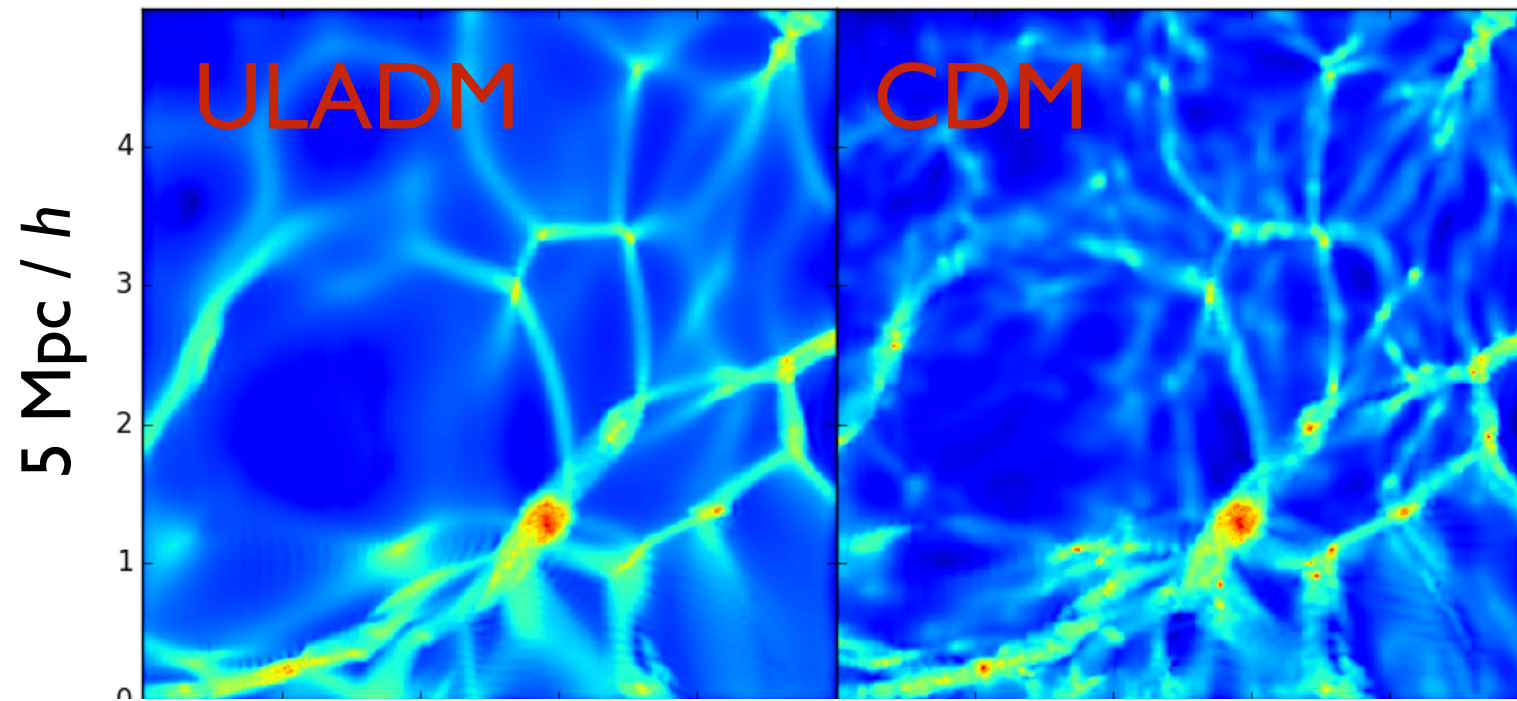


The background of the slide is a deep blue field filled with a complex network of glowing blue filaments and nodes, representing the cosmic web. The filaments are thin and interconnected, forming a web-like structure that spans the entire frame. The nodes are small, bright blue dots where the filaments intersect. The overall effect is a dense, intricate pattern of light against a dark blue background.

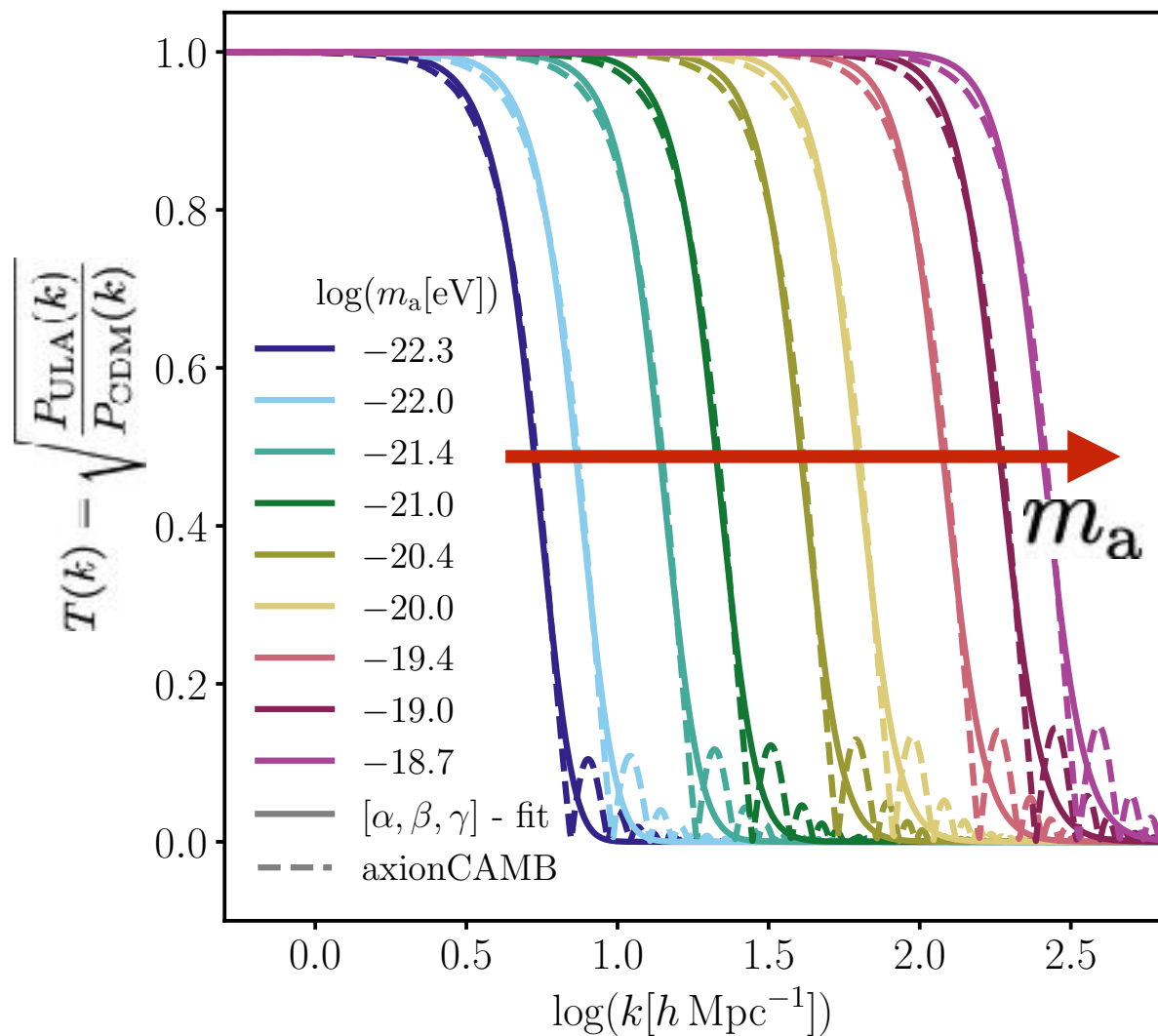
STRONG BOUND ON
CANONICAL ULTRA-LIGHT AXION DARK MATTER
FROM THE LYMAN-ALPHA FOREST

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~ $10^{-22} - 10^{-21}$ eV
 (ultra-light axions)
 may be preferred
 DM mass scale
 (axiverse/
 small-scale crisis)

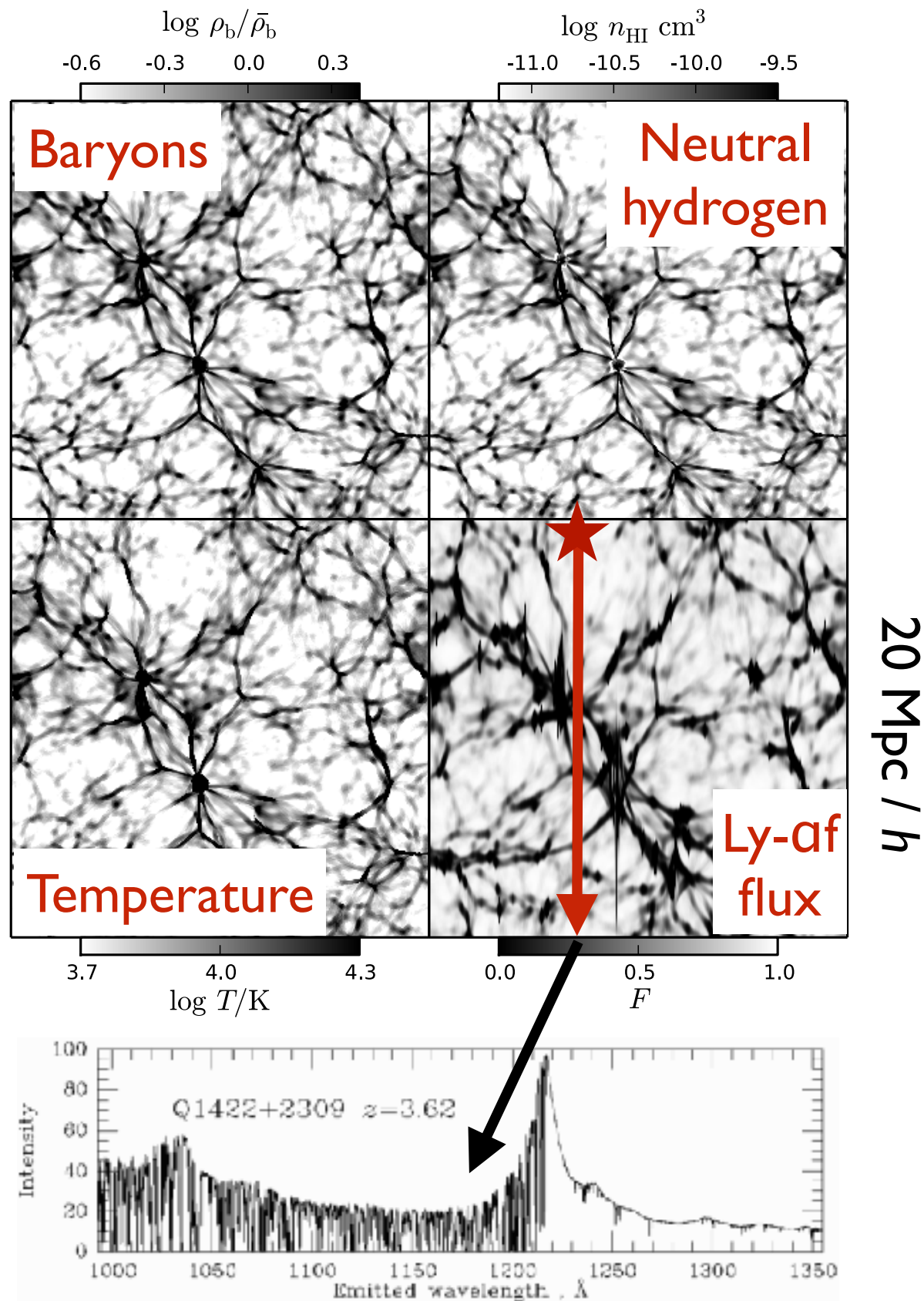


Ly-alpha forest traces
linear-order (mostly),
high-redshift ($z \sim 5$),
small-scale ($< \text{Mpc}$)
 density perturbations

$$k_{\frac{1}{2}} \propto m_a^{\frac{4}{9}}$$

↑

Hu et al. (2000)



Ly-alpha forest
 traces the cosmic
 density field —
 model with
**hydrodynamical
 simulations**

- Improved **physically-consistent astrophysical model** — wider range of reionisation histories
- **Emulator/active learning** to marginalise robustly astrophysical uncertainty (Rogers et al. 2019, JCAP)
- Exploit new data measuring smallest scales in density field — **search for ULA DM cut-off from heavier axions**



“Canonical” 10^{-22} - 10^{-21} eV ULA DM is strongly disfavoured by new bound

