

# Constraints on the mass of the thermal relic warm dark matter particle

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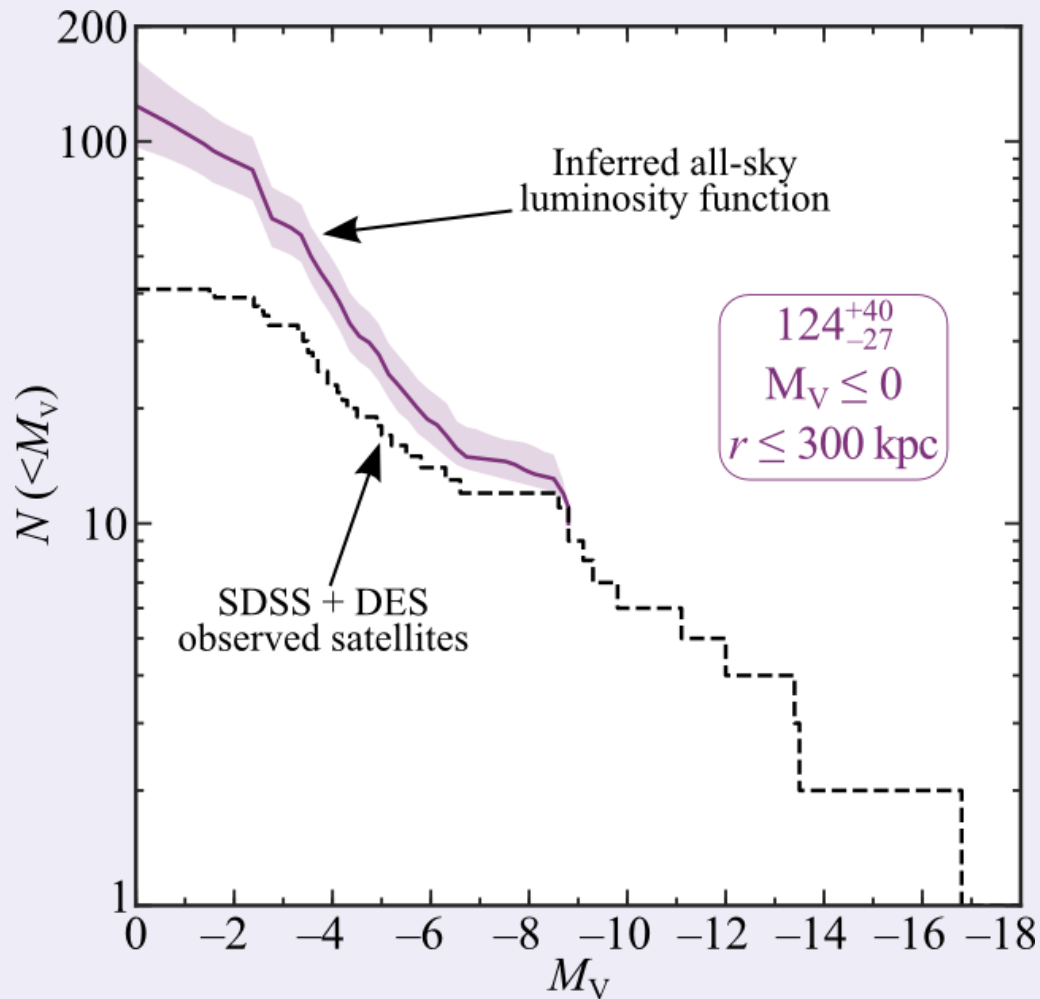
# Warm dark matter

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- Search for alternative models motivated by:
  - Small-scale problems in  $\Lambda$ CDM
  - Observations of a 3.5 keV line
- Thermal relic one of simplest WDM models
- Power spectrum suppressed at scales relevant for dwarf galaxies
- Rule out WDM models with insufficient substructure

# How many MW satellites?

Newton+(2018)  
MNRAS, **479**, 2853



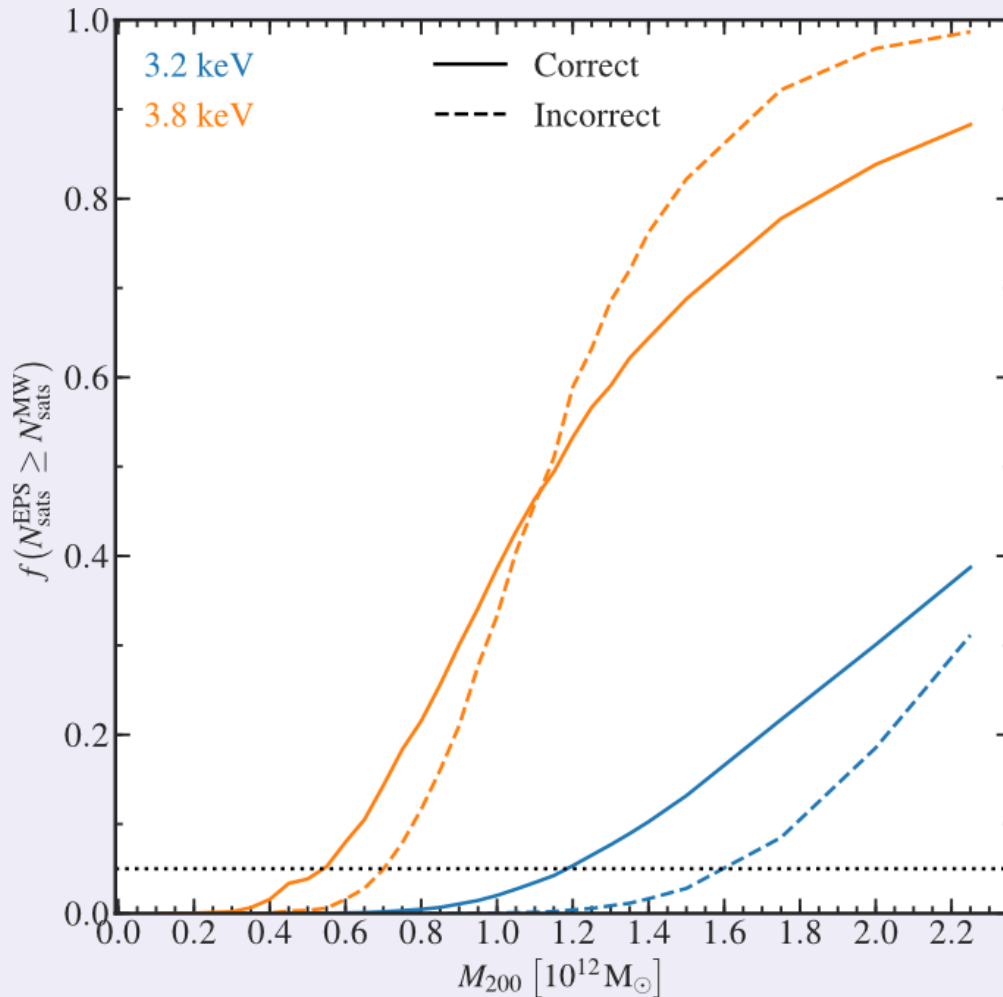
# Estimates of WDM substructure

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- Extended Press-Schechter formalism
- Calibrated with COCO haloes
- MW  $M_{200}$  in range  $[0.5, 2.0] \times 10^{12} M_{\odot}$



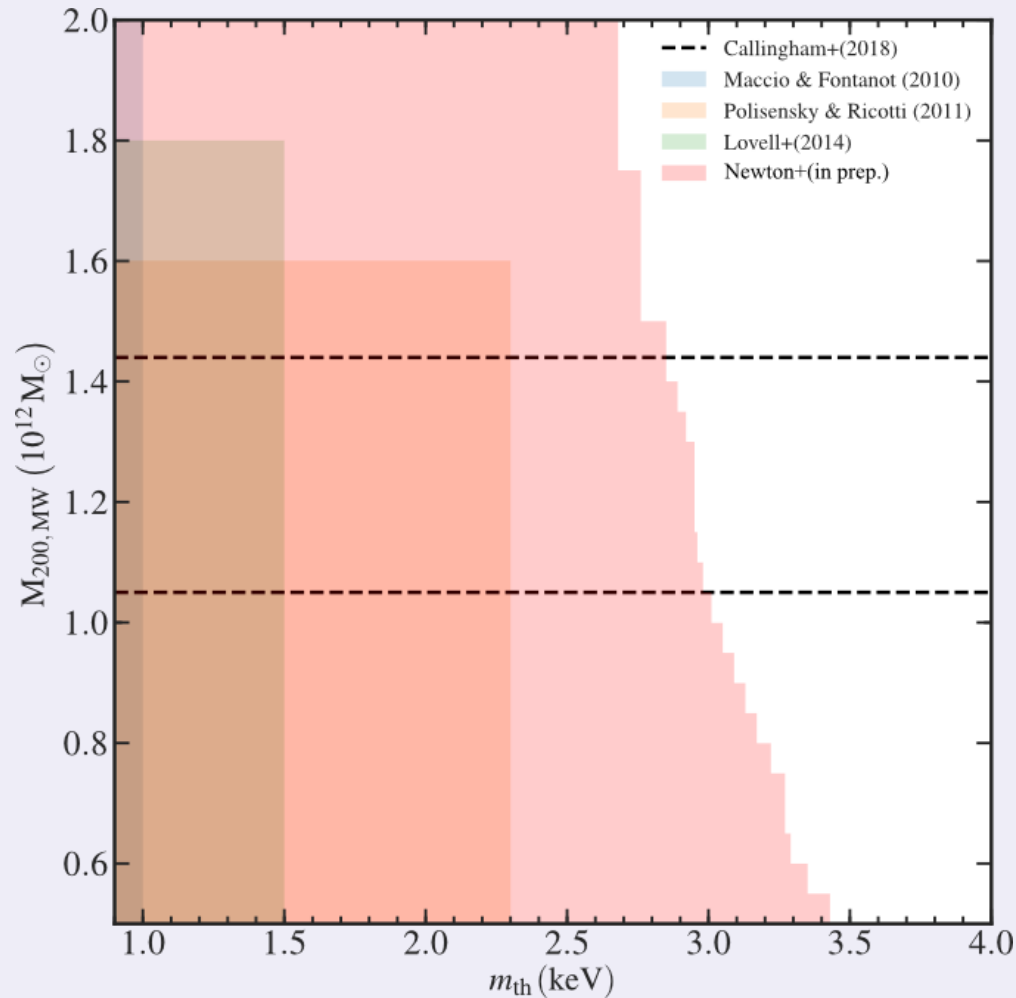
# Setting the constraints



- Conservative assumption: all DM subhaloes host a galaxy(!)
- Must account for scatter in number of MW satellites
- Rule out WDM models with  $f < 0.05$



# Thermal relic constraints

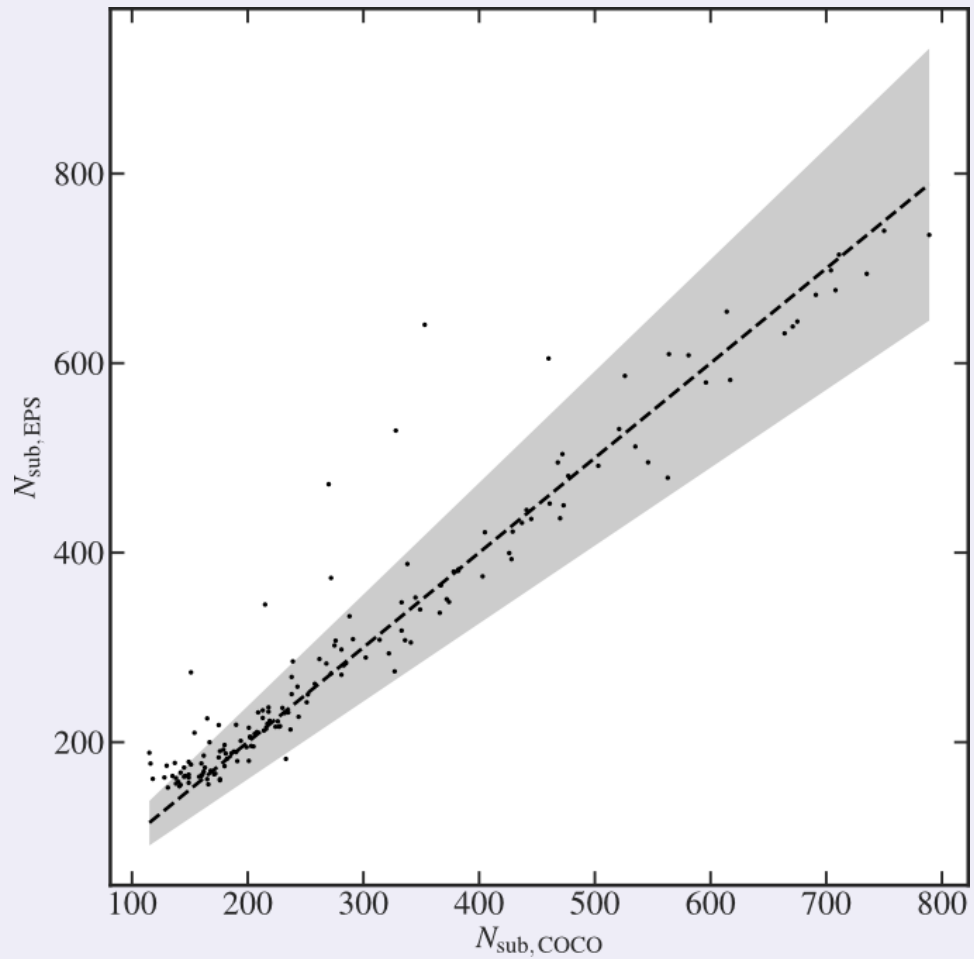


# Summary

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- Used estimates of number of MW satellites to place constraints on thermal relic WDM particle mass
- Constraints from previous analyses were too generous
- Will be on arXiv soon™
- Could use galaxy formation models to improve constraints
- Applying same technique to sterile neutrino models

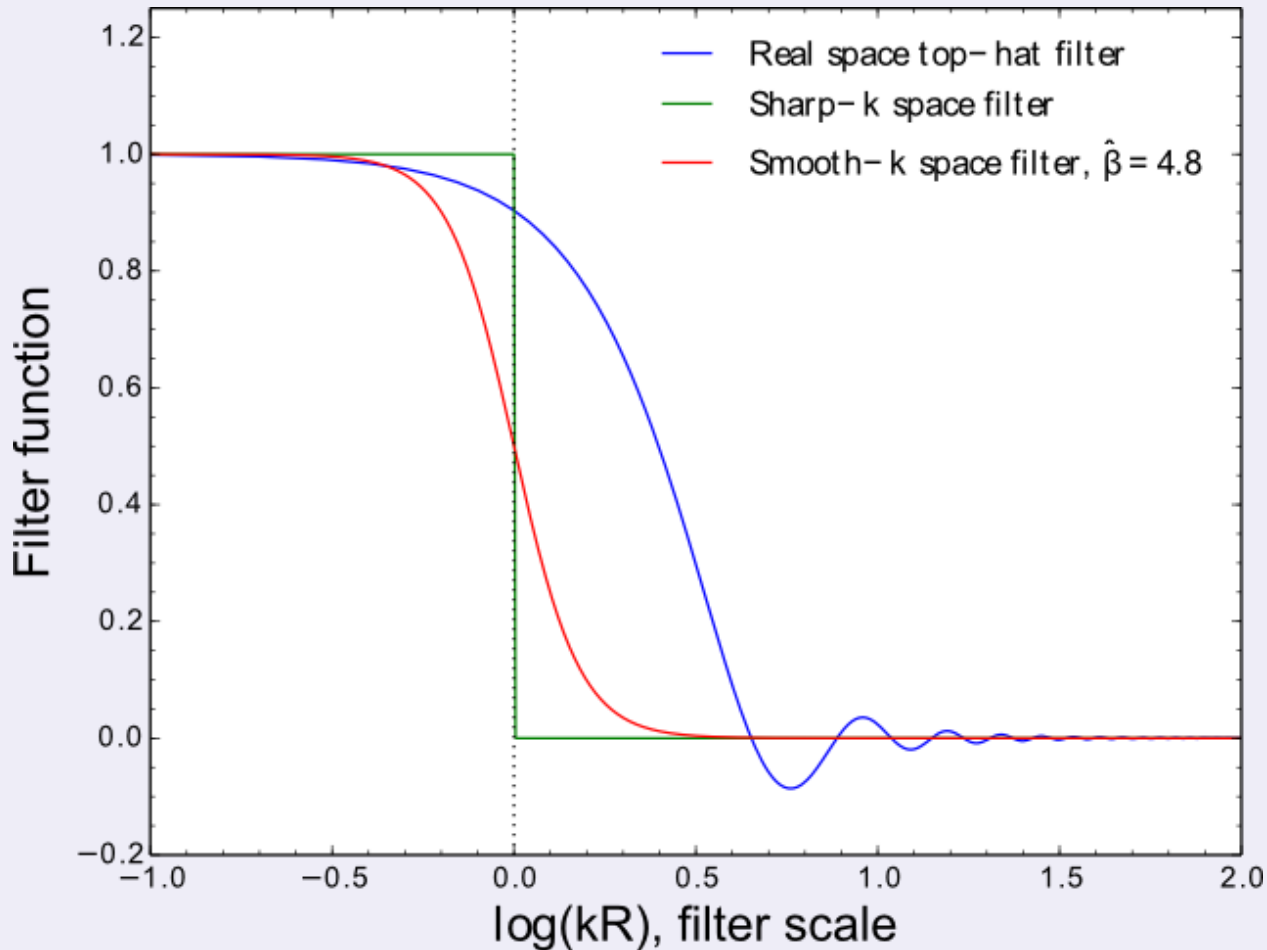
# Calibrating EPS



$$\hat{\beta} = 4.8, \hat{c} = 4.9$$



# Smooth- $k$ filter



Leo+(2018)  
arXiv:1801.02547

$$\tilde{W}(k|R) = \left[1 + (kR)^{\hat{\beta}}\right]^{-1}$$
$$M(R) = \frac{4\pi}{3} \bar{\rho}(\hat{c}R)^3$$

# Radial distribution of subhaloes

