The InterGalactic Medium
IGM

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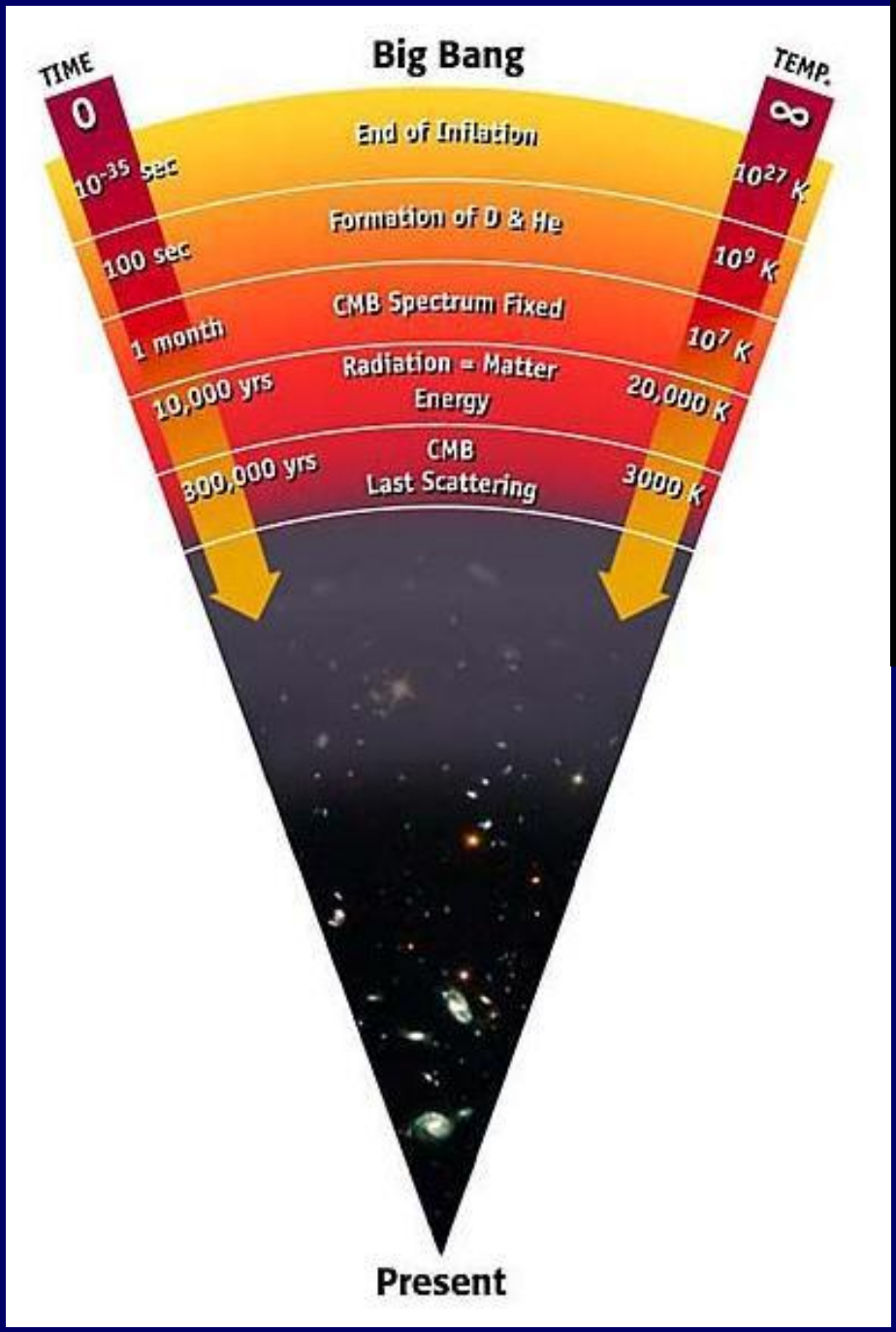
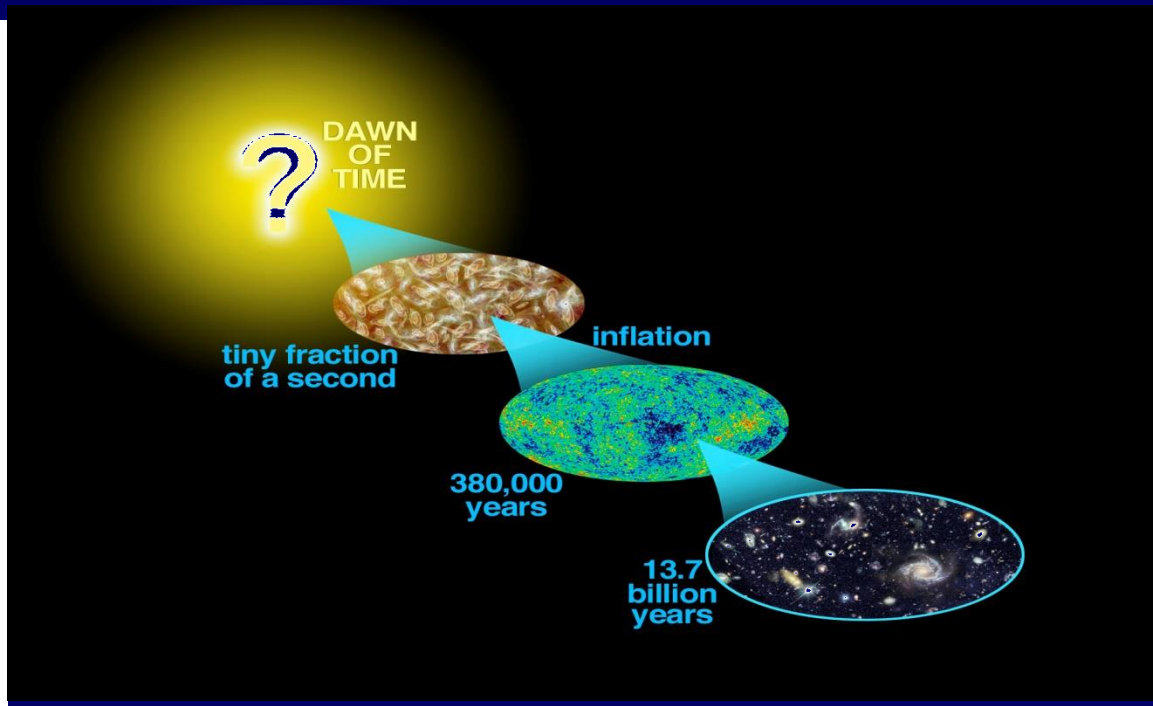
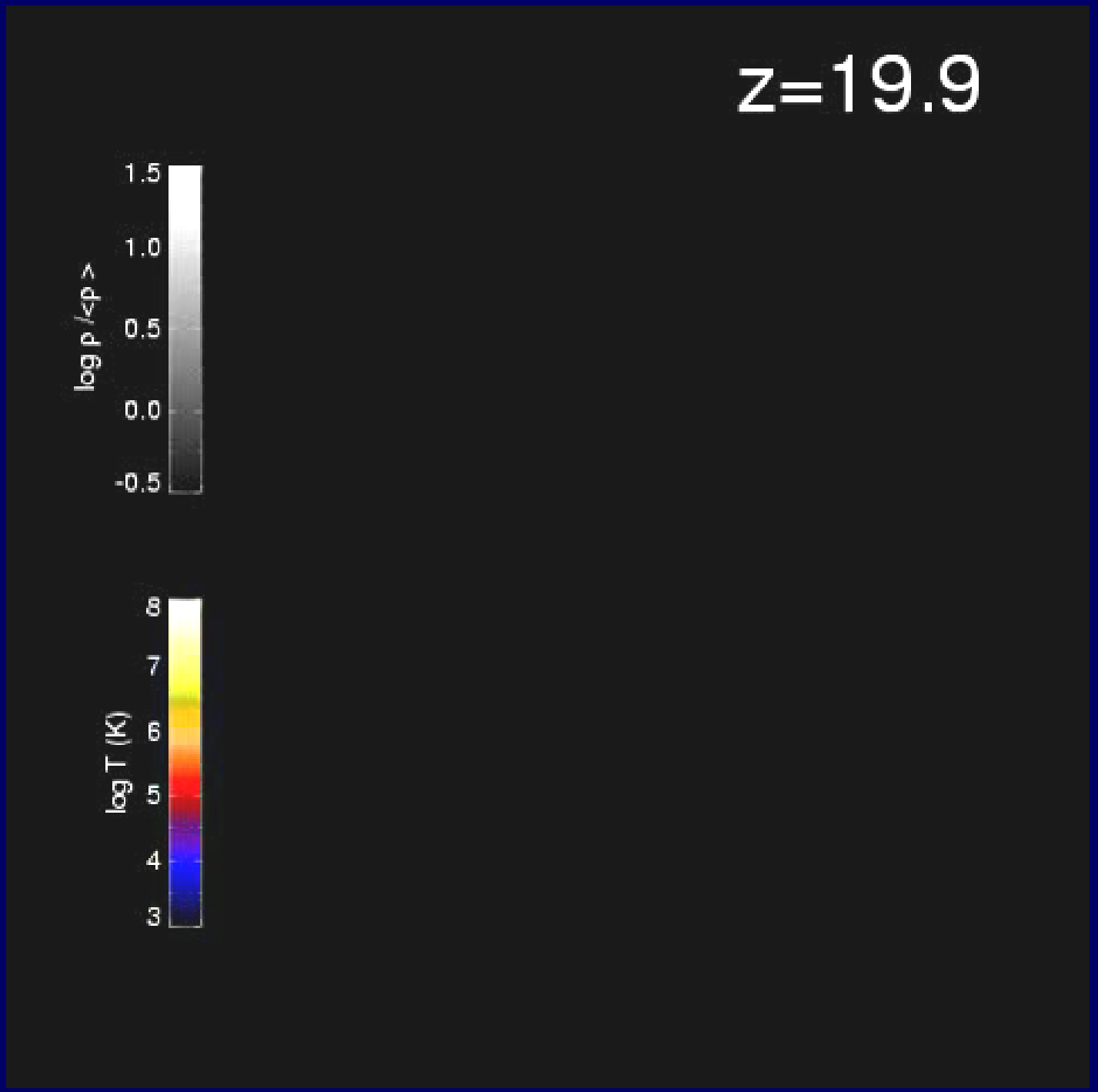
AA 2020-2021





- Big Bang
- Recombination
- Dark Ages
- Formation of stars, galaxies and QSOs
- Reheating and reionization



Simulation
32 Mpc/h box
17,000,000 gas particles
Momentum-driven wind
Density - temperature

- Big Bang
- Recombination
- Dark Ages
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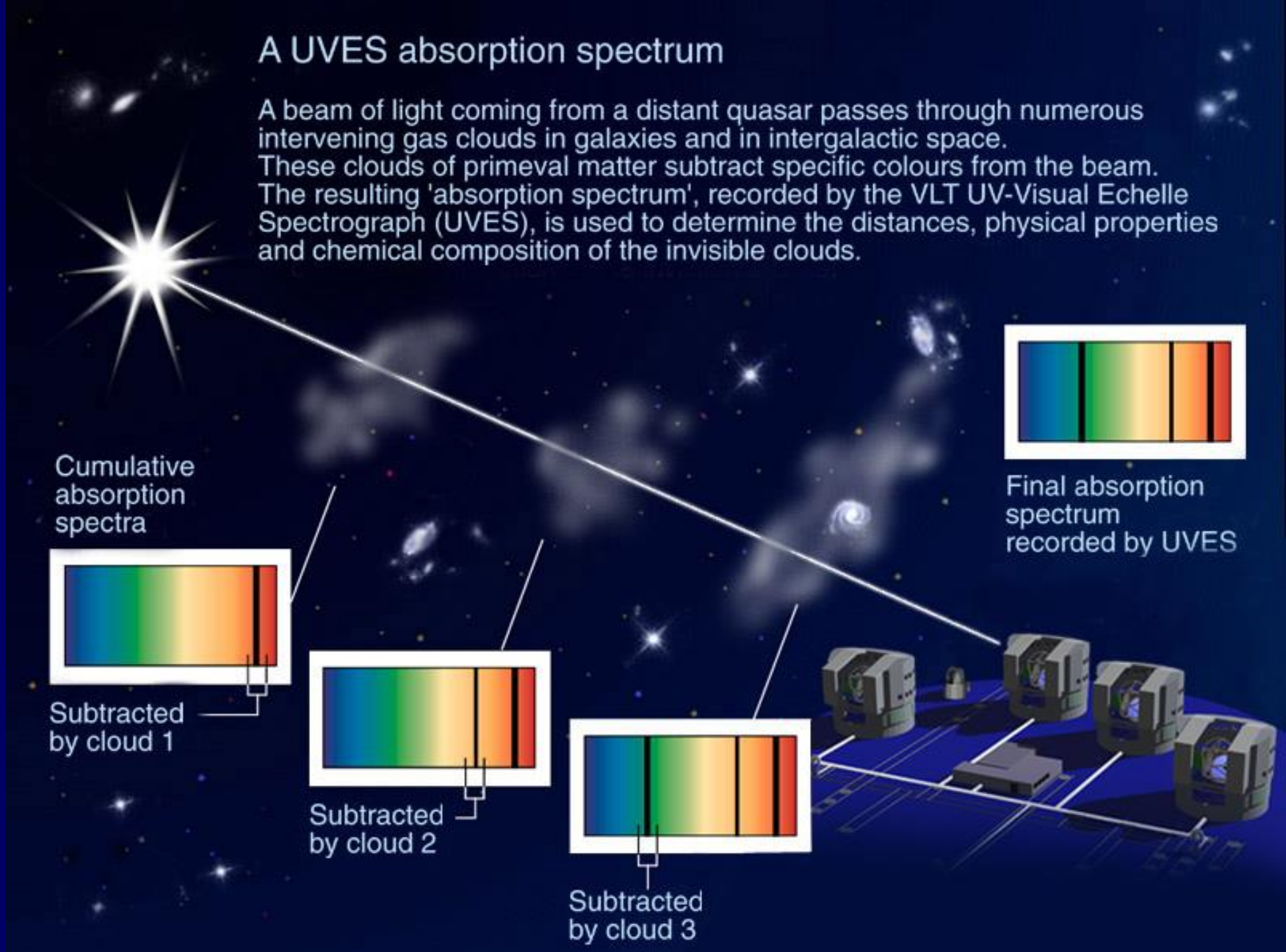
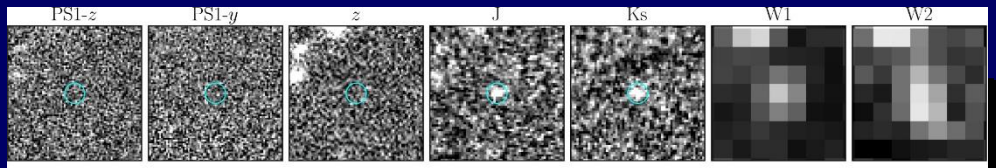
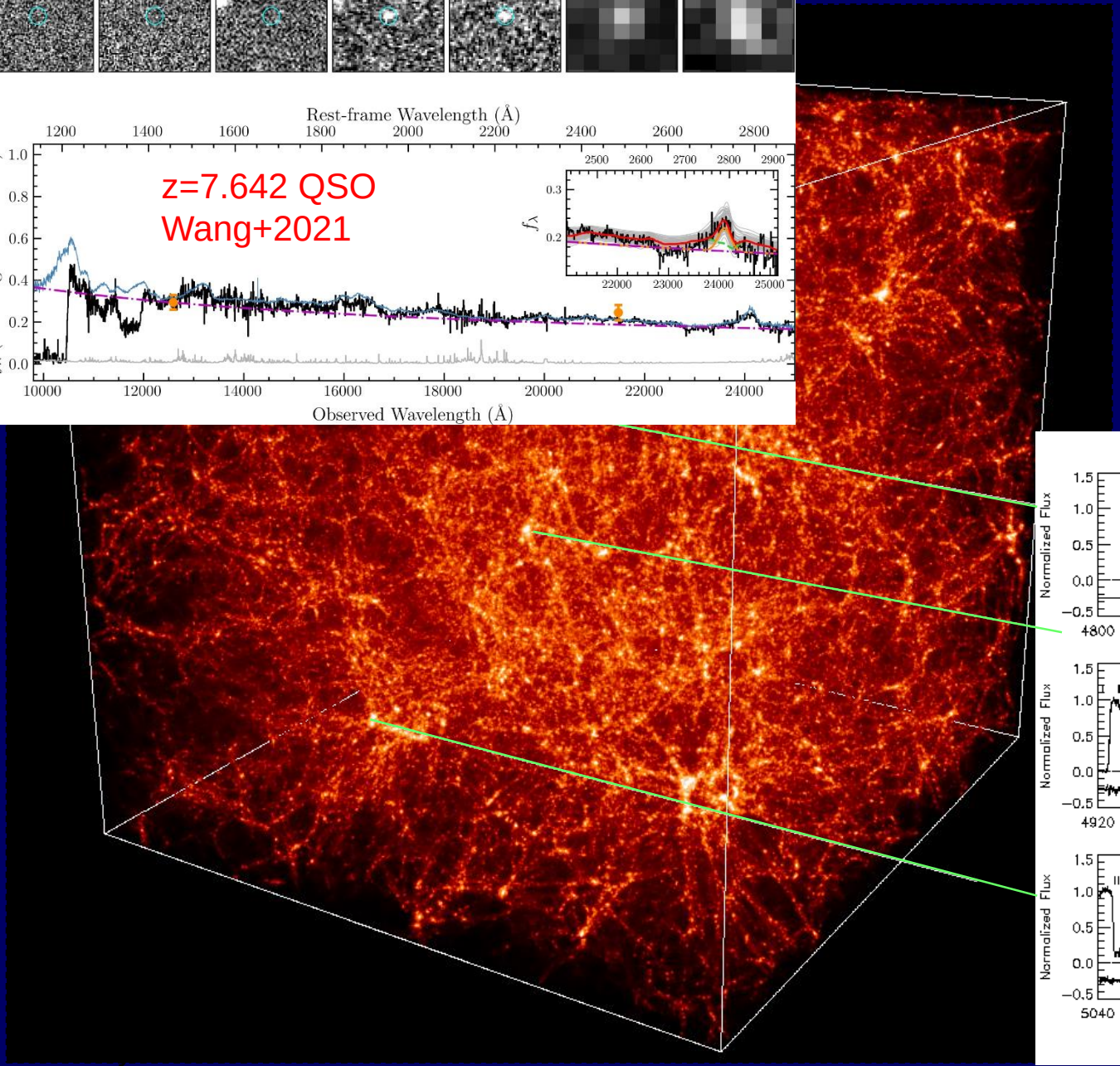
A UVES absorption spectrum

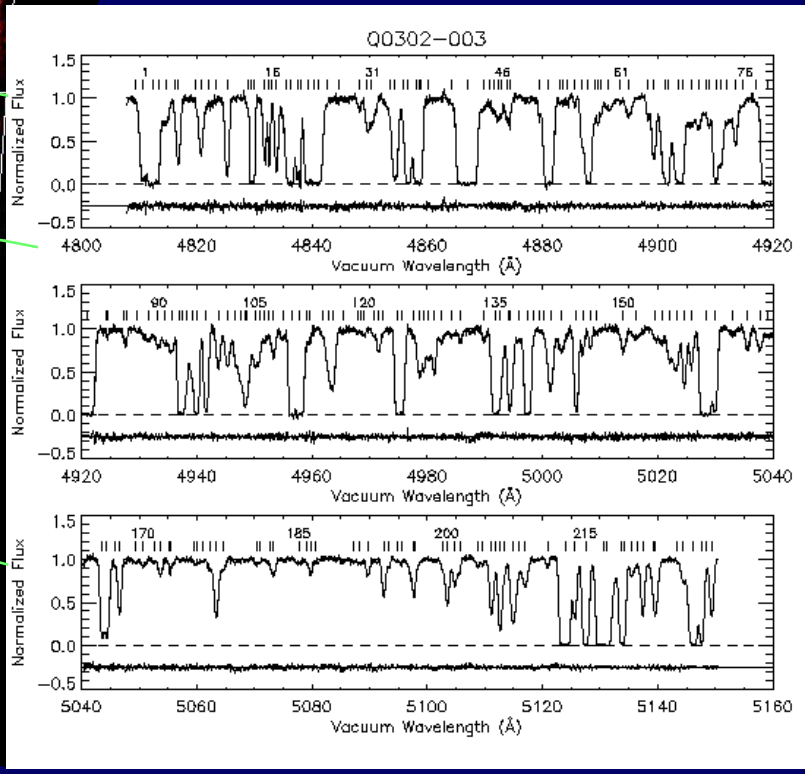
A beam of light coming from a distant quasar passes through numerous intervening gas clouds in galaxies and in intergalactic space. These clouds of primeval matter subtract specific colours from the beam. The resulting 'absorption spectrum', recorded by the VLT UV-Visual Echelle Spectrograph (UVES), is used to determine the distances, physical properties and chemical composition of the invisible clouds.




PS1-z
PS1-y
z
J
Ks
W1
W2

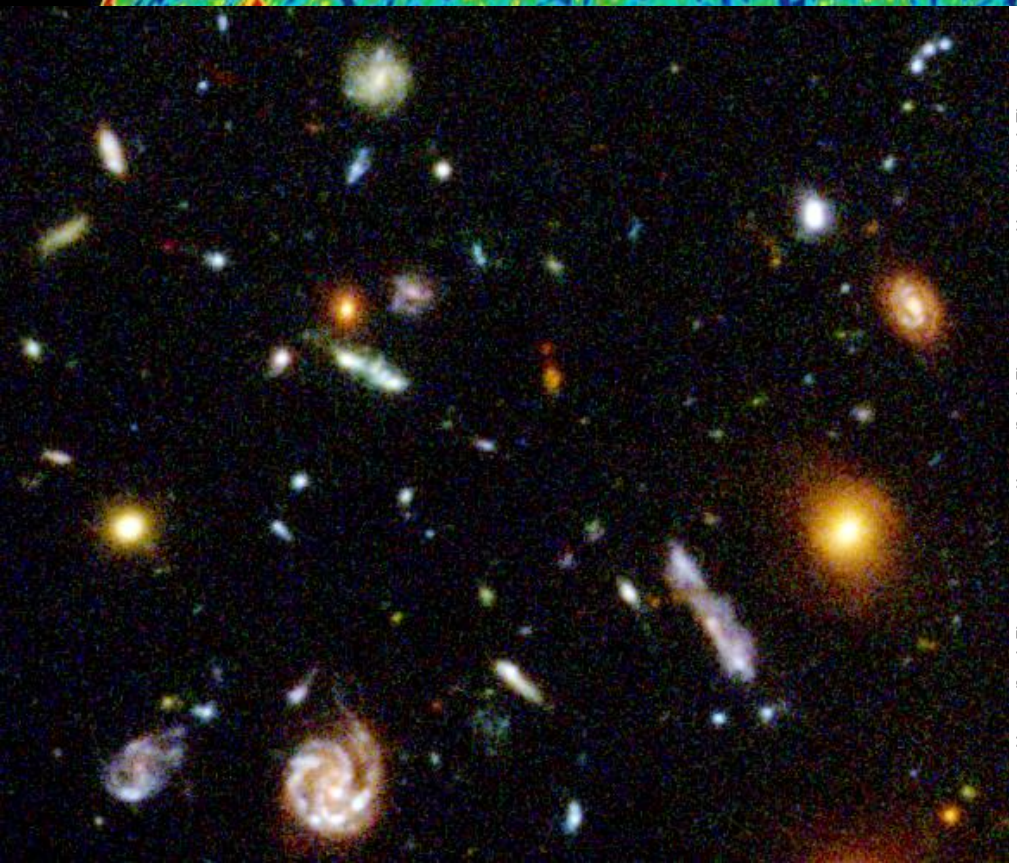
Rest-frame Wavelength (Å)
Observed Wavelength (Å)
z=7.642 QSO
Wang+2021

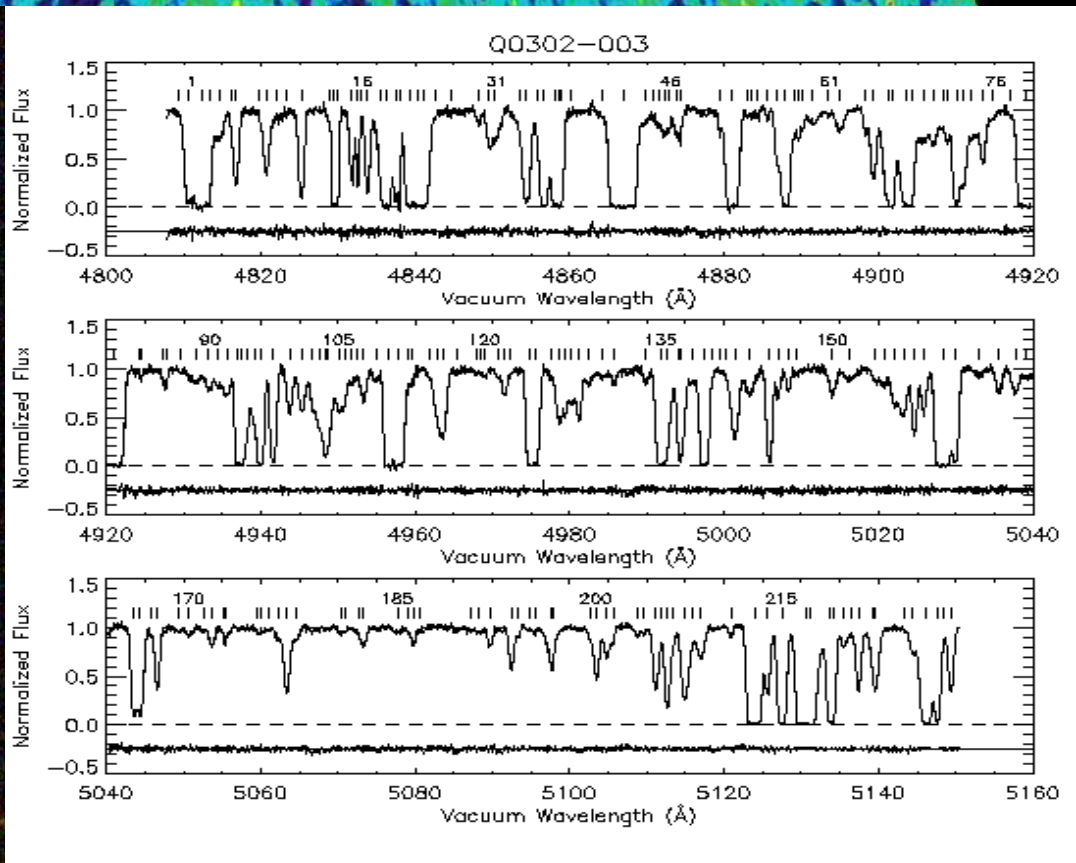



Q0302−003
Normalized Flux
Vacuum Wavelength (Å)

IGM - absorption lines

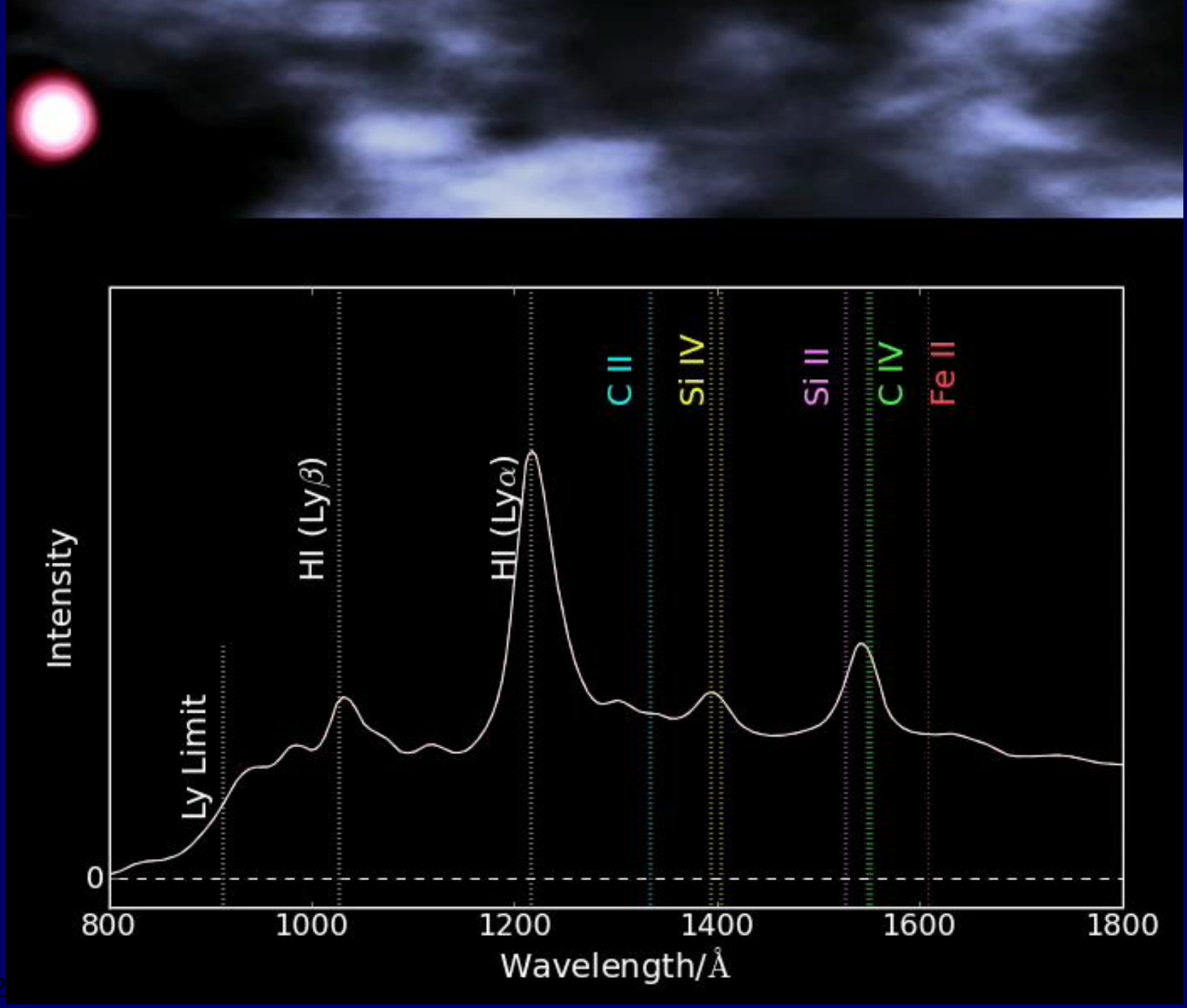
A unique and independent source of information between the CMB, at z~1000, and the large scale distribution of galaxies





IGM - Absorption Lines - Goals

- What were the physical conditions of the primordial Universe?
- What fraction of the matter was in a diffuse medium and how early did it condense in clouds?
- Where are most of the baryons at the various redshifts?
- How early and in what amount have metals been produced?
- When and how, after the Dark Ages following recombination, did the Universe get reionized?
- What was the typical radiation field, how homogenous, and what was producing it?
- Which constraints on cosmology & types of DM (e.g. ν) are derived from the IGM LSS?
- Does the SBBN correctly predict primordial element abundances and CMB T evolution?
- Do fundamental constants of physics (e.g. α, μ) vary with time?


Intensity
0
Ly Limit
HI (Lyβ)
HI (Lyα)
C II
Si IV
Si II
C IV
Fe II
800
1000
1200
1400
1600
1800
Wavelength/Å

Evaluation

- 1 question per person at the beginning of the lecture on the topics of the previous lecture
- (Final) discussion of 1 (or more) papers – possibly recent - on a topic of the course with a short (~20 min) presentation.