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# OBSERVATIONAL CONSTRAINTS ON VARYING-ALPHA DOMAIN WALLS

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Lara Sousa

Instituto de Astrofísica e Ciências do Espaço

# SPATIAL VARIATIONS OF $\alpha$

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$$\frac{\Delta\alpha}{\alpha} = (0,57 \pm 0,11) \times 10^{-5}$$

UVS/VLT:

Much smaller...

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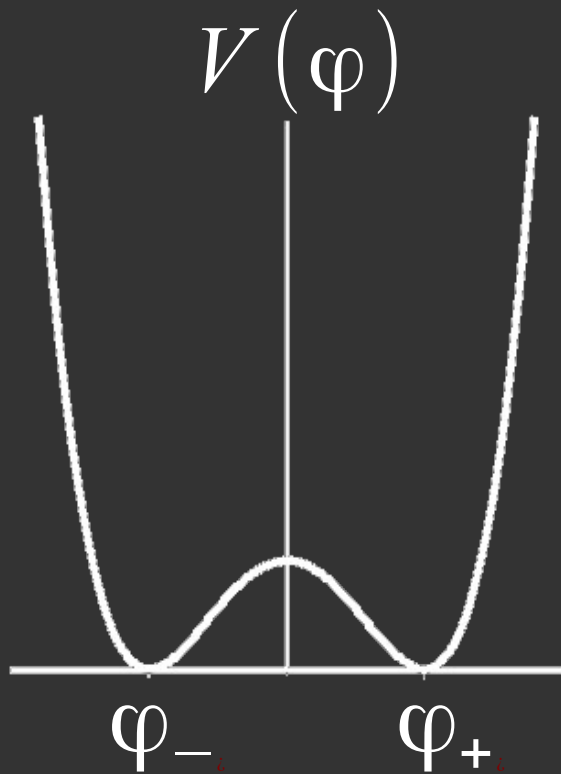
COMBINED SAMPLE OF 295 ABSORBERS FROM VLT AND KECK IS COMPATIBLE WITH A DIPOLE MODEL WITH AMPLITUDE

$$\frac{\Delta\alpha}{\alpha} = \left( 0,97^{+0,22}_{-0,20} \right) \times 10^{-5}$$

[King et al, astro-ph:1202.4758]

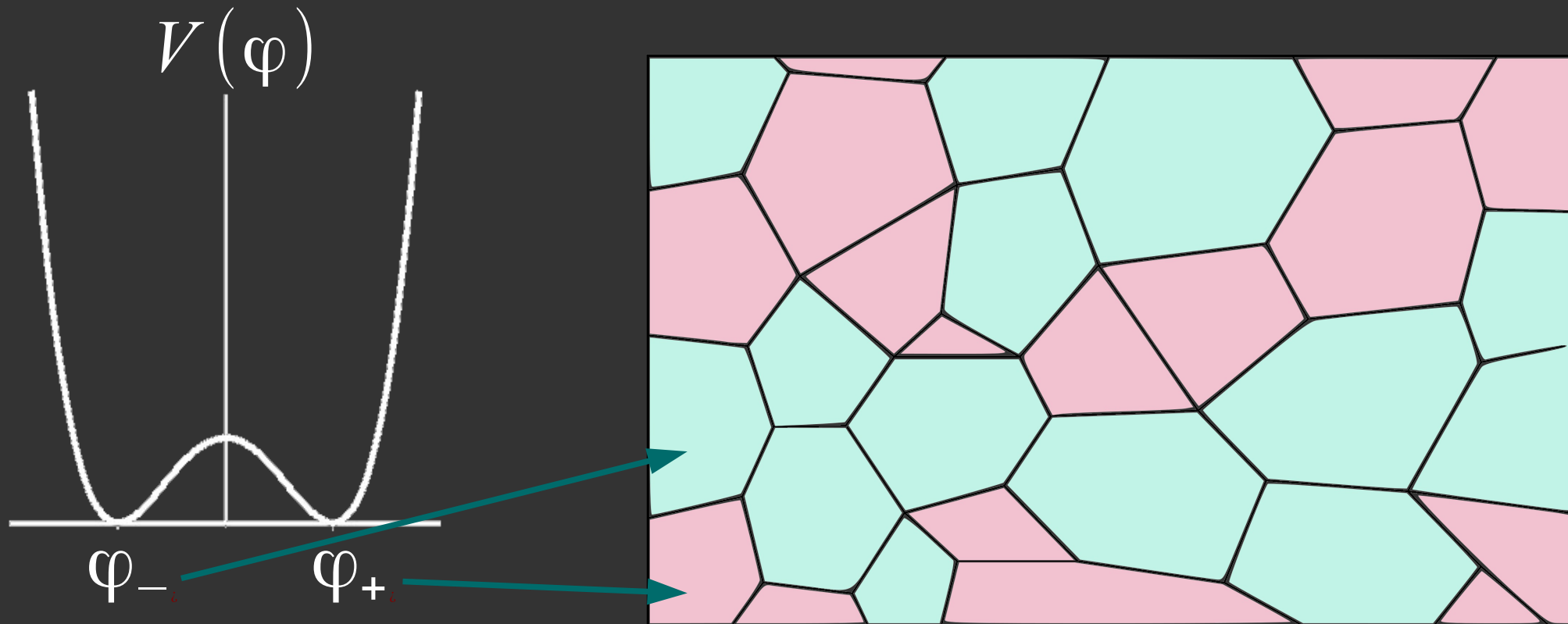
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DOMAIN WALLS ARE BE FORMED WHEN DISCRETE SYMMETRIES ARE SPONTANEOUSLY BROKEN IN PHASE TRANSITIONS.



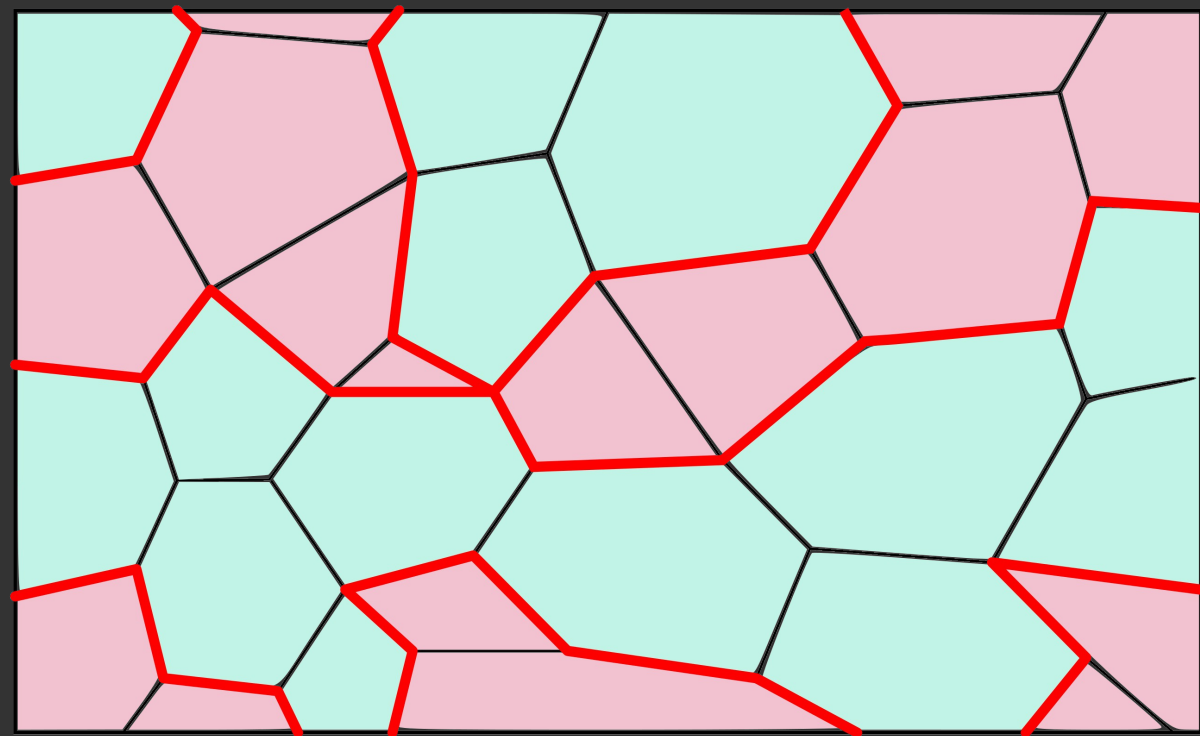
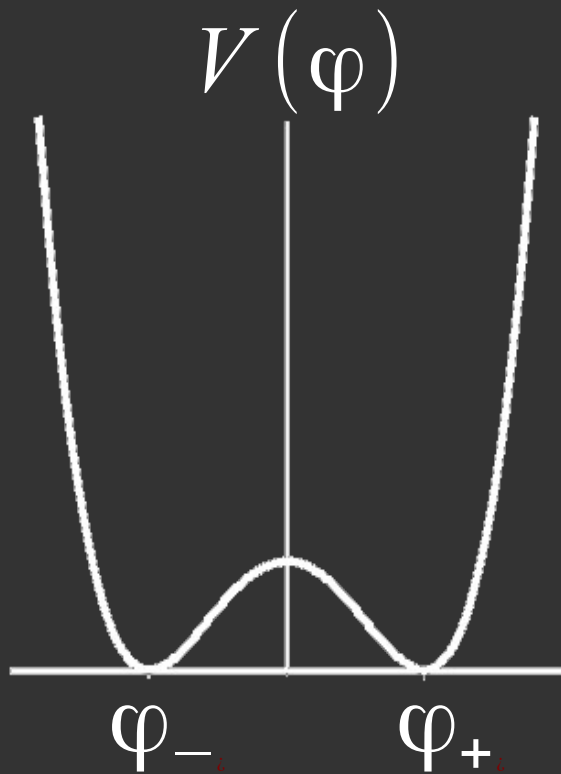
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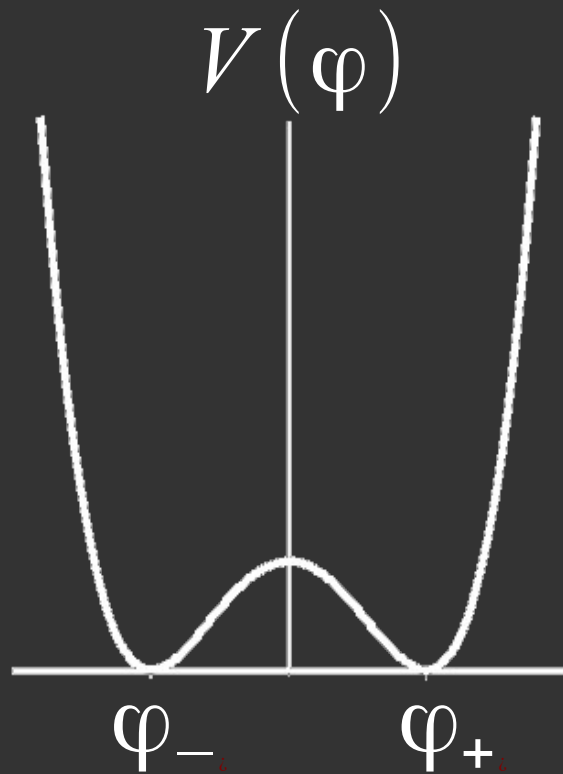
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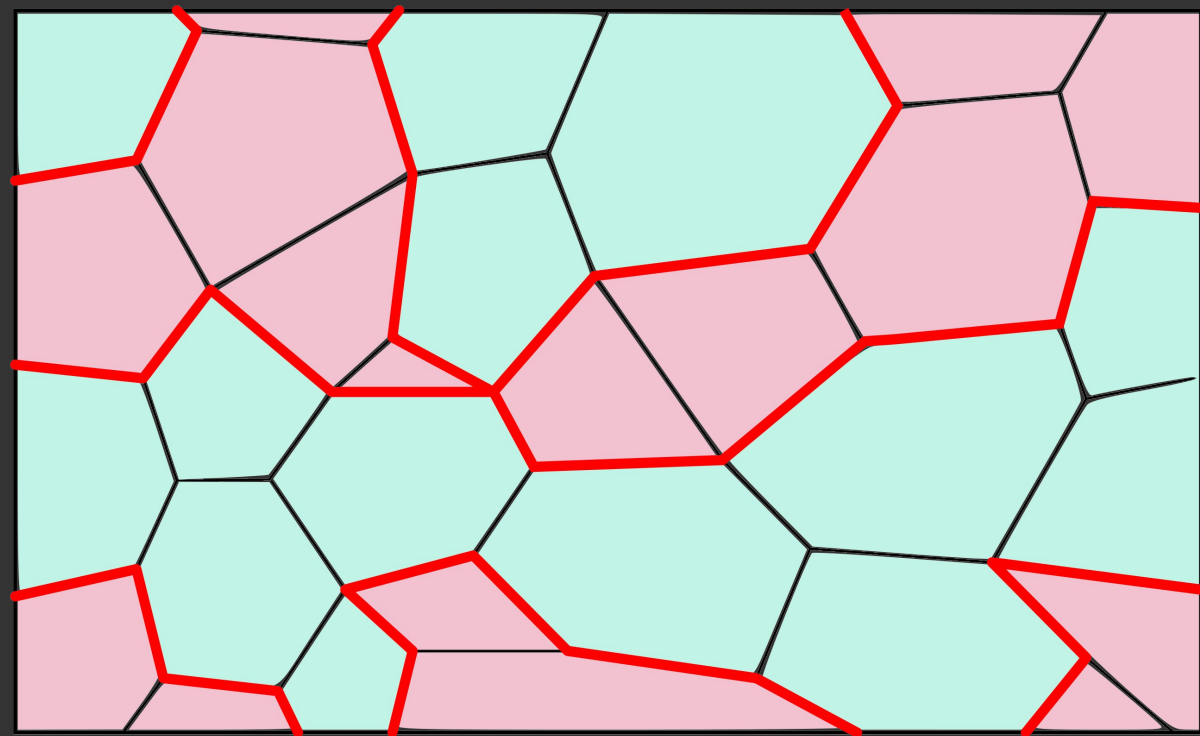
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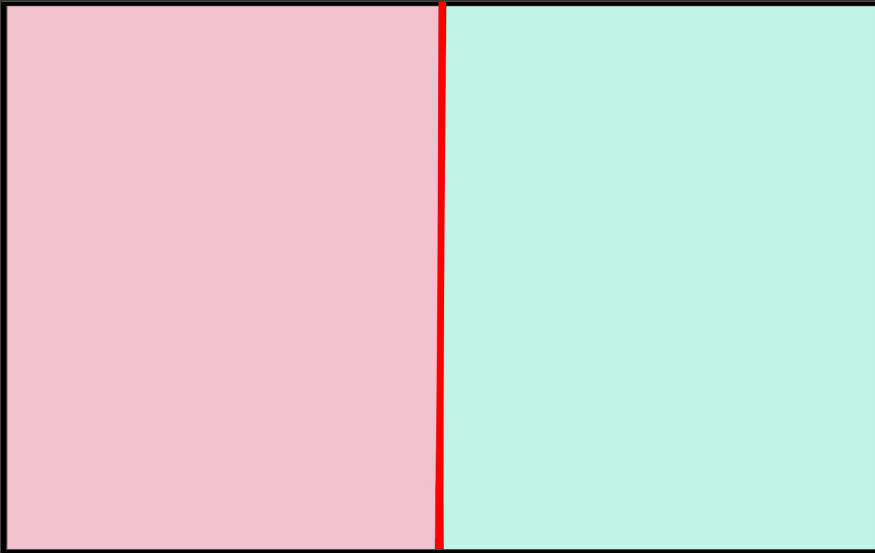
$$\alpha = \alpha(\varphi)$$



**DOMAIN WALLS!**

# BIASED DOMAIN WALLS

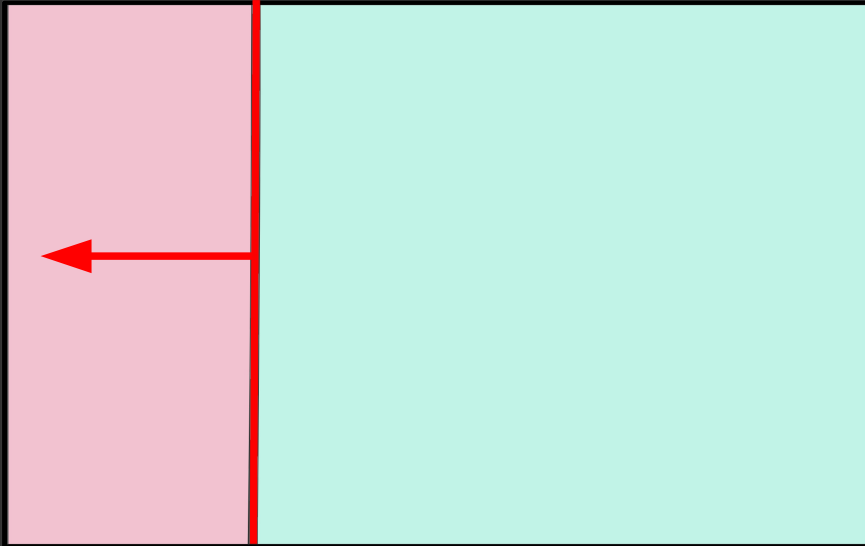
DOMAINS ON EACH SIDE OF A WALL HAVE  
DIFFERENT BARYON ENERGY DENSITIES  $\epsilon = \rho_{B+} - \rho_{B-}$





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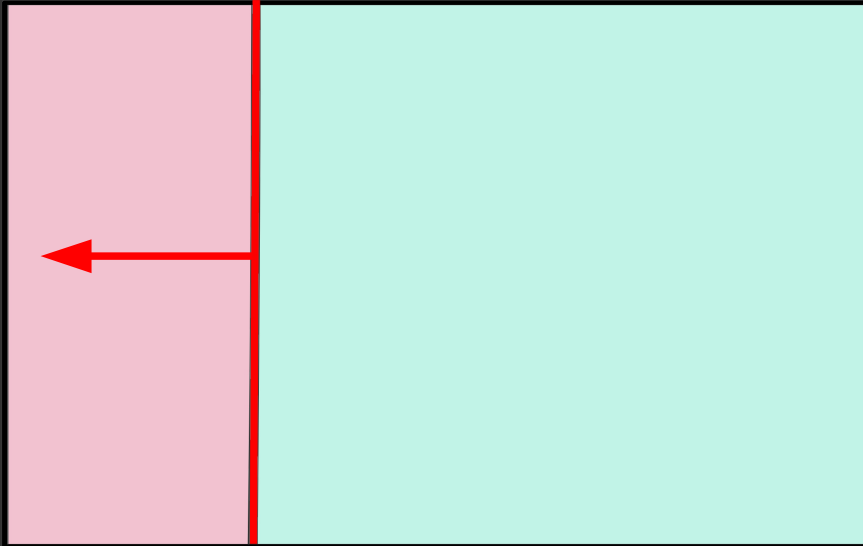


WALL GAINS MOMENTUM:

$$\frac{dv}{dt} = \frac{1}{R_\epsilon \gamma^3}, \quad R_\epsilon = \frac{\sigma}{\epsilon}$$

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DOMAIN WALLS ARE PUSHED TOWARDS REGIONS WITH A HIGHER ENERGY DENSITY.

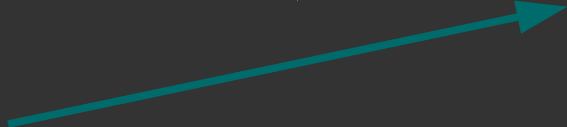
# BIASED DOMAIN WALLS

IN COSMOLOGICAL BACKGROUNDS

$$\frac{dv}{dt} = (1 - v^2) \left( \frac{2}{R} + \frac{1}{\gamma R_\epsilon} - 3Hv \right)$$

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DECAY IS TRIGGERED WHEN BIAS  
TERM DOMINATES:

$$\frac{\sigma}{\epsilon L} = \frac{\Omega_w}{\Omega_B} \left| \xi \frac{\Delta \alpha}{\alpha} \right|^{-1} < 1$$

# OBSERVATIONAL CONSTRAINTS

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WALLS SHOULD BE AT  $z \sim 0,5 - 1$  IN ORDER TO  
CAUSE REPORTED DIPOLE VARIATION OF  $\alpha$ :  
[Olive et al, astro-ph:1204.4931]

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NARROW OBSERVATIONAL WINDOW

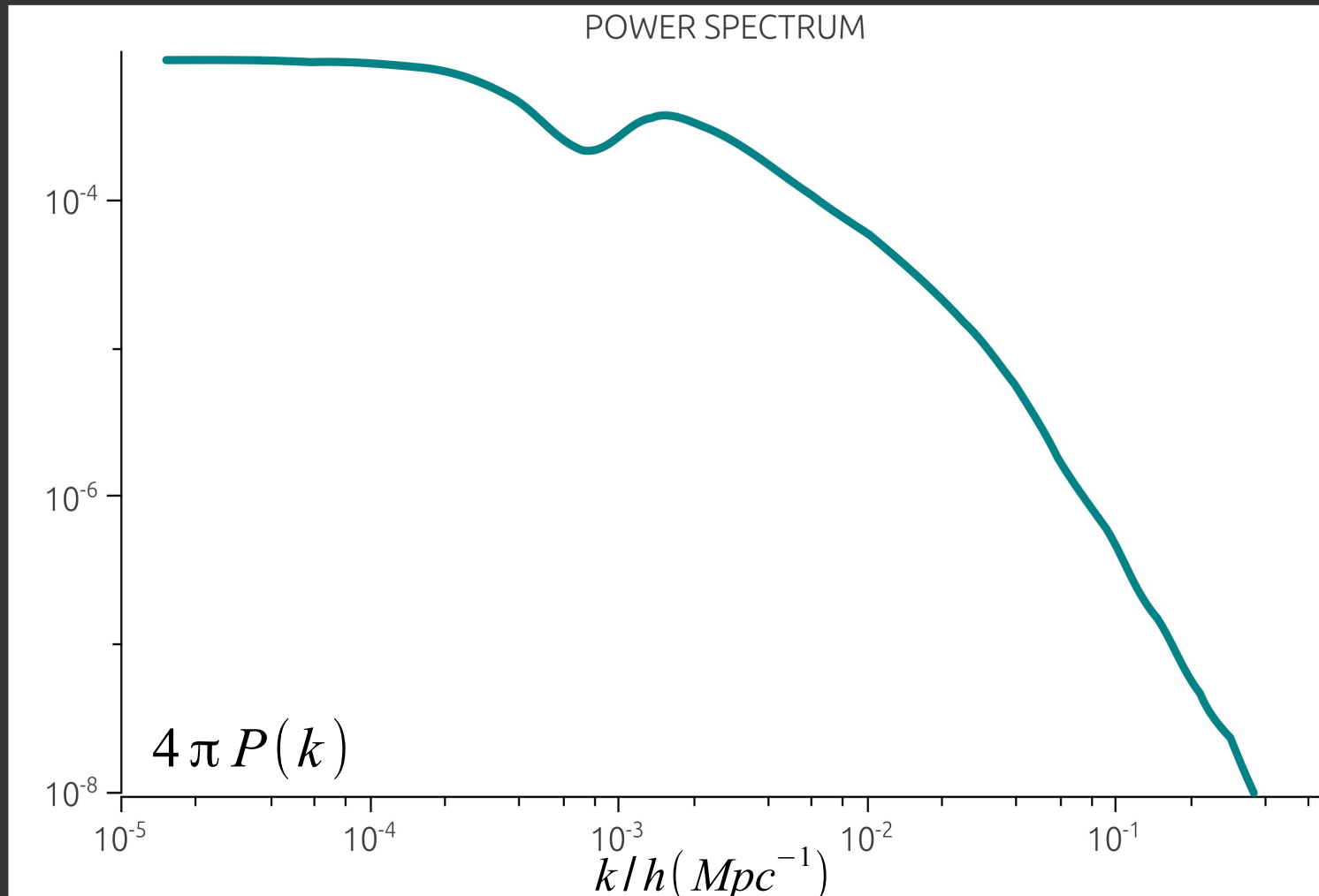
$$10^{-10} < \Omega_{w0} < 10^{-5}$$

SPATIAL VARIATION  
ON  $\alpha$

CMB  
ANISOTROPIES

# COMING SOON

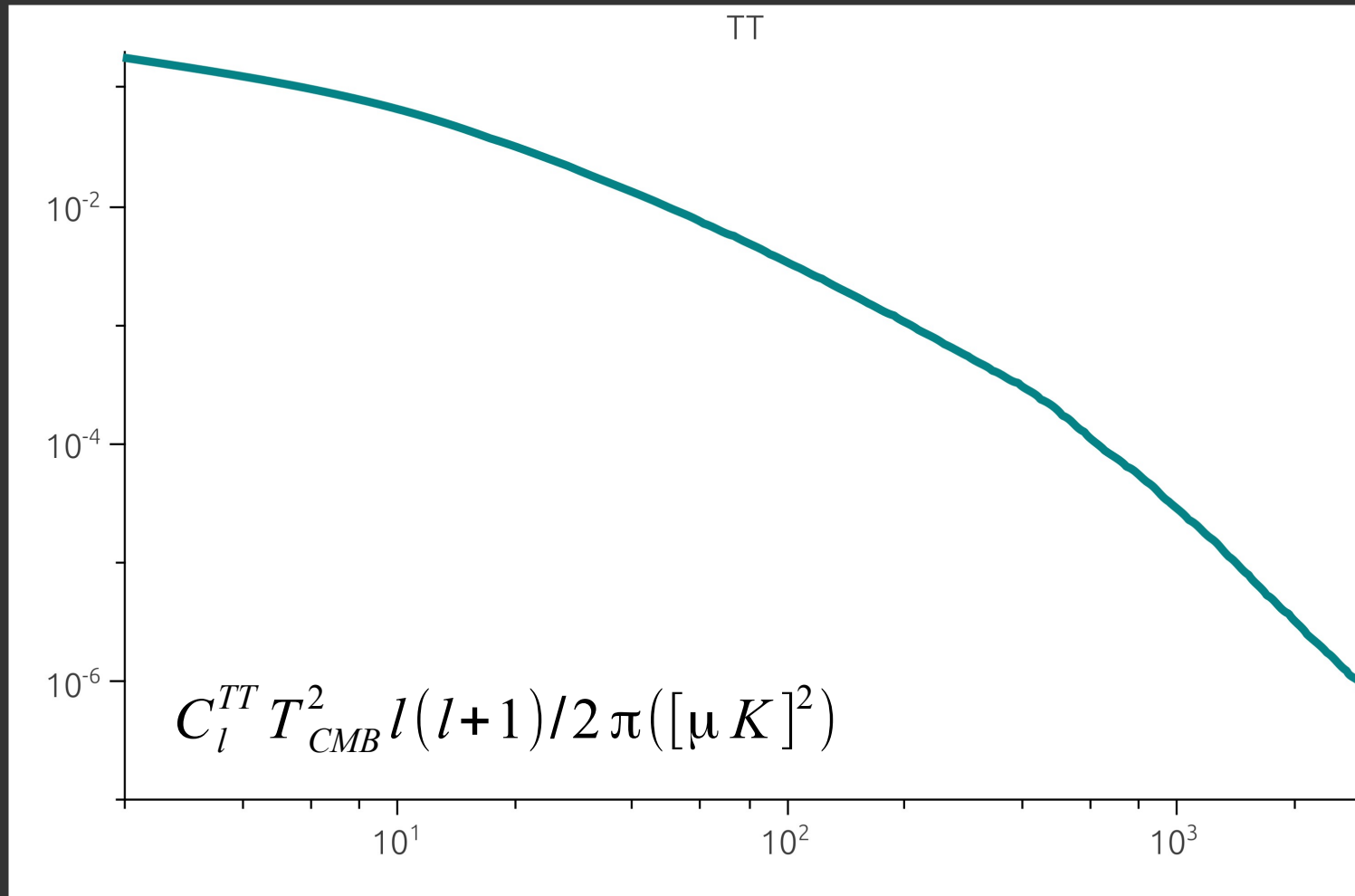
## CONTRIBUTIONS TO THE CDM POWER SPECTRUM ON SMALL SCALES IS REDUCED





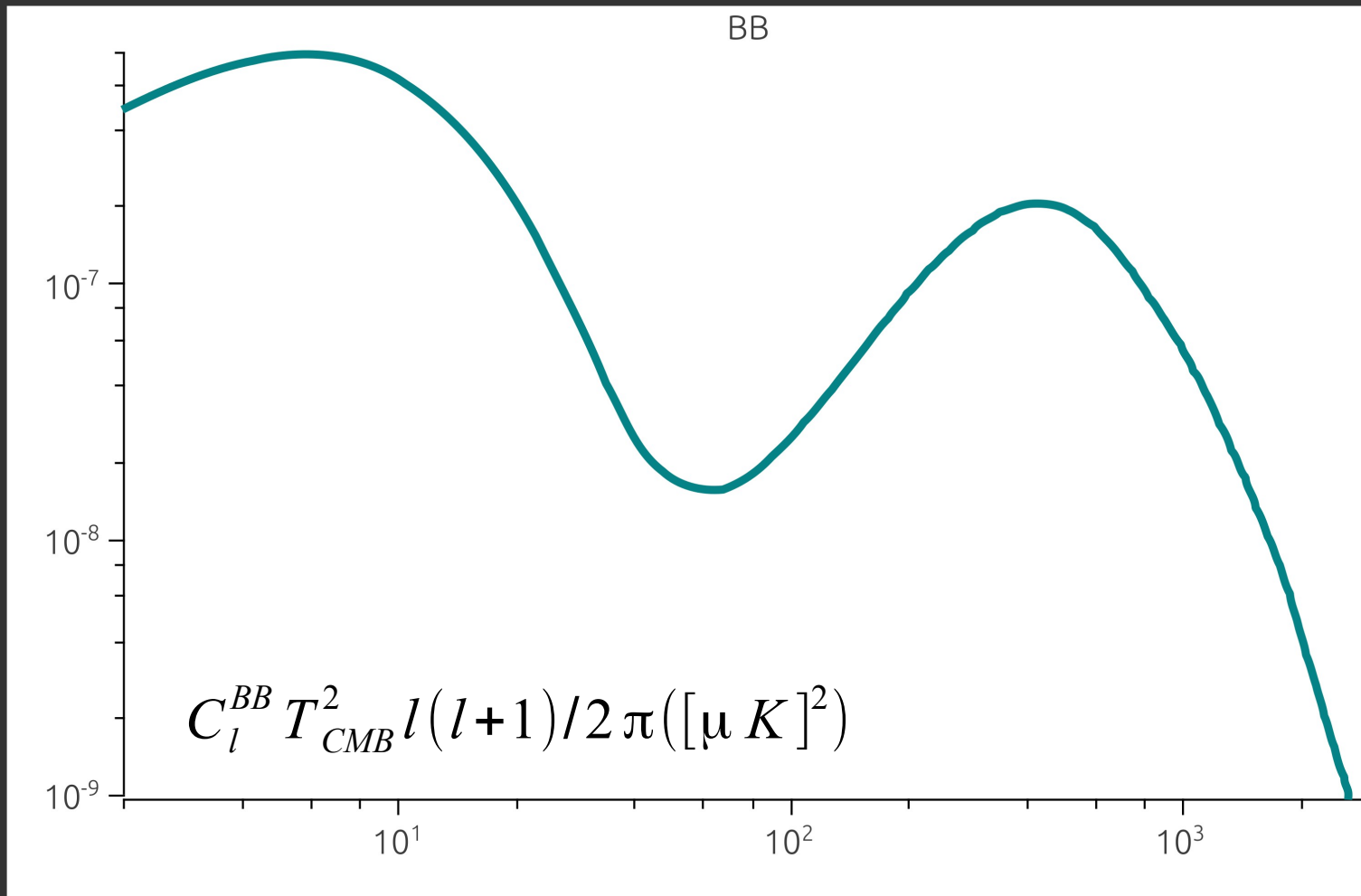
# COMING SOON

UNLIKE OTHER DEFECTS CONTRIBUTIONS TO PRIMARY CMB ANISOTROPIES ARE NEGLIGIBLE



# COMING SOON

HOWEVER, CONTRIBUTIONS TO B-MODE POLARIZATION MAY STILL BE SIGNIFICANT.



# ACKNOWLEDGMENTS

This talk was based on work done in collaboration with P. P. Avelino that resulted in the following article:

P. P. Avelino and L. Sousa, *Observational Constraints of Varying-alpha domain walls*, *Universe*, 1, 6-16, 2015

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