

# Impact of a wCDM cosmology on the tSZ power spectrum

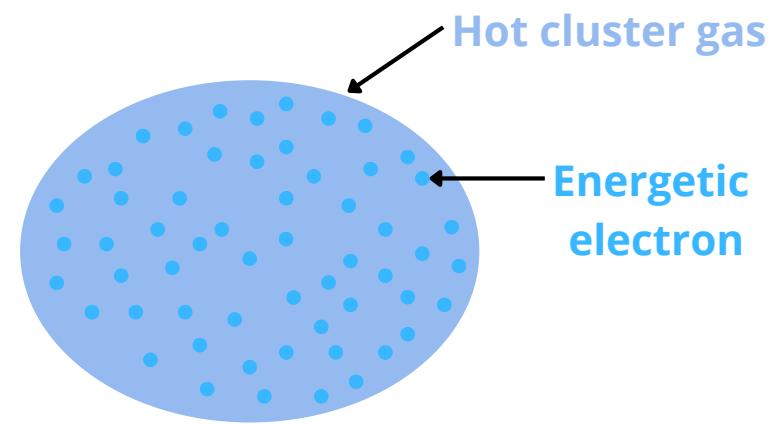
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Work done in collaboration with Karim Benabed & Yohan Dubois

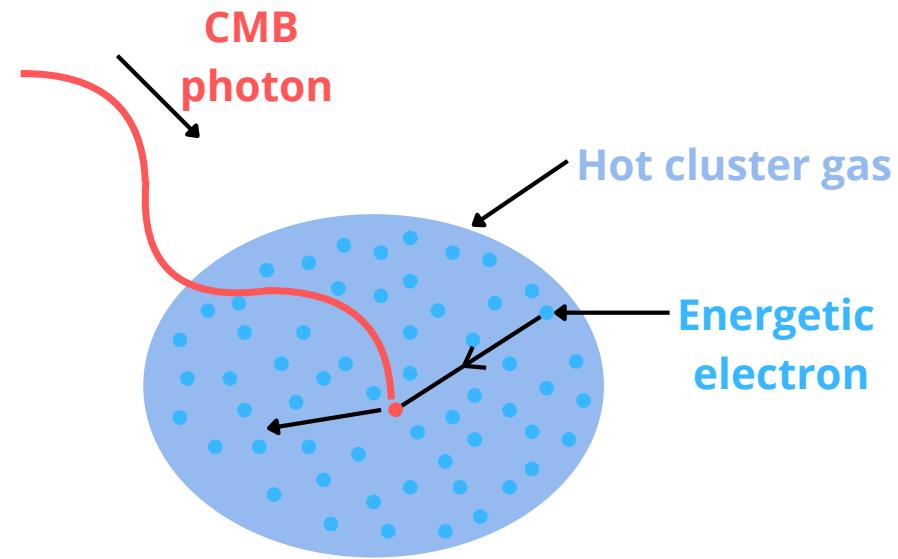
# Effet Sunyaev-Zel'dovich thermique

- Comes from the **thermal electrons**, which reside mostly in **galaxy clusters**



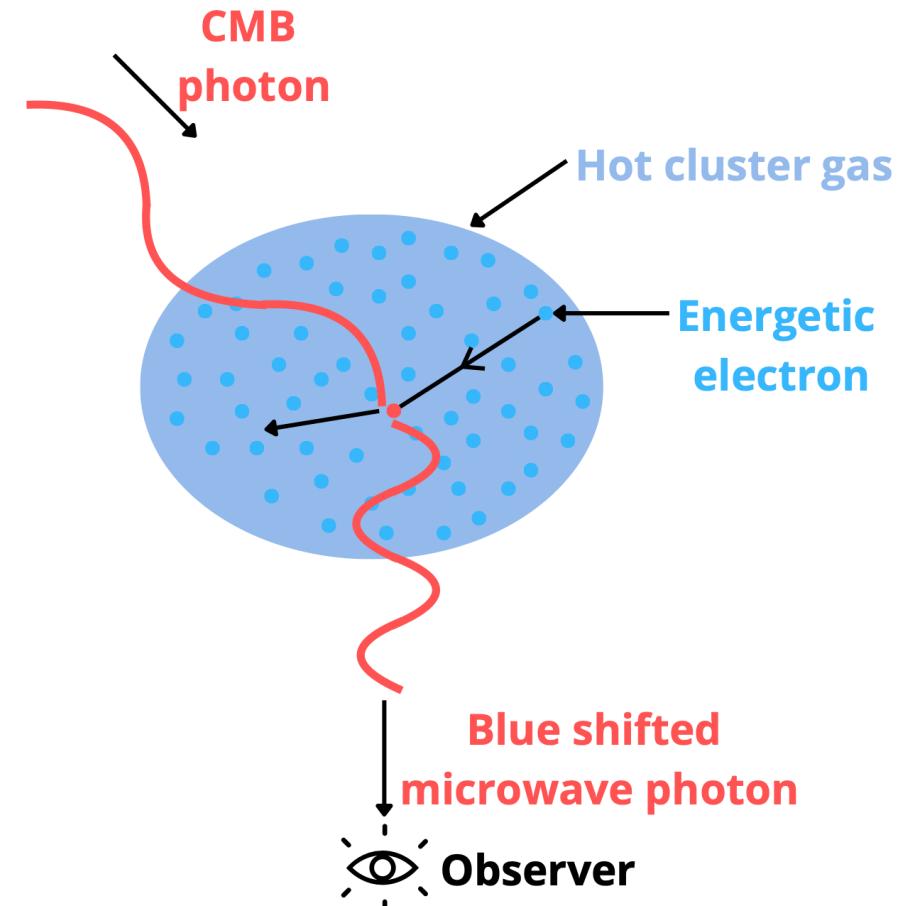
# Effet Sunyaev-Zel'dovich thermique

- ▶ Comes from the **thermal electrons**, which reside mostly in **galaxy clusters**
- ▶ Energy is transferred from **hot electrons** to **CMB photons** through **inverse Compton scattering**

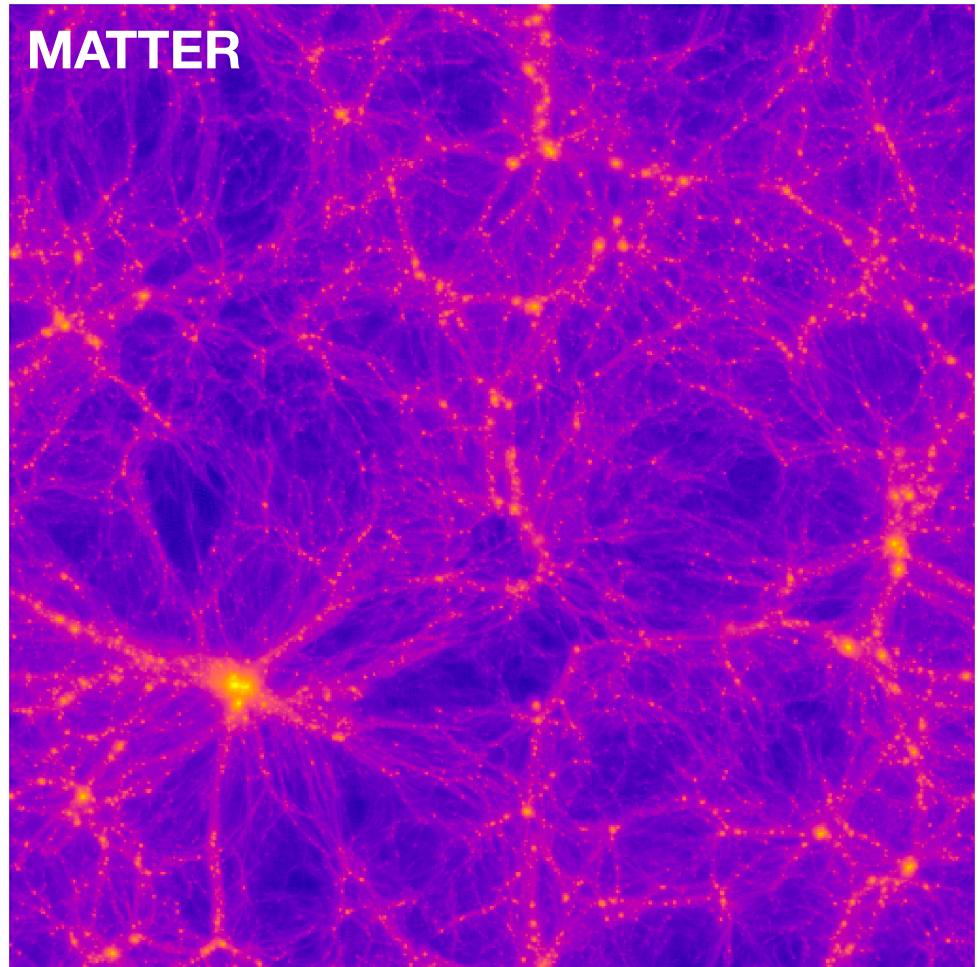
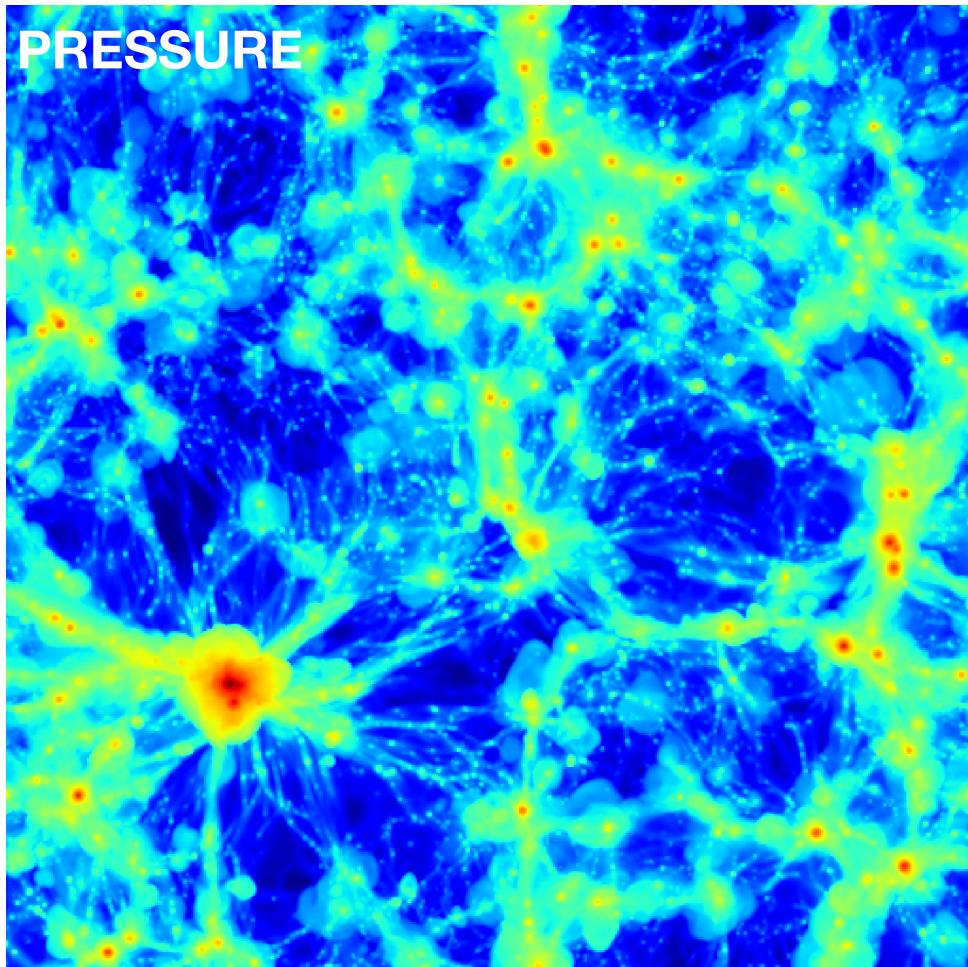


# Effet Sunyaev-Zel'dovich thermique

- ▶ Shift in **energy**
- ▶ Information about the late time Universe
- ▶ Dependence: **gas density and temperature**
- ▶ Electron pressure along the line of sight



# Horizon-AGN



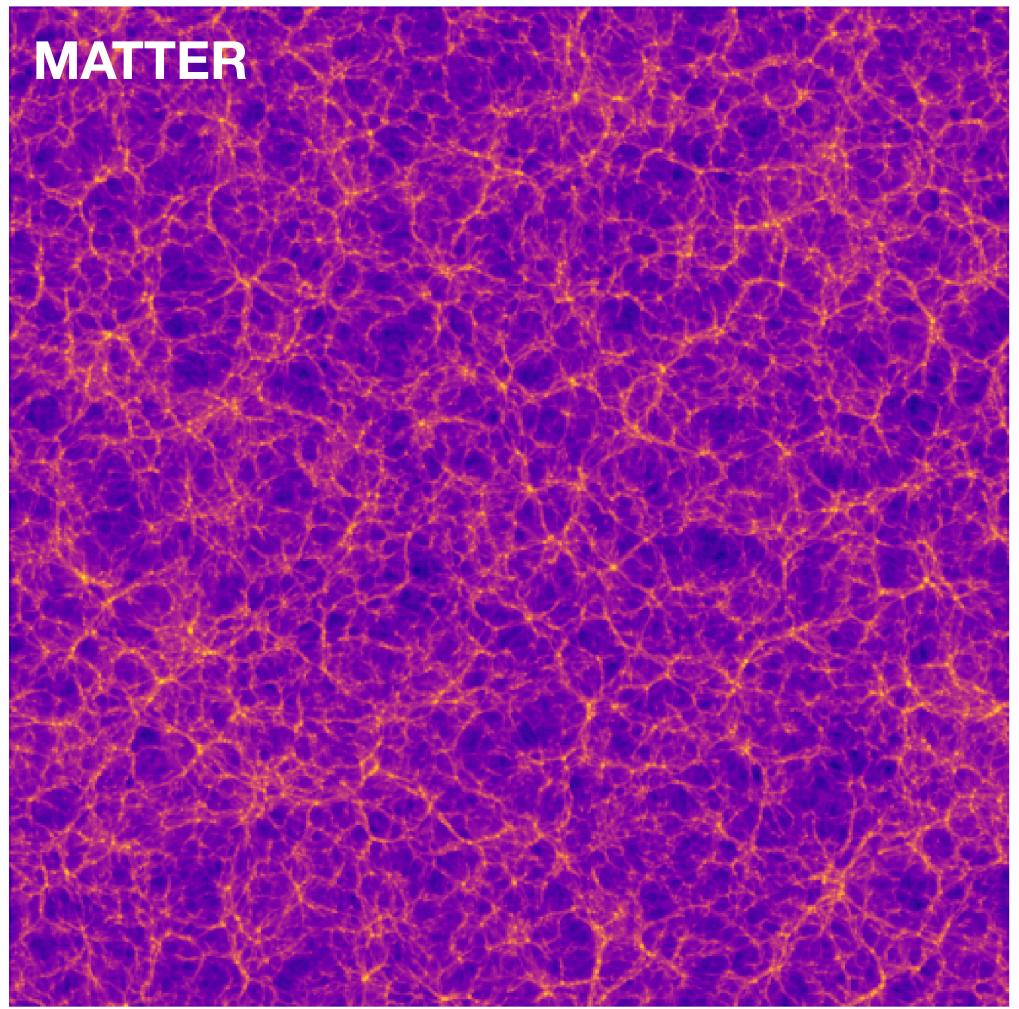
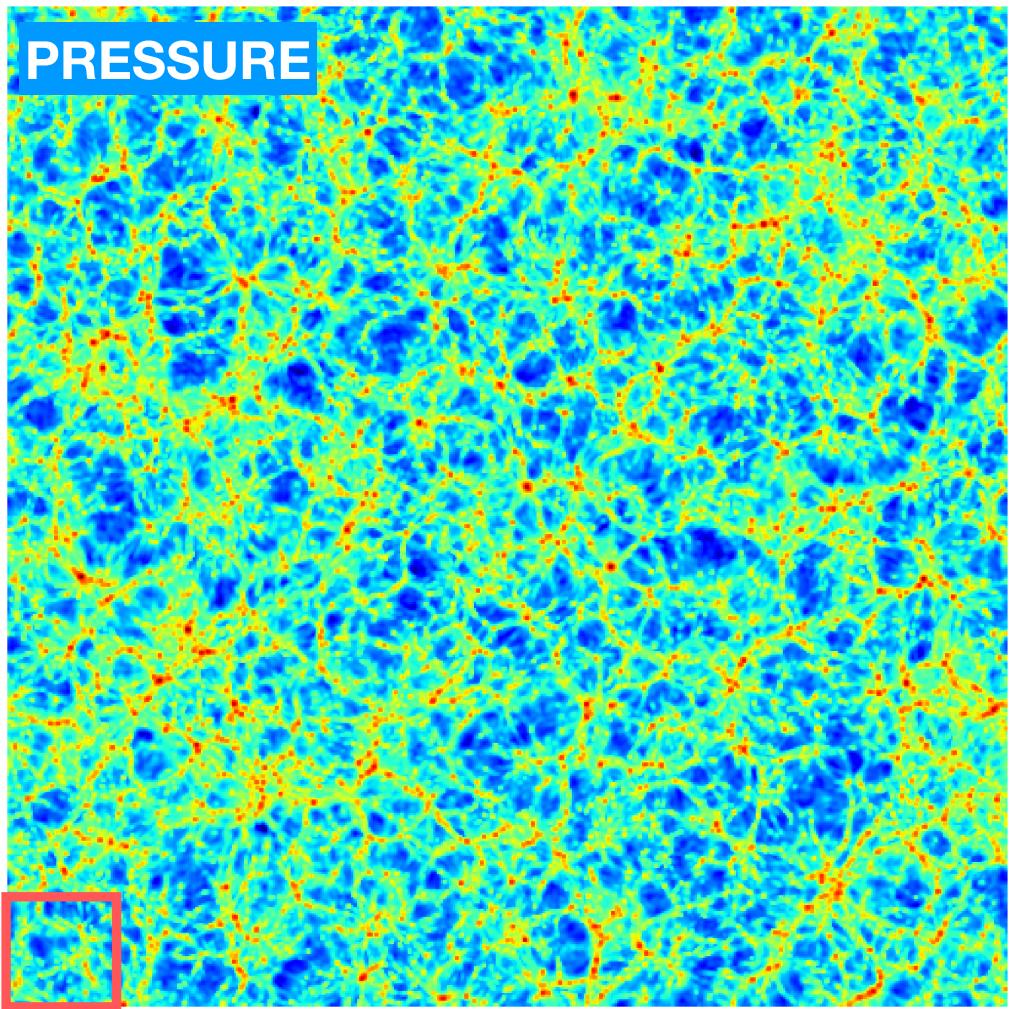
# L896\_wCDM simulations

- ▶ Cosmological hydrodynamical simulations
- ▶  $896 h^{-1}\text{Mpc}$  comoving volume,  $1024^3$  DM particle  $\rightarrow M_{\text{DM, res}} = 6 \times 10^{10} M_\odot$
- ▶ Gas cooling and heating, no galactic physics
- ▶ Initial condition using 2LPT
- ▶ **Cosmology wCDM:**  $P = w\rho$  with different  $w$ 
  - $w(a) = w_0 + w_a(1 - a)$
  - $w = -0.8, w = -1, w = -1.2$

Equivalent to  $\Lambda\text{CDM}$

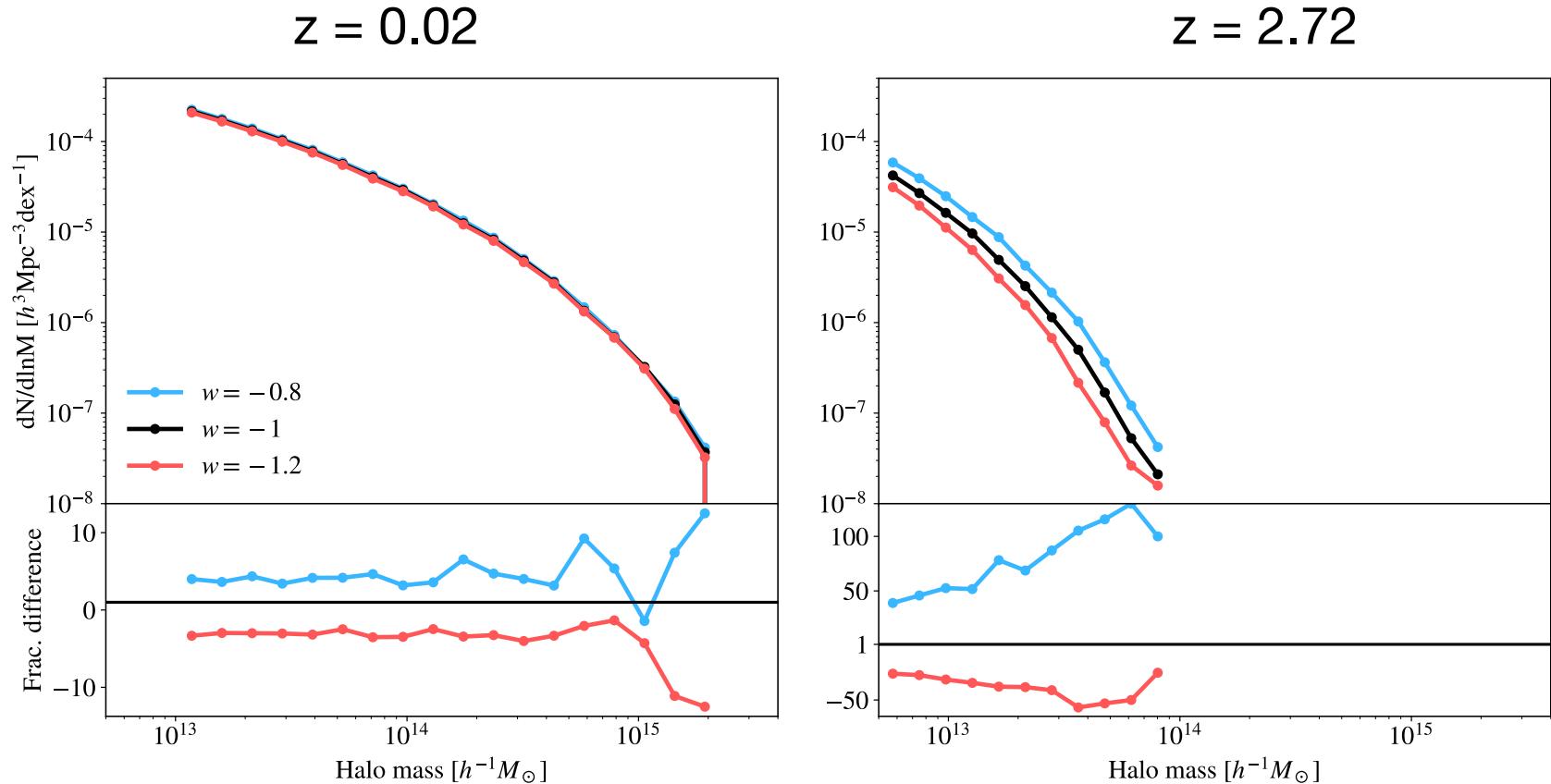
# L896\_wCDM simulations

Size of Horizon-AGN



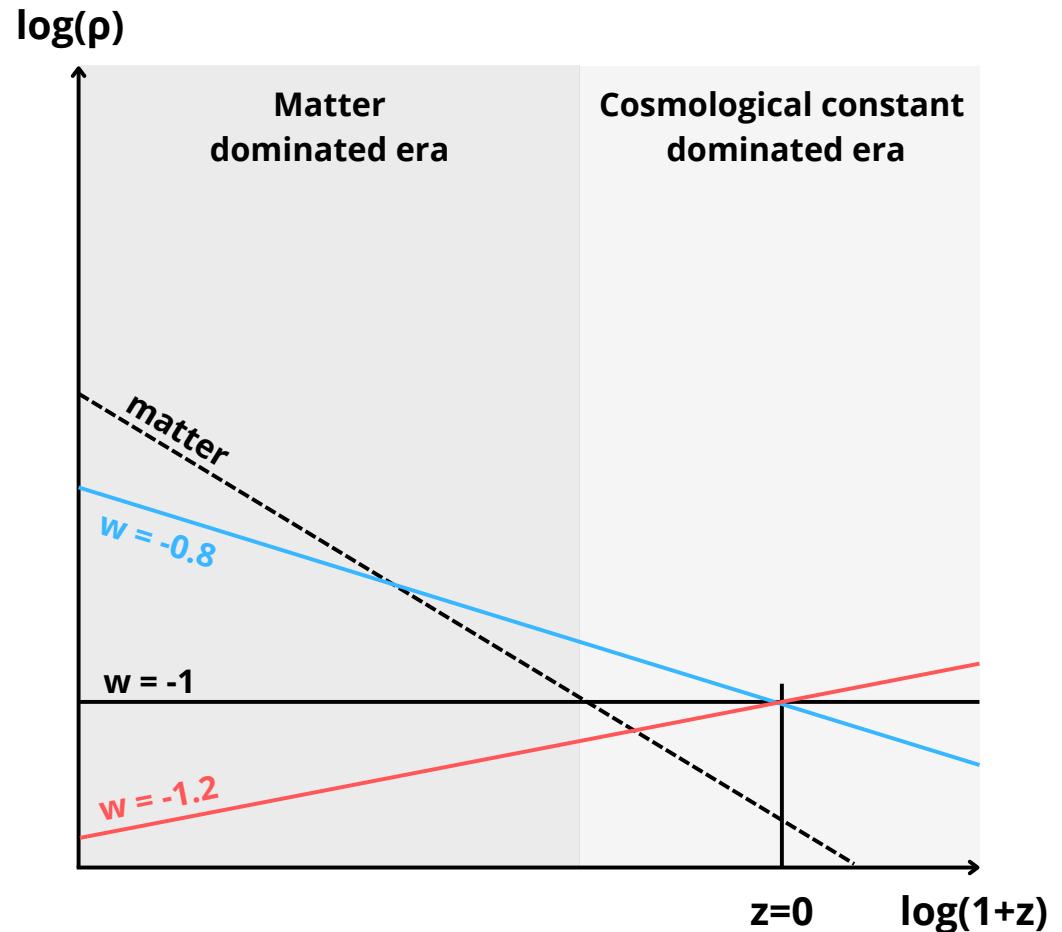
# Halo mass function

- ▶ Dark energy impacts the growth of structures
- ▶  $P = w\rho$



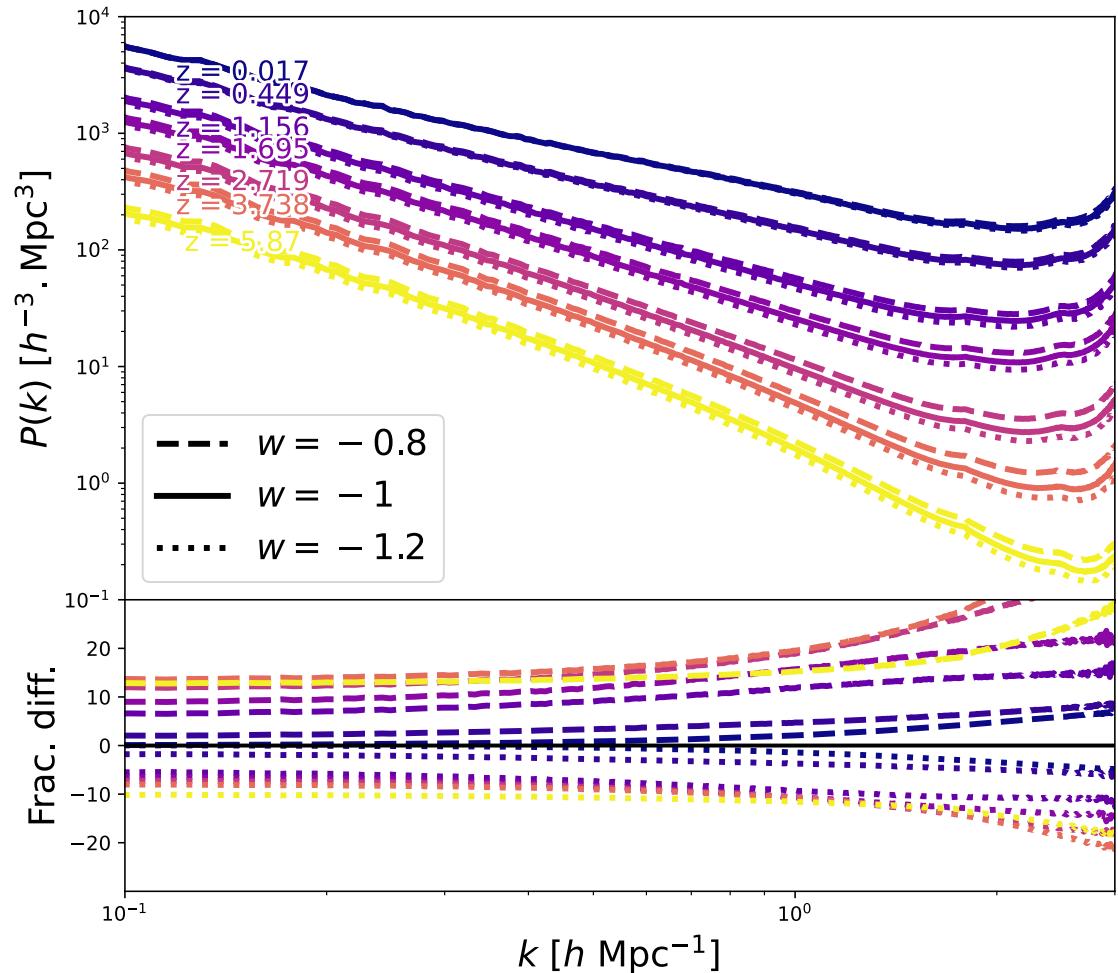
# Growth of structures

- ▶  $\sigma_8$  imposed
- ▶  **$w = -0.8$  accelerated expansion starts earlier**
  - growth of structures is slower
  - **structure more developed earlier**
- ▶ Opposite trend for  $w = -1.2$



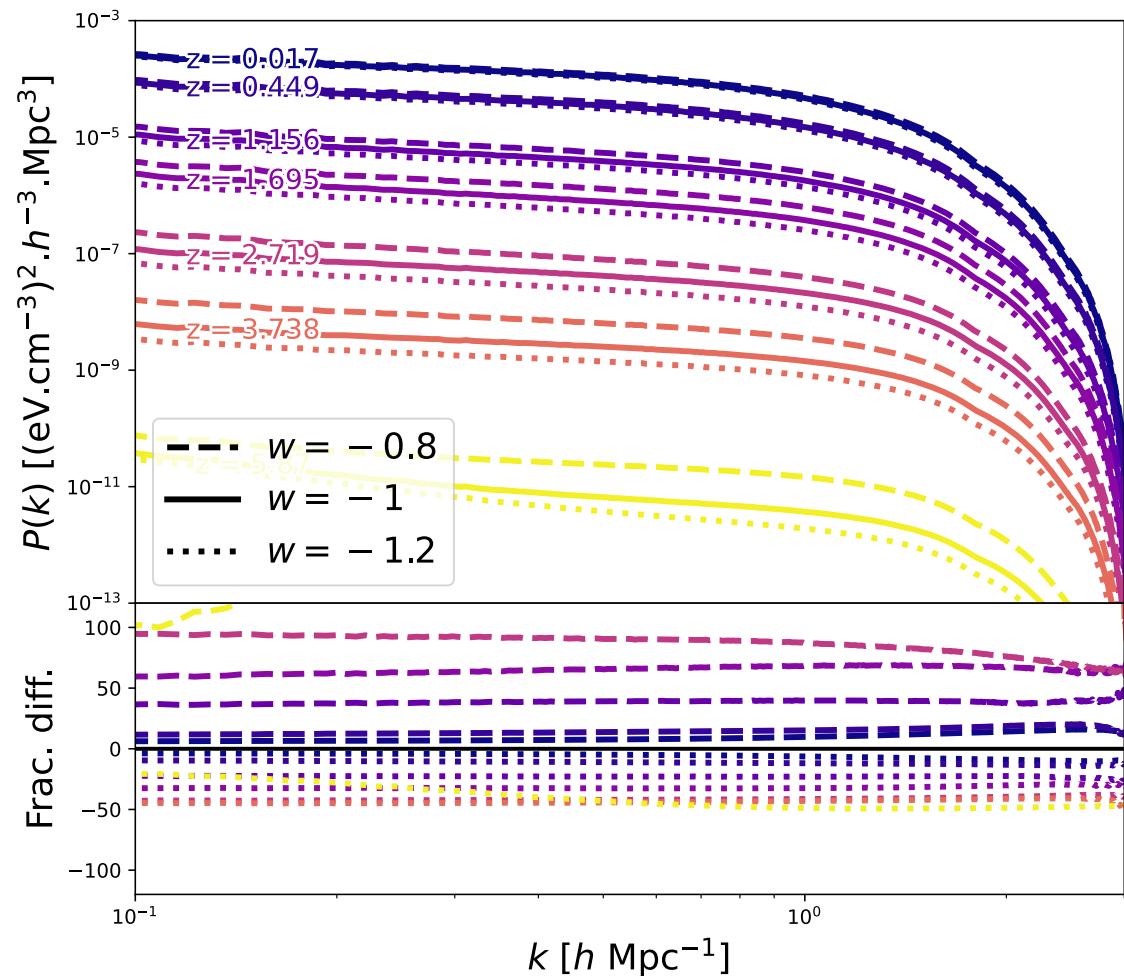
# Matter power spectrum

- ▶ Power increases from  $w = -0.8$  to  $w = -1$  to  $w = -1.2$
- ▶ These trends are expected



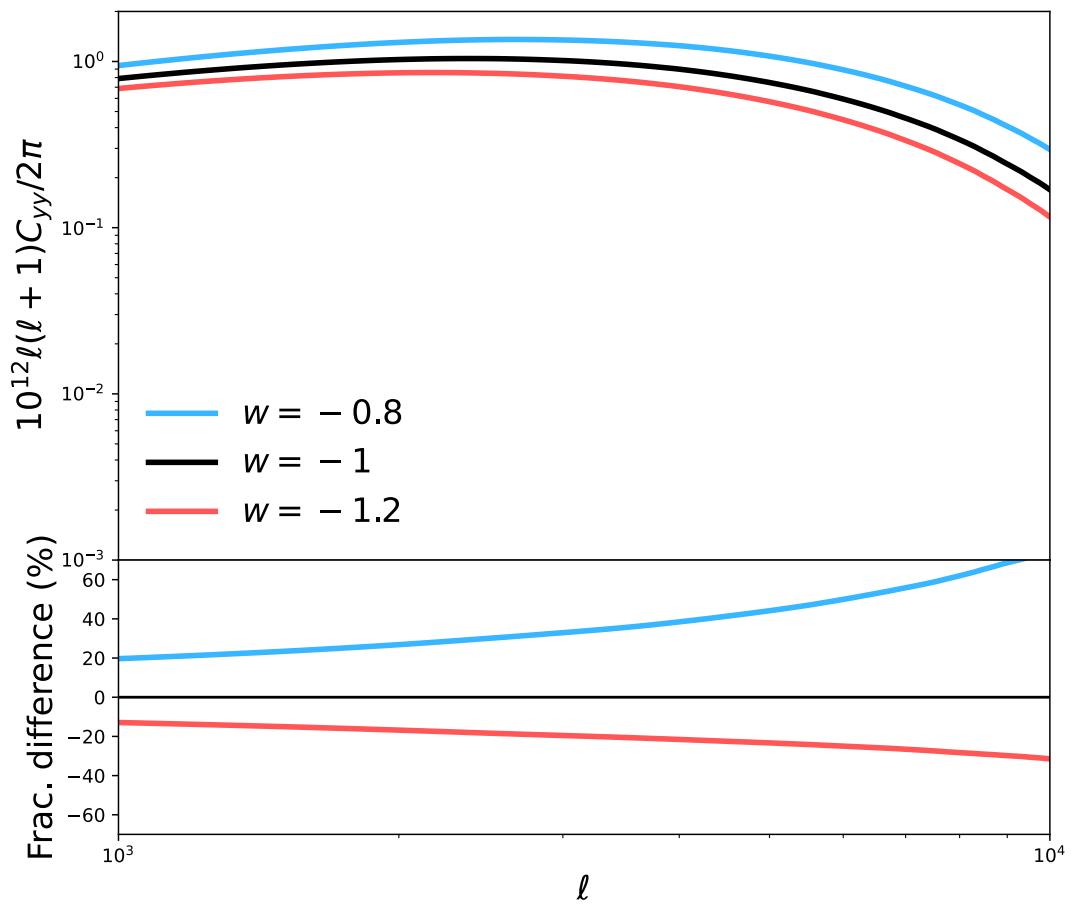
# Pressure power spectrum

- ▶ Power increases from  $w = -0.8$  to  $w = -1$  to  $w = -1.2$
- ▶ These trends are expected
- ▶ Can it be predicted by simple quantity?



# Angular pressure power spectrum

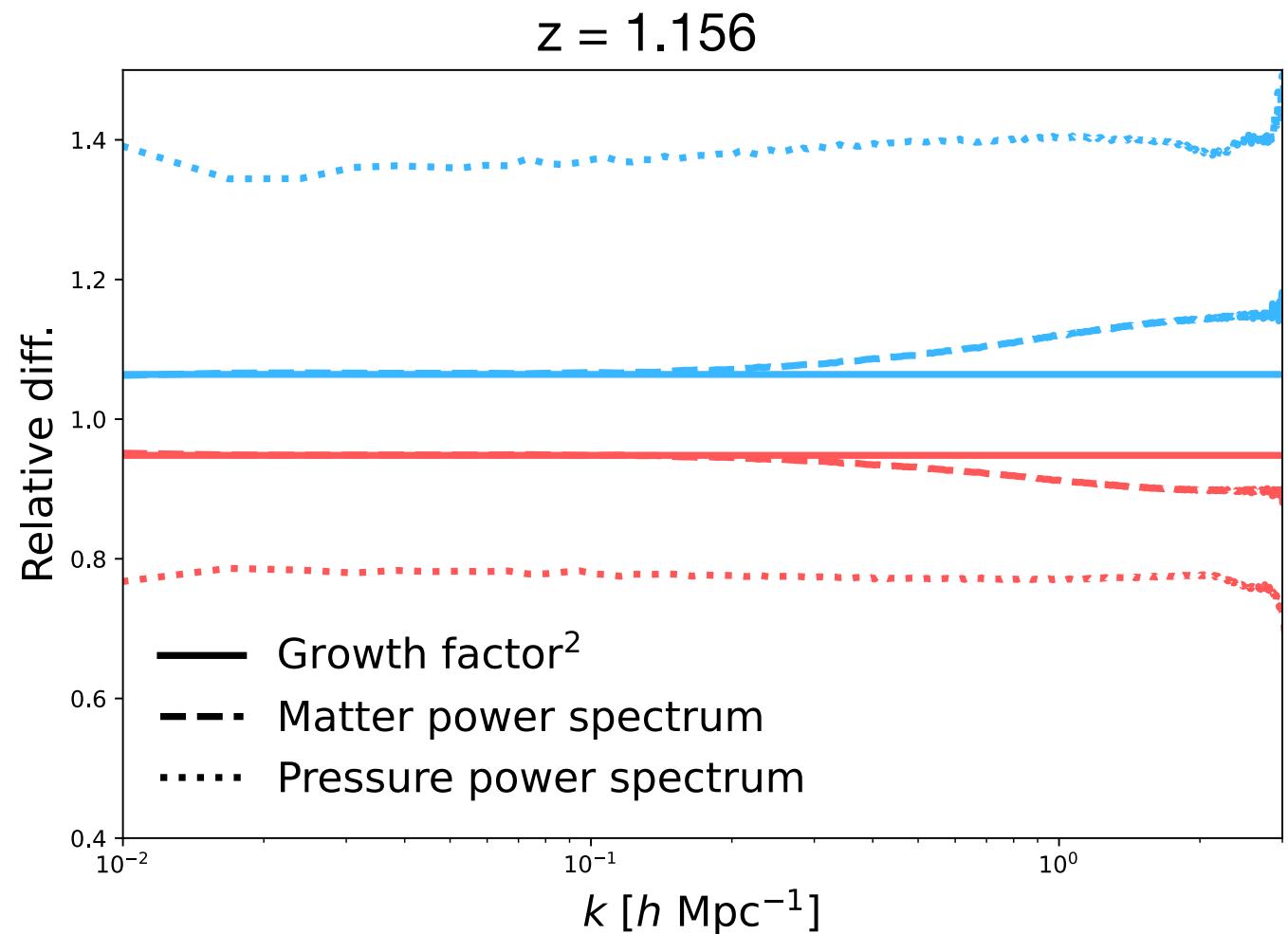
- ▶  $w = -0.8$ : 20% to 80% more power
- ▶  $w = -1.2$ : 15% to 40% less power



# Predictability of the spectrum

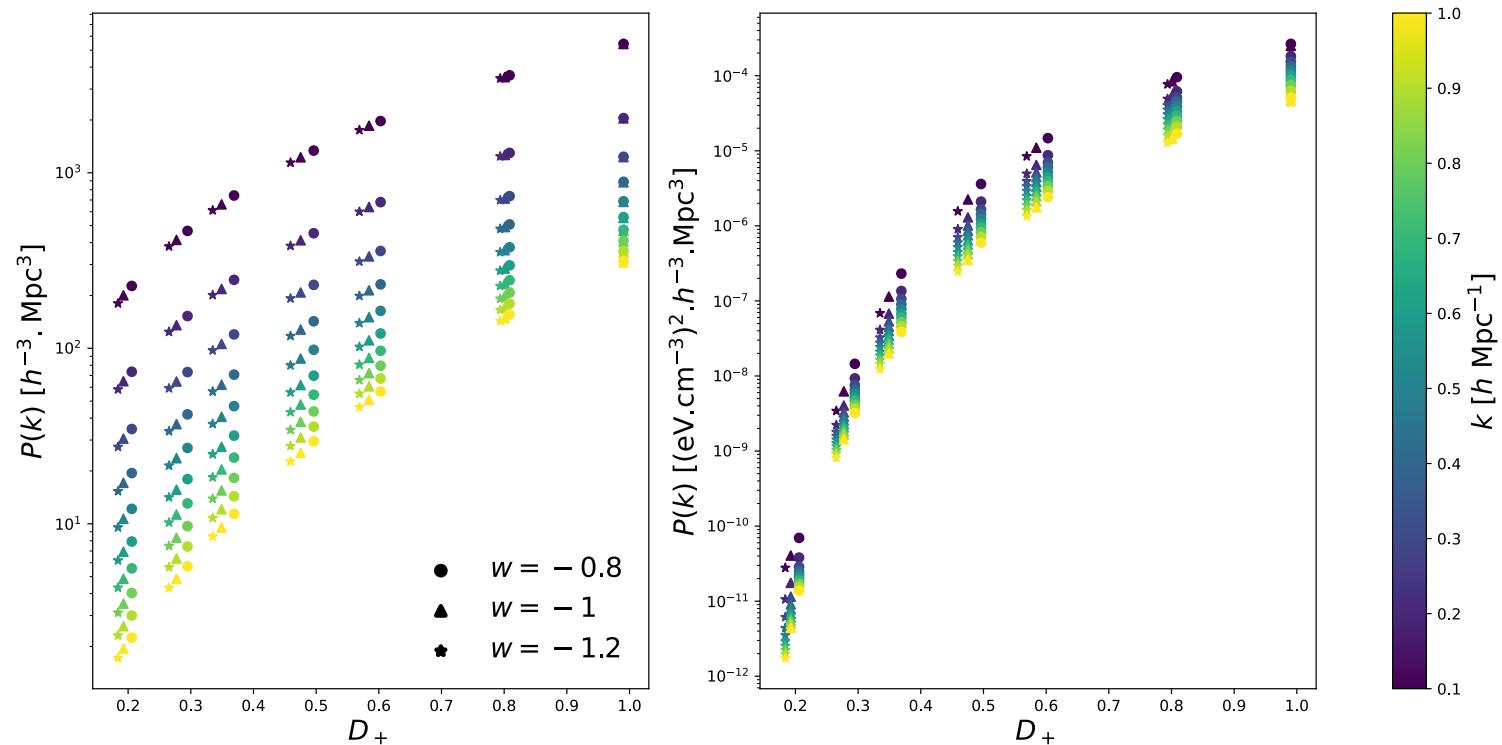
$$\frac{w = -0.8}{w = -1}$$

$$\frac{w = -1.2}{w = -1}$$



# Predictability of the spectrum

- ▶ Is the scaling a function of  $D_+$ ?
- ▶ Go to the ratios
- ▶ Find the fitting function



# Conclusions

- ▶ Impact of  $w$  on the halo mass function, matter and pressure power spectrum
  - $w = -0.8 \rightarrow$  more halos, more massive halos, more power (matter & pressure)
  - Growth factor alone seems to be not enough to predict the trends

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Perspectives

- ▶ Try to predict the trends
- ▶ New suite of simulations with a  $w_0 w_a$ CDM cosmology
- ▶ Impact on other properties: profile, concentration,...

# Next steps

- ▶ Use more realistic baryonic physics → **Horizon-AGN-like setup**
  - What power are we loosing if we keep the simple physic?
- ▶ Go from  $w$ CDM to  **$w_0 w_a$ CDM** cosmologies  $\left(w(a) = w_0 + w_a(1 - a)\right)$
- ▶ Good balance between volume, resolution and physical processes included
  - → map the  **$w_0 - w_a$  plane**
  - → **degeneracies between cosmological and astrophysical parameters** thanks to a few simulations that vary keys physical processes