How we can explain the result of EDGES?

IGM theory group
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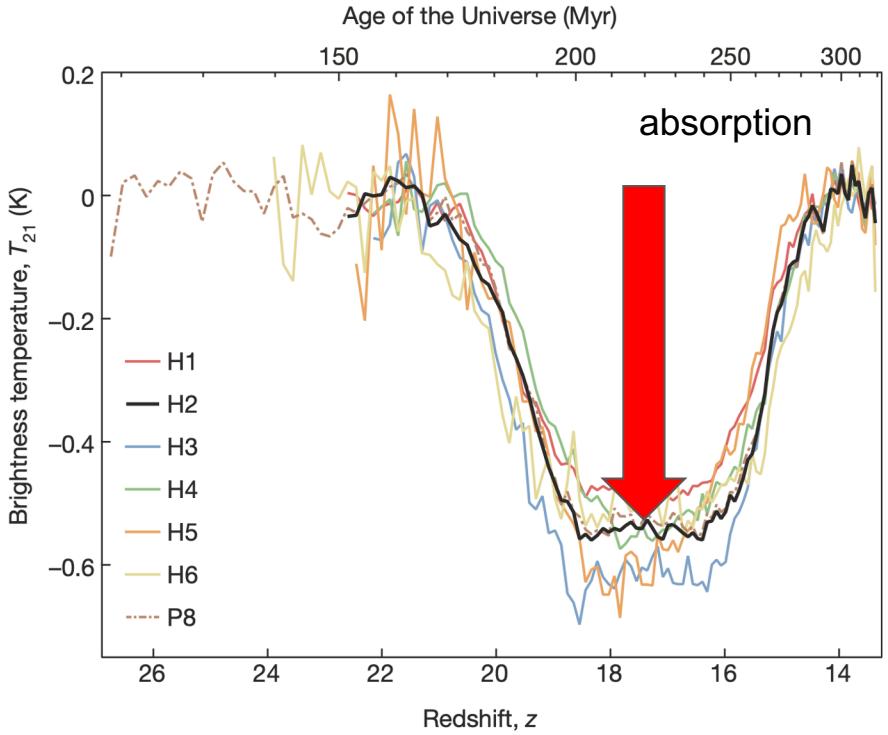
We talk about...



EDGES observed HI absorption

@

$15 < z < 20$

Results

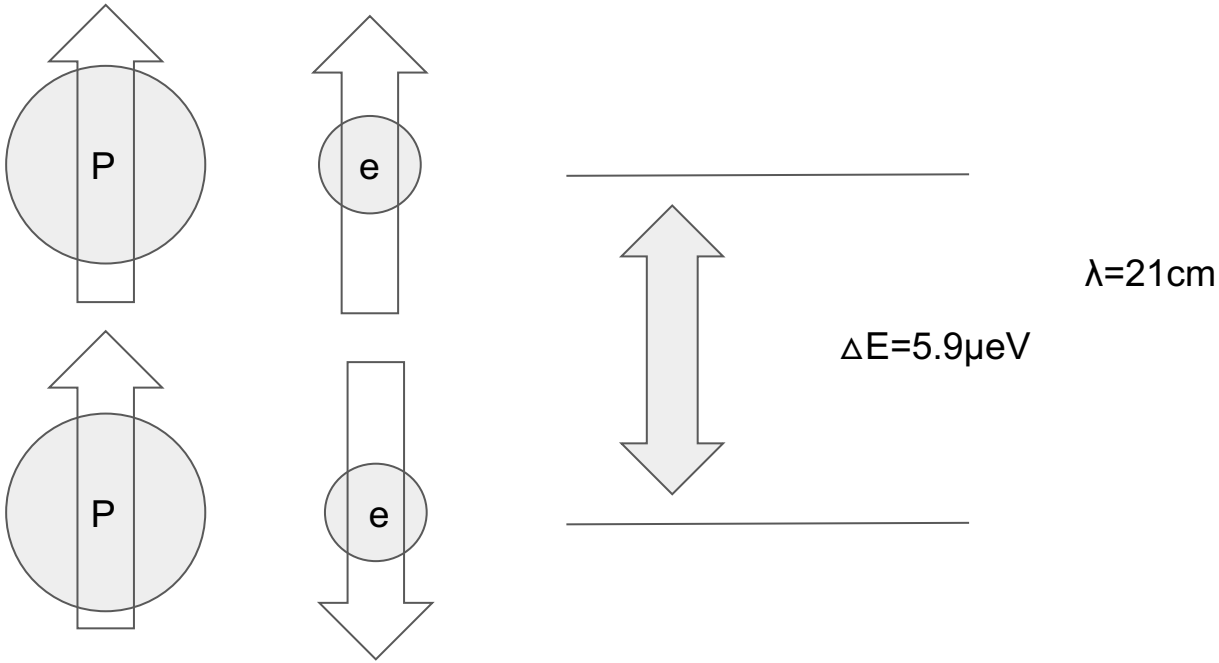
More than twice the maximum value

expected in the standard cosmological model.

If EDGES true

How we can explain this result?

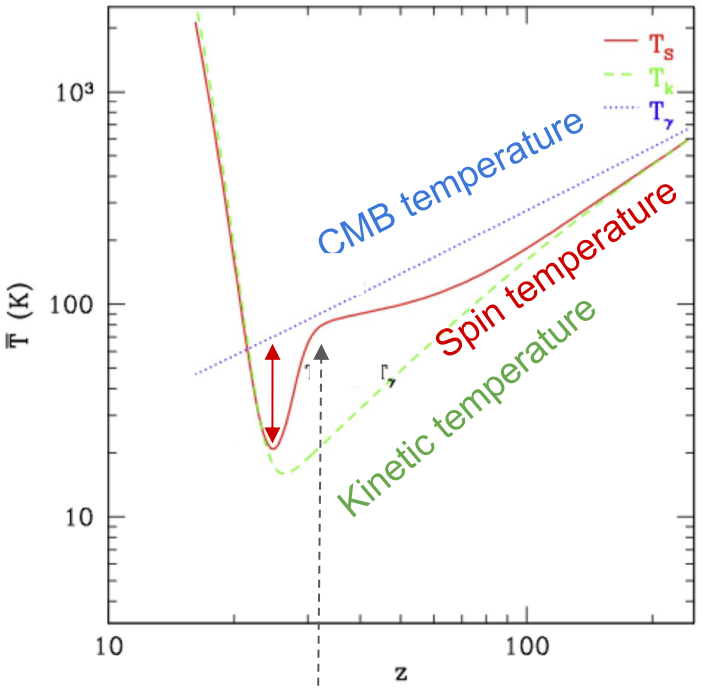
21cm line: hyperfine transition of HI (neutral hydrogen)



Spin Temperature

... defined through $n_{\uparrow\uparrow}$ / $n_{\uparrow\downarrow}$

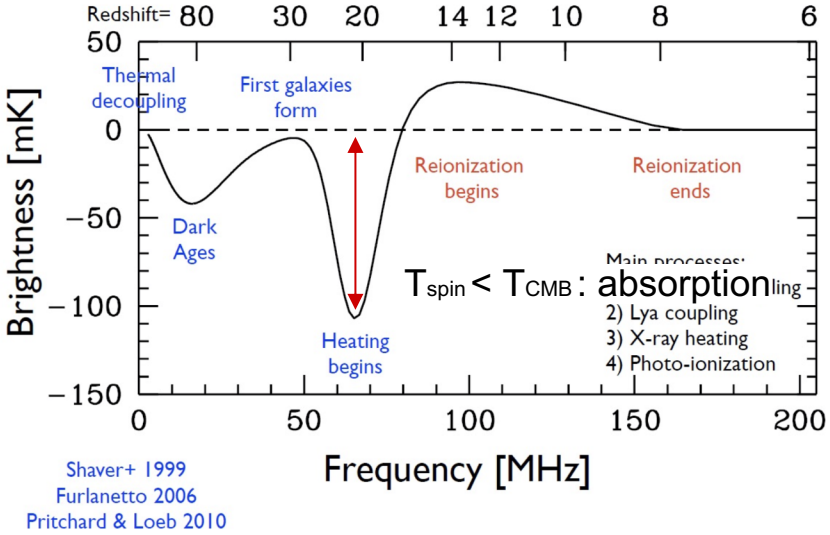
$$T_S^{-1} = \frac{T_\gamma^{-1} + x_c T_K^{-1} + x_\alpha T_c^{-1}}{1 + x_c + x_\alpha}$$



WF effect ← Lyα from first stars

Observable: Brightness temperature

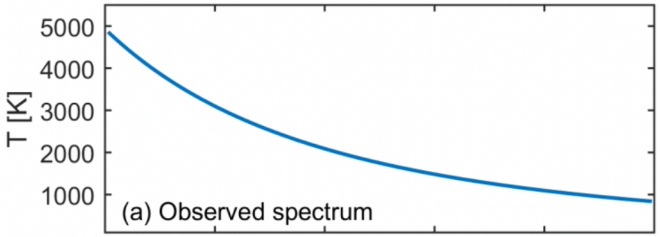
difference between T_{spin} and T_{CMB}



Shaver+ 1999
Furlanetto 2006
Pritchard & Loeb 2010

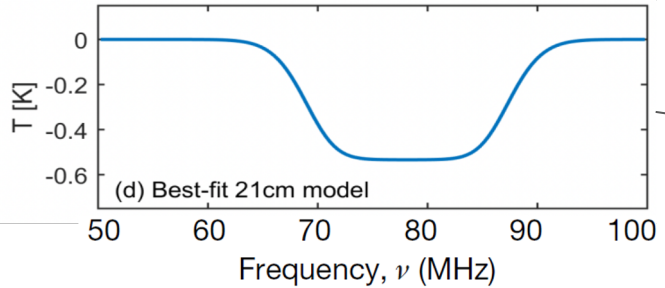
EDGES: Detection of 21cm Signal

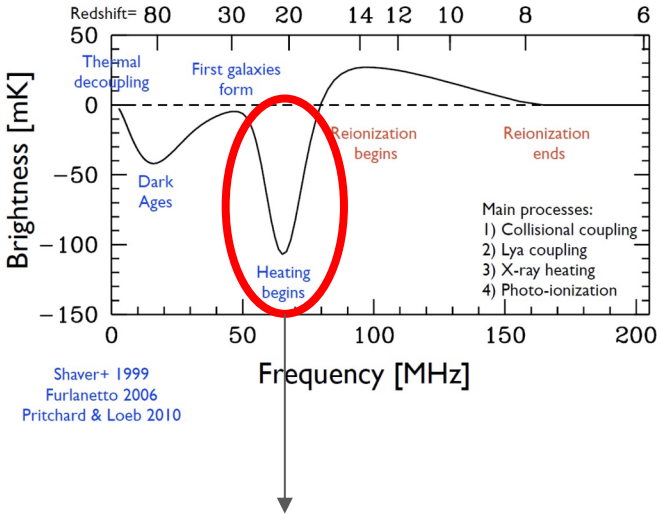
Measured spectrum without interferences



- foreground model

Model profile of the 21-cm absorption





Should be the same ?

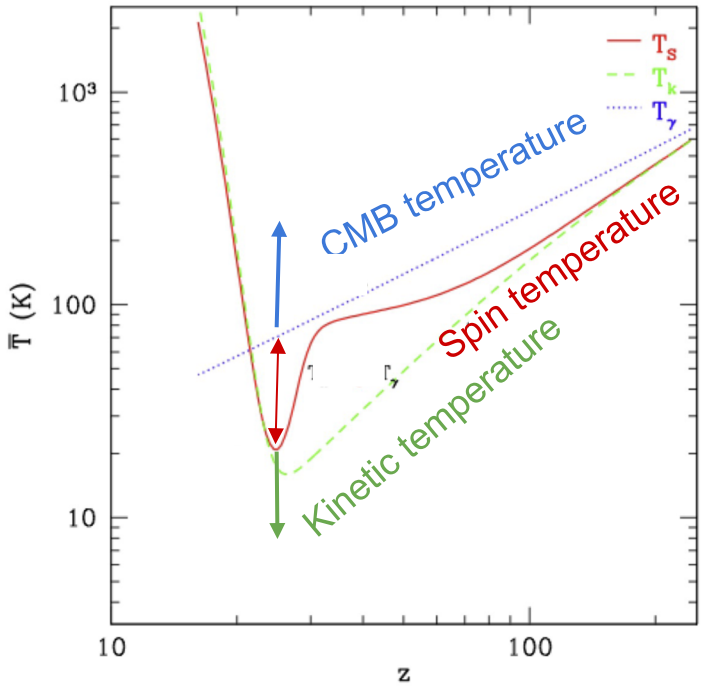
Detection of 21cm Signal?

=> Differential brightness temperature:

$\delta T_b \propto (T_s - T_\gamma)/T_s$

=> Only two solutions seems to explain higher absorption :

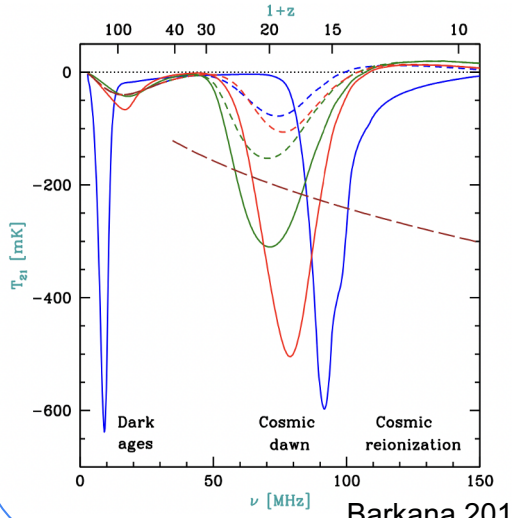
- Higher CMB temperature,
- Lower Gas temperature.



Existing scenarios ~ To decrease gas temperature

- DM-baryon interaction

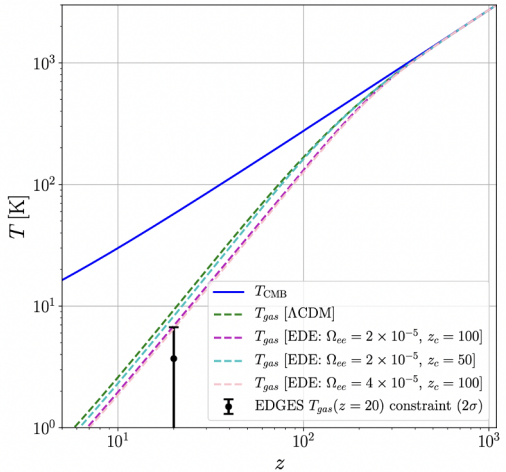
  cooled by b-DM scattering



Barkana 2018

- Early dark energy scenario

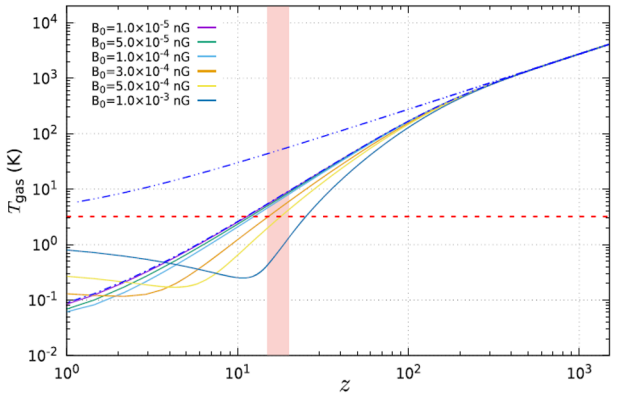
  Colder due to the cosmic expansion



Hill & Baxter 2018

- Primordial magnetic field amplification

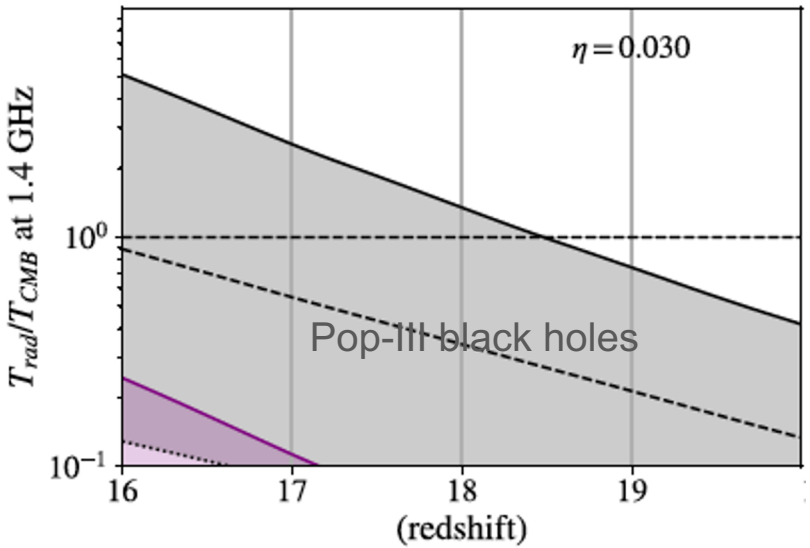
  Effective cooling due to turbulence (alpha-effect).



Natwariya & Bhatt 2020

Existing scenarios ~ To enhance radio background temperature, Tγ

Radio emission : Radio loud AGN, Galaxy, Unresolved source



Ewall-Wice et al. 2018

Group work task : Propose new scenario for EDGES

- scenario with supernova → already proposed(Jana et al. 2019).

- combine some ideas → already proposed
  e.g DM + PBH (Halder et al. 2021)

  → how about radio emitter + Magnetic Field ?

- $T_{Spin} < T_{Kinetic}$? → no idea about such physical process

Summary

- EDGES obtained larger absorption signal of 21cm line than expected.

- There are many scenarios which explain EDGES observation.

- We discussed new scenarios.
    - some scenarios are already proposed.
    - how about $T_{Spin} < T_{Kinetic}$