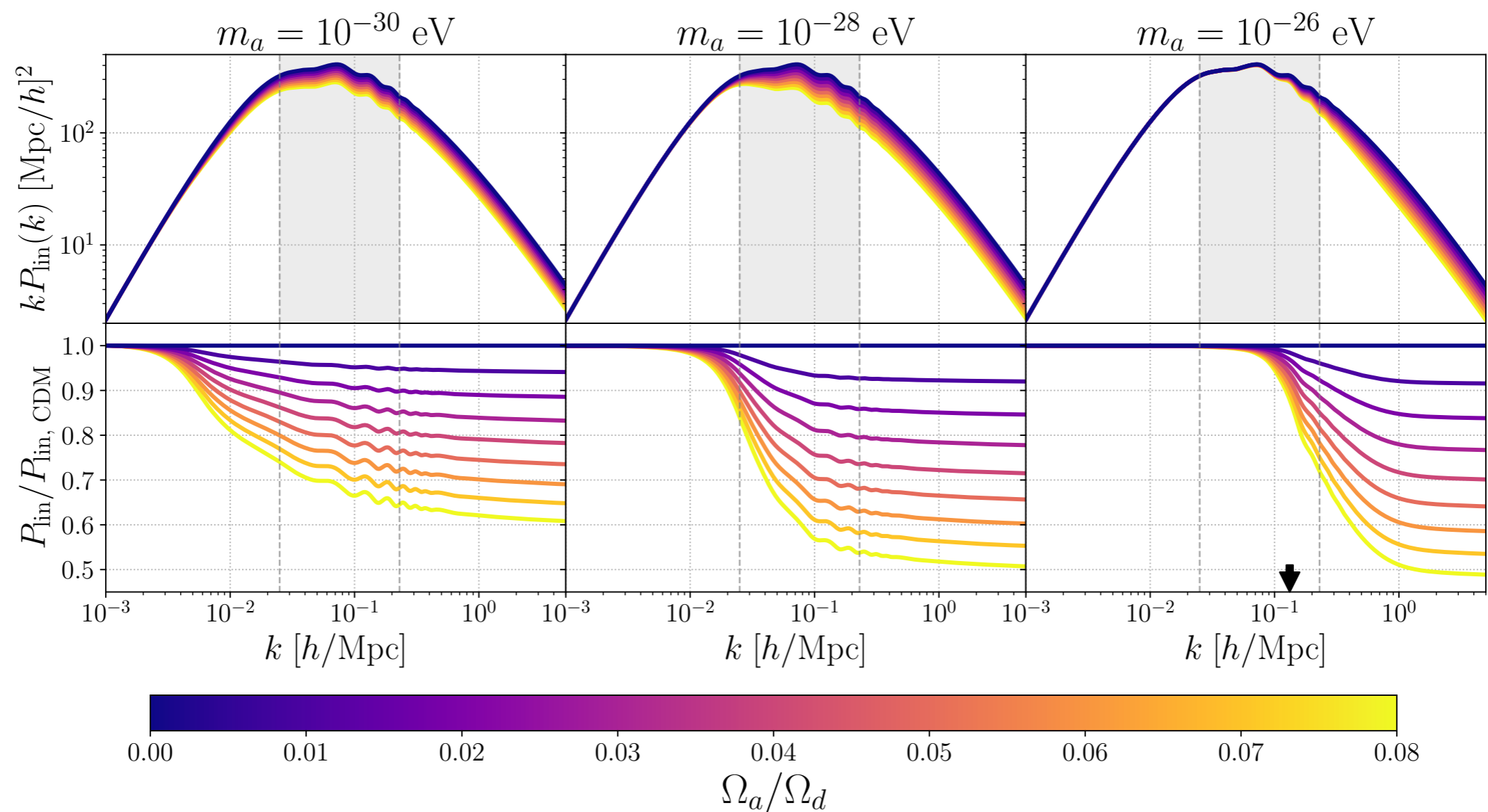
Canonical ULA DM: Rogers & Peiris (2021, PRL); Light particle DM: Rogers et al. (2022, PRL)



Without Axions

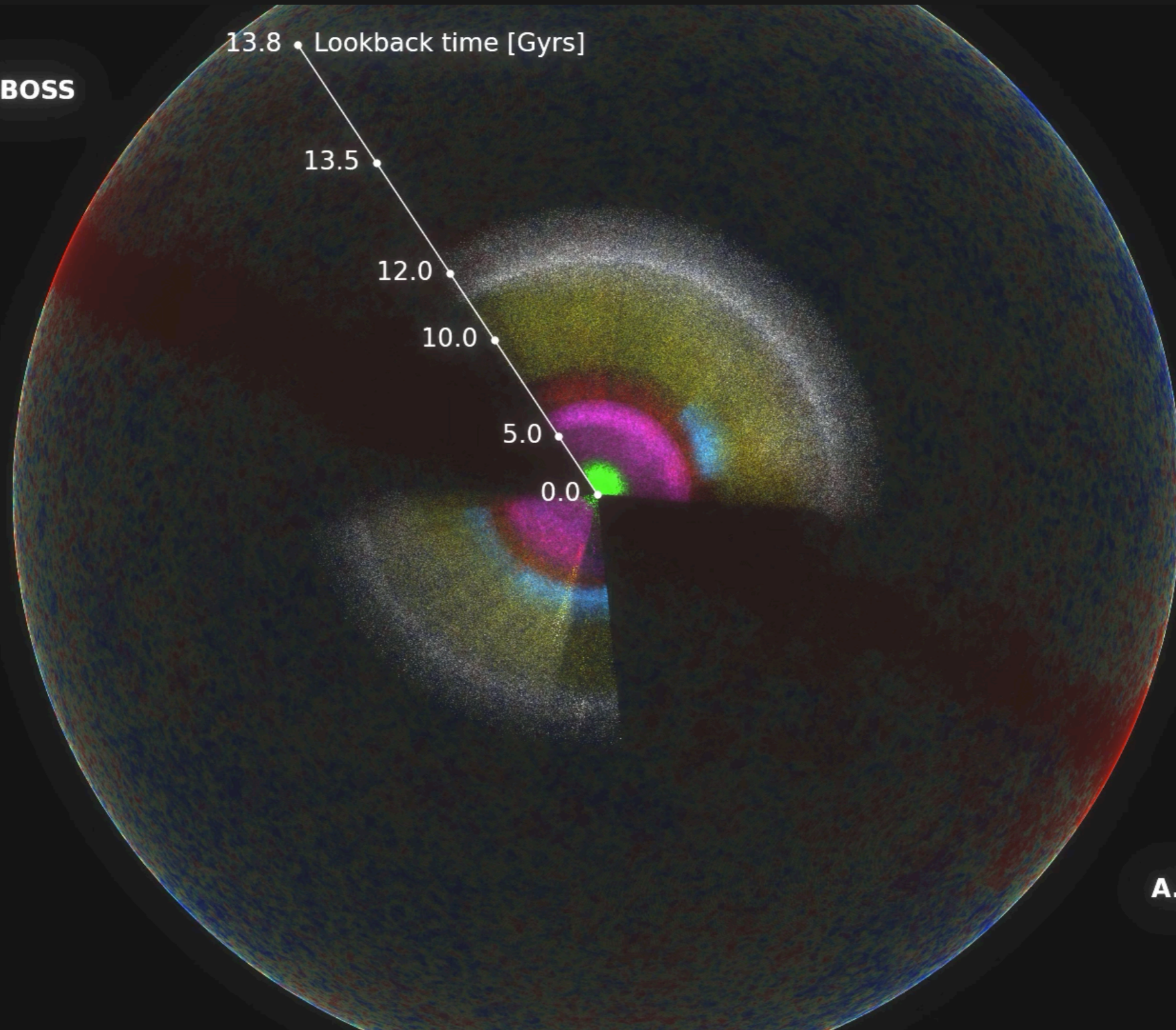
Ultra-light axion dark matter causes scale-dependent suppression in matter clustering

$$\lambda_{\text{Jeans}} = 9.4 (1+z)^{\frac{1}{4}} \left(\frac{\Omega_a h^2}{0.12} \right)^{-\frac{1}{4}} \left(\frac{m}{10^{-26} \text{ eV}} \right)^{-\frac{1}{2}} \text{ Mpc}$$



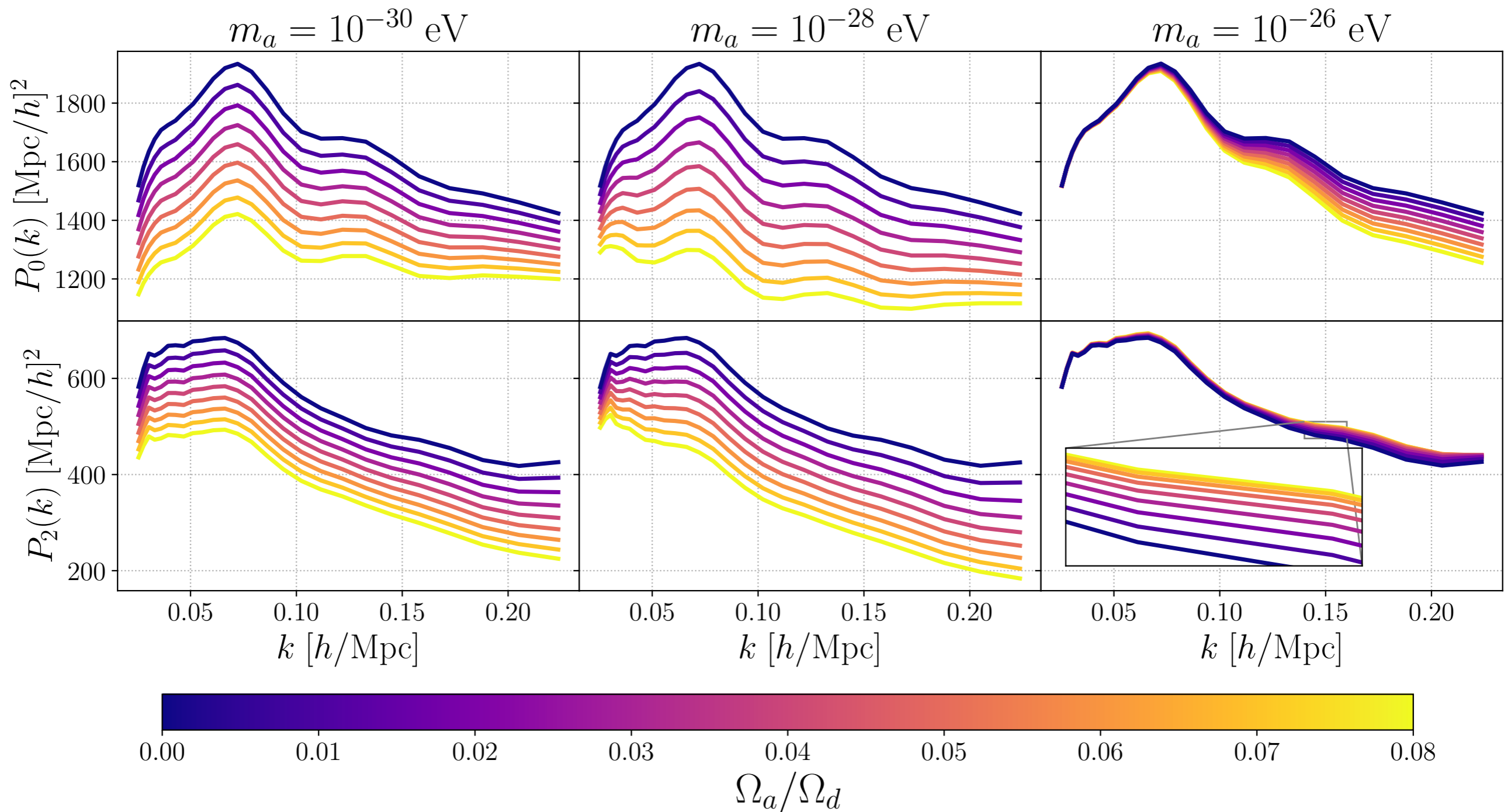
Sloan Digital Sky Survey maps distribution of galaxies towards edge of observable Universe

SDSS I-II + BOSS + eBOSS
(1998-2019)



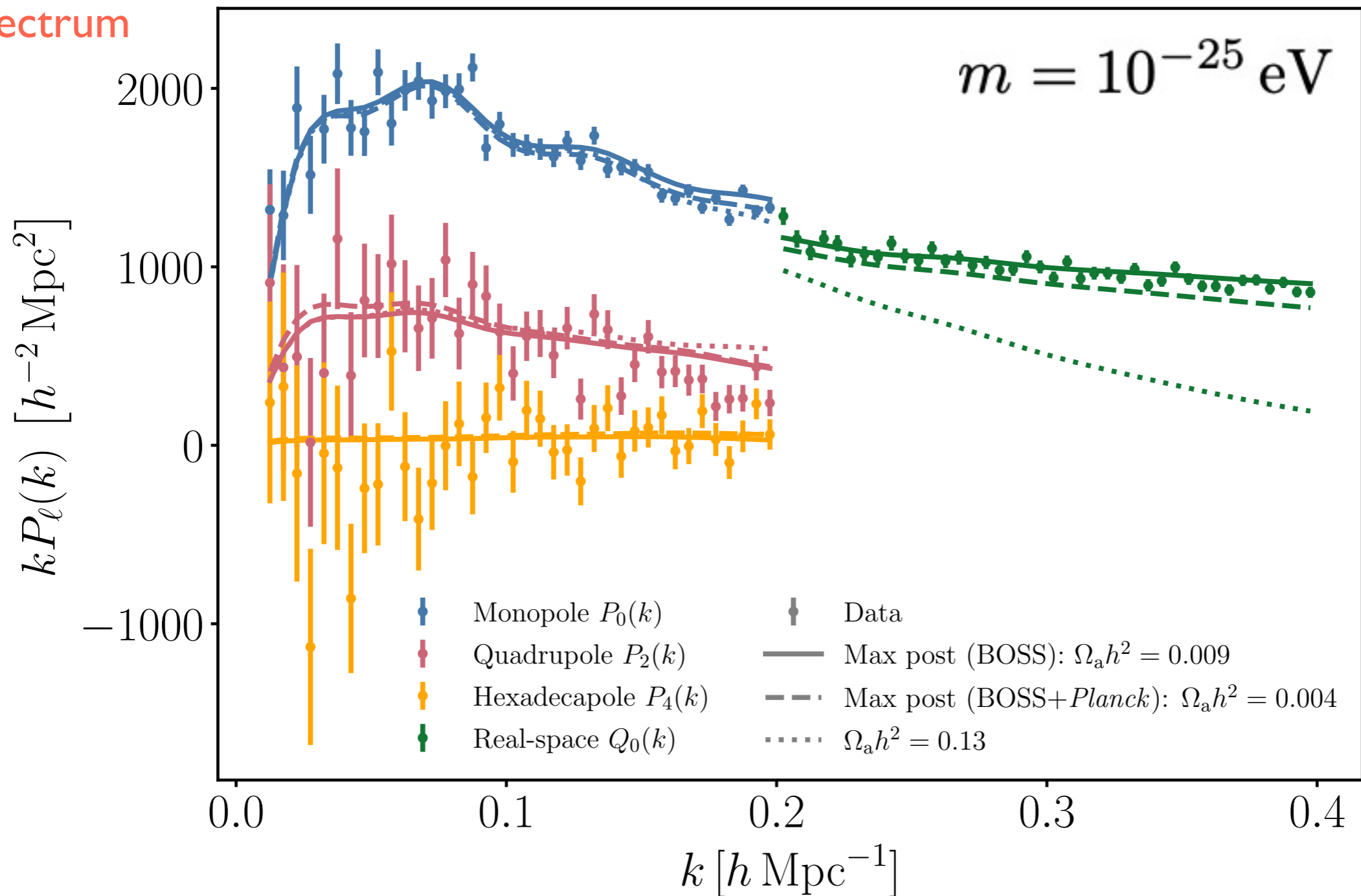
A. Raichoor (EPFL)

Galaxy clustering traces dark matter clustering — revealing signature of ultra-light axions

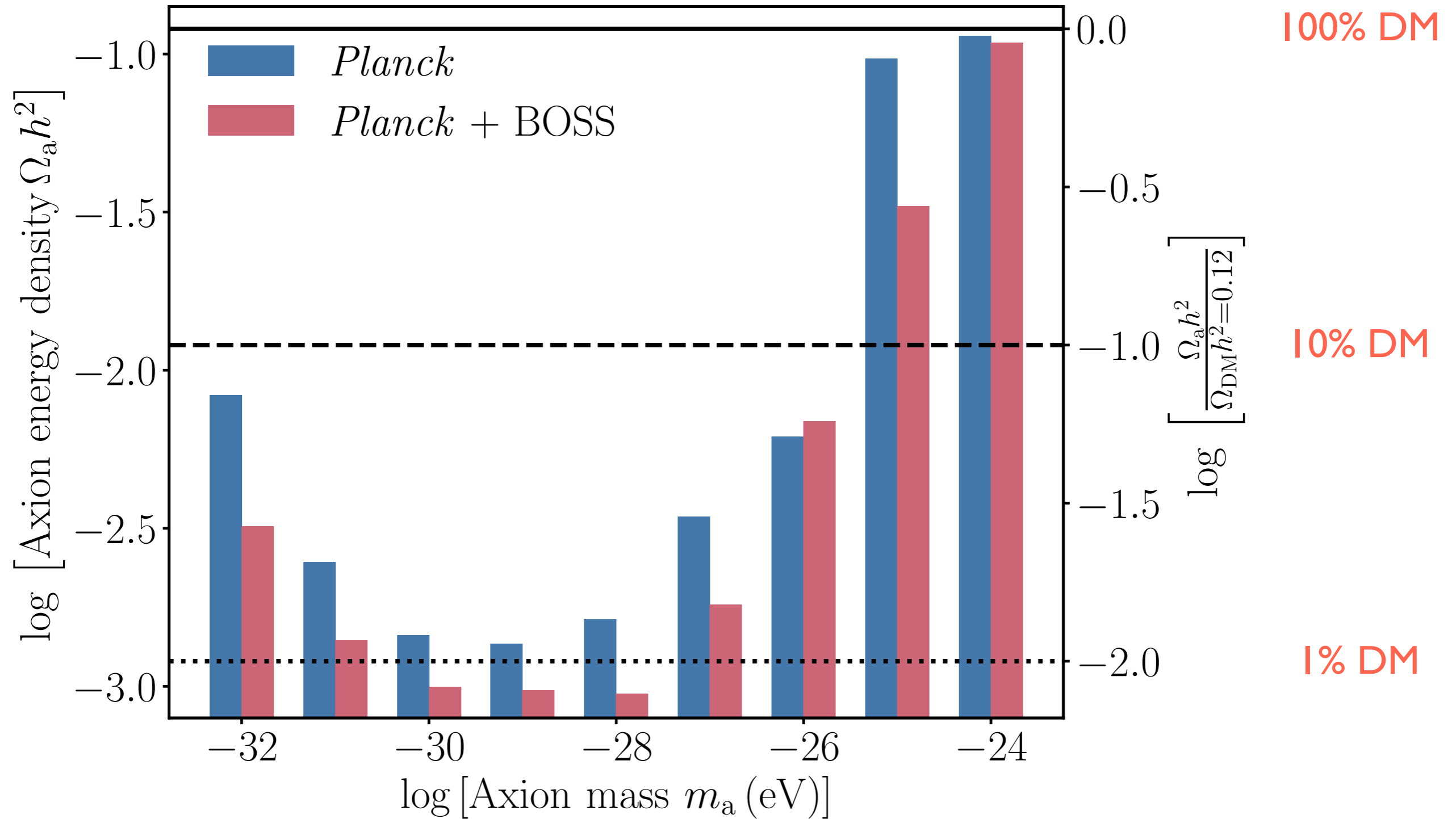


SDSS (BOSS DRI2) galaxy clustering rules out new parts of axion parameter space

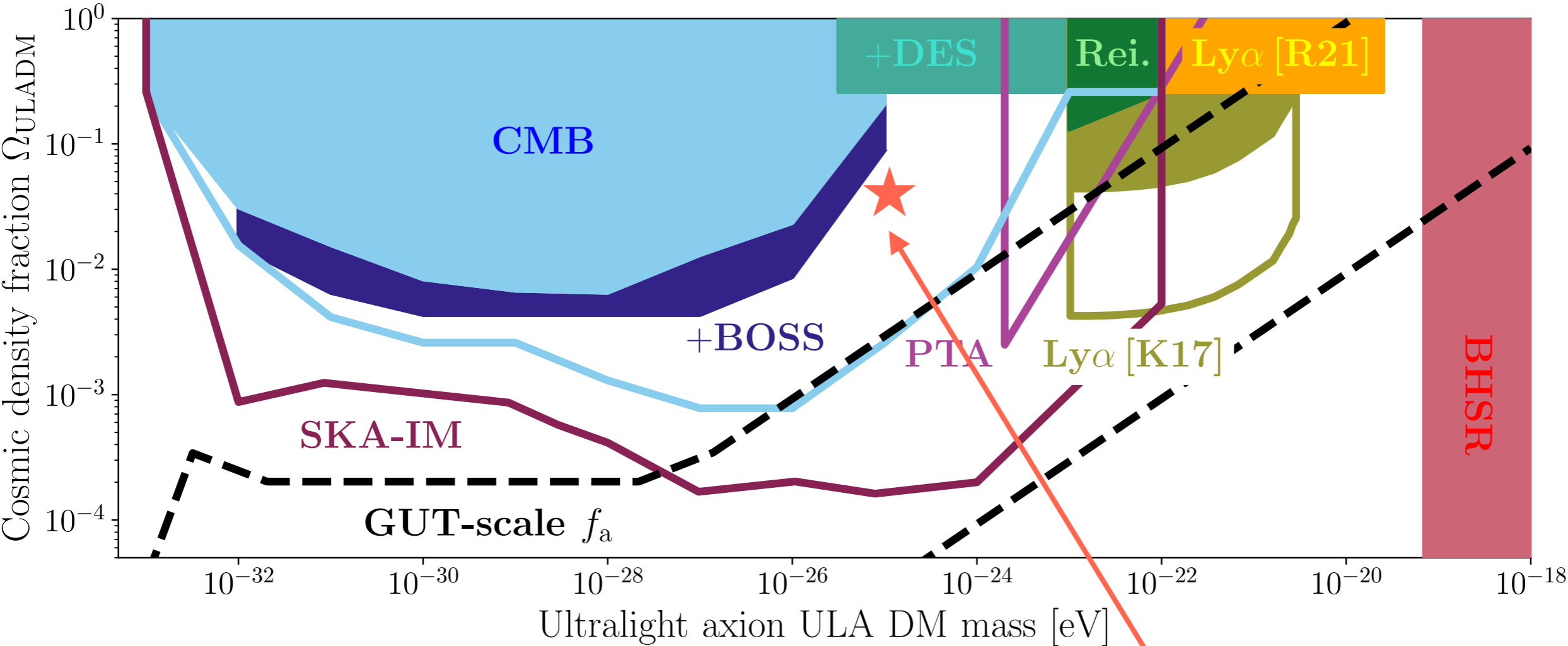
Power
spectrum



Strongest axion bounds come from combining cosmic microwave background & large-scale structure



Multi-probe approach to detect ultra-light axions



Resolve S_8 tension?