

High Redshift FRBs

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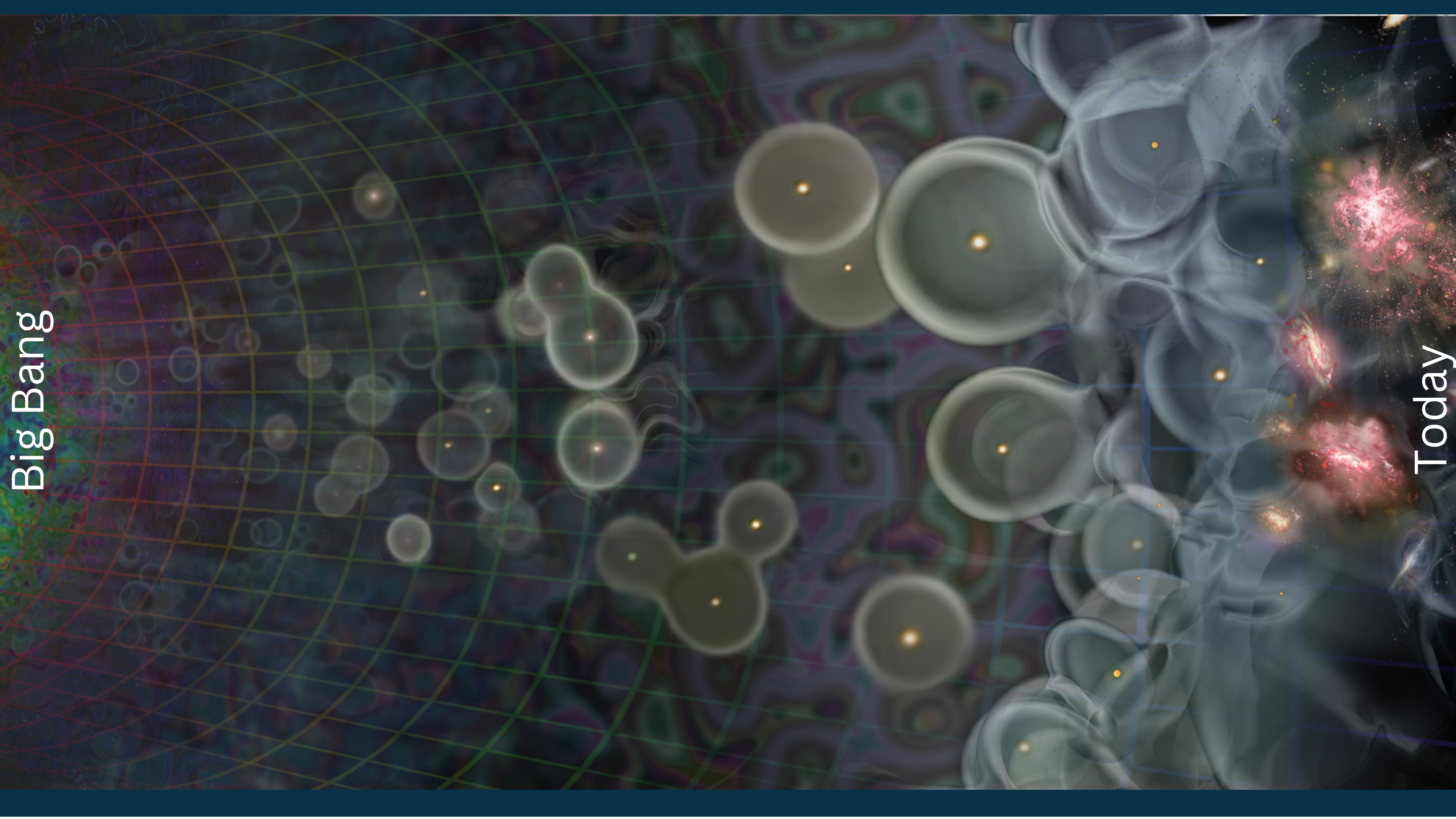


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SURREY

Big Bang



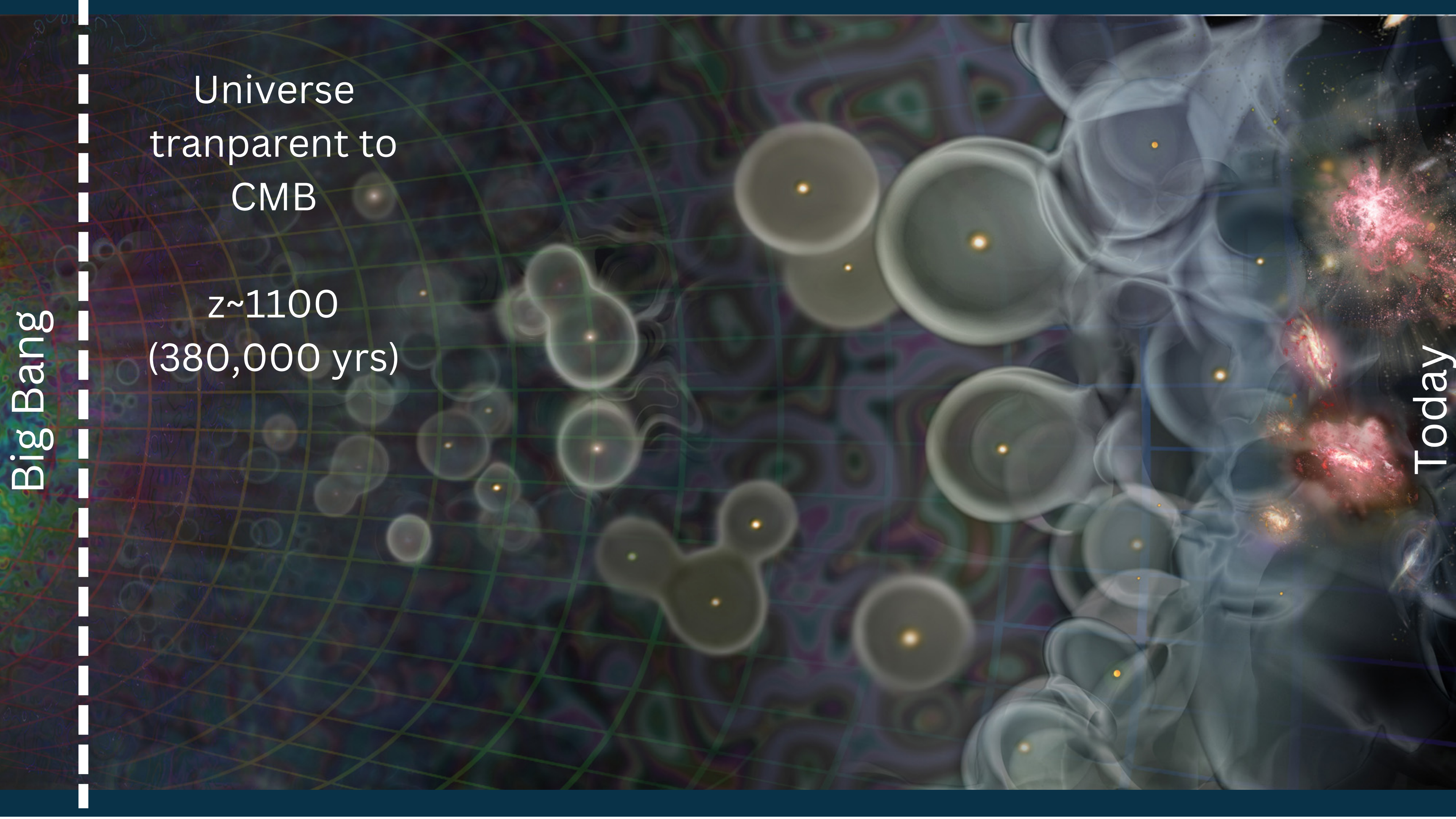
Today

Big Bang

Universe
transparent to
CMB

$z \sim 1100$
(380,000 yrs)

Today



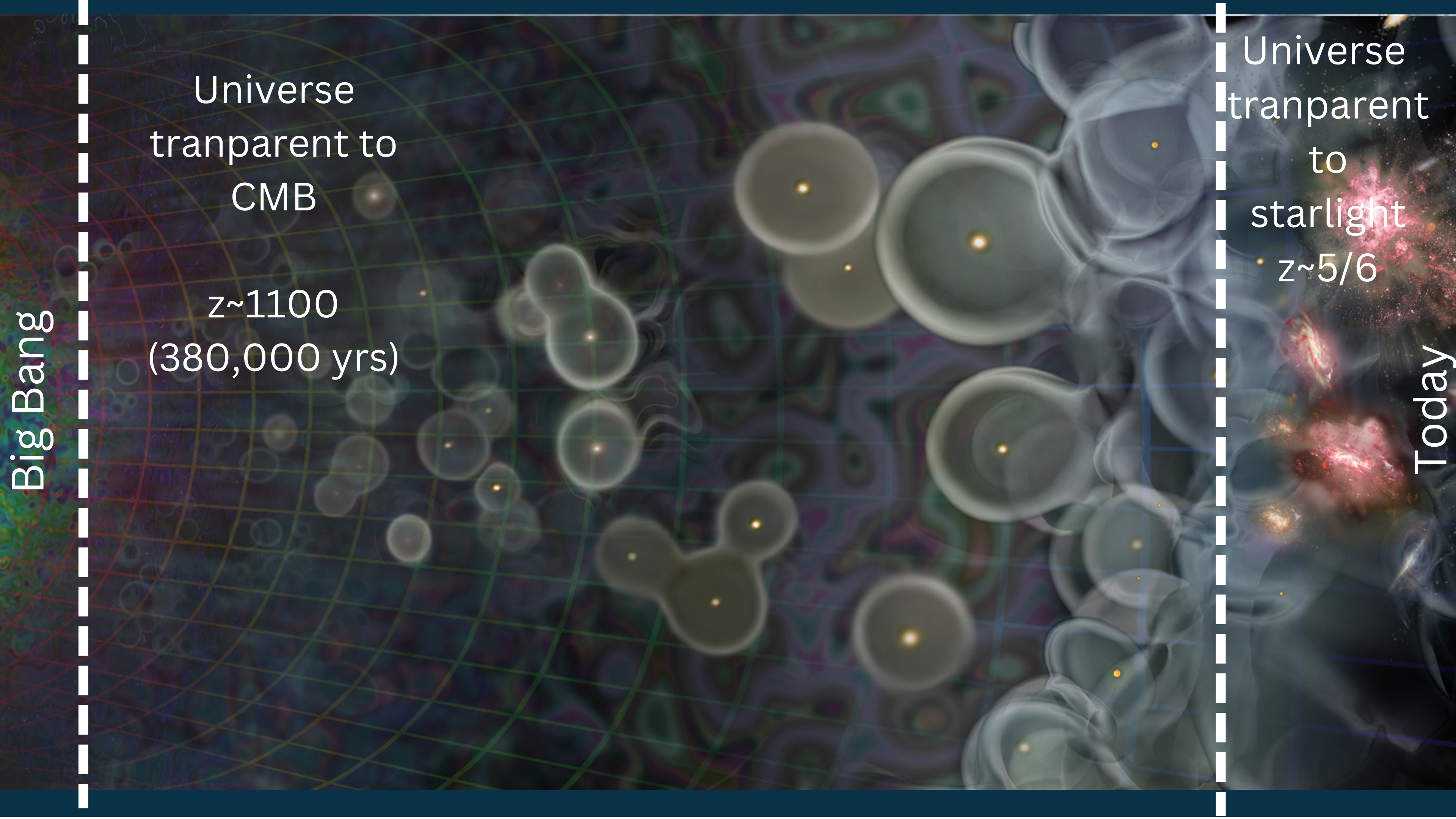
Big Bang

Universe
transparent to
CMB

$z \sim 1100$
(380,000 yrs)

Universe
transparent
to
starlight
 $z \sim 5/6$

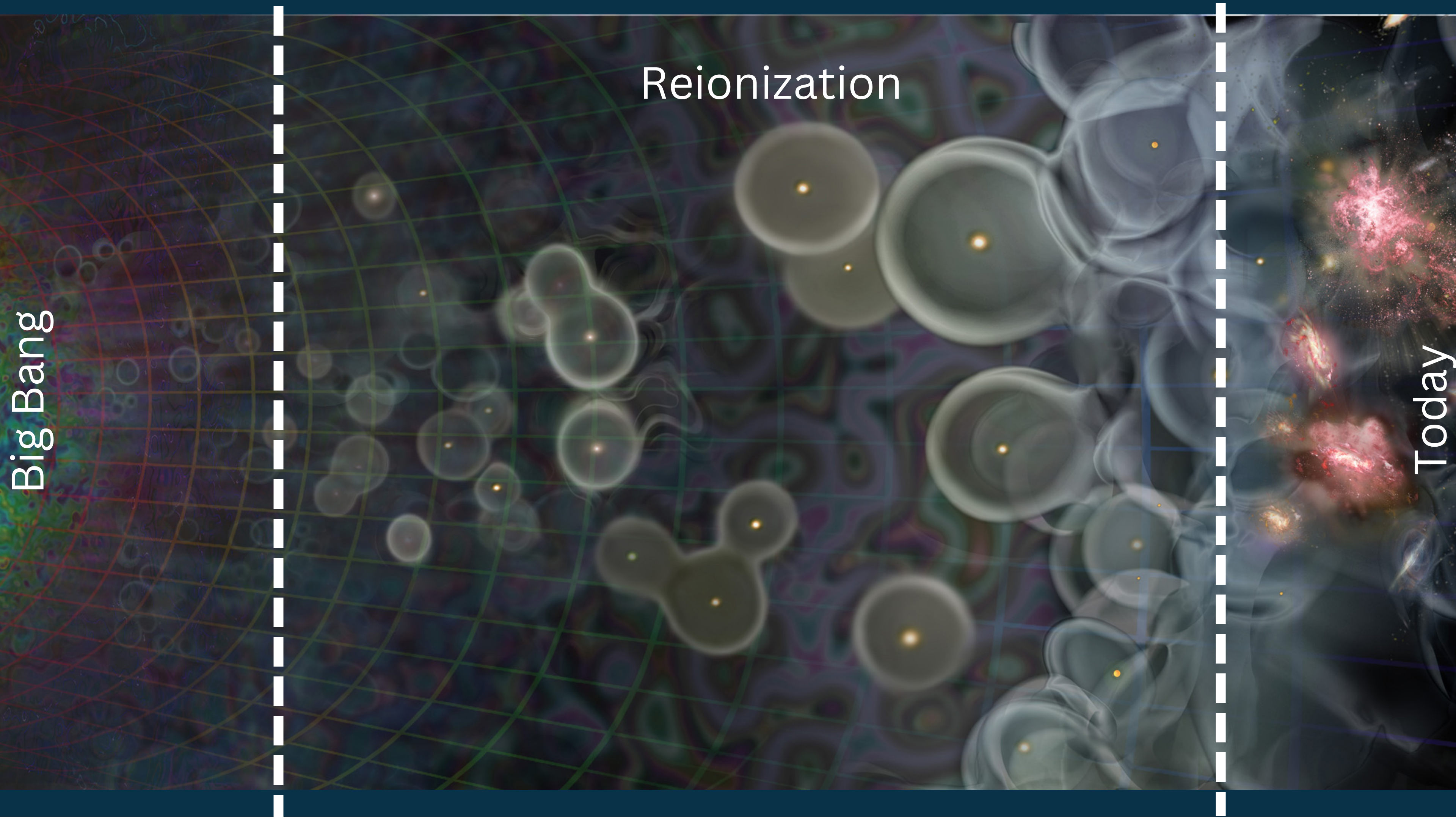
Today



Big Bang

Reionization

Today



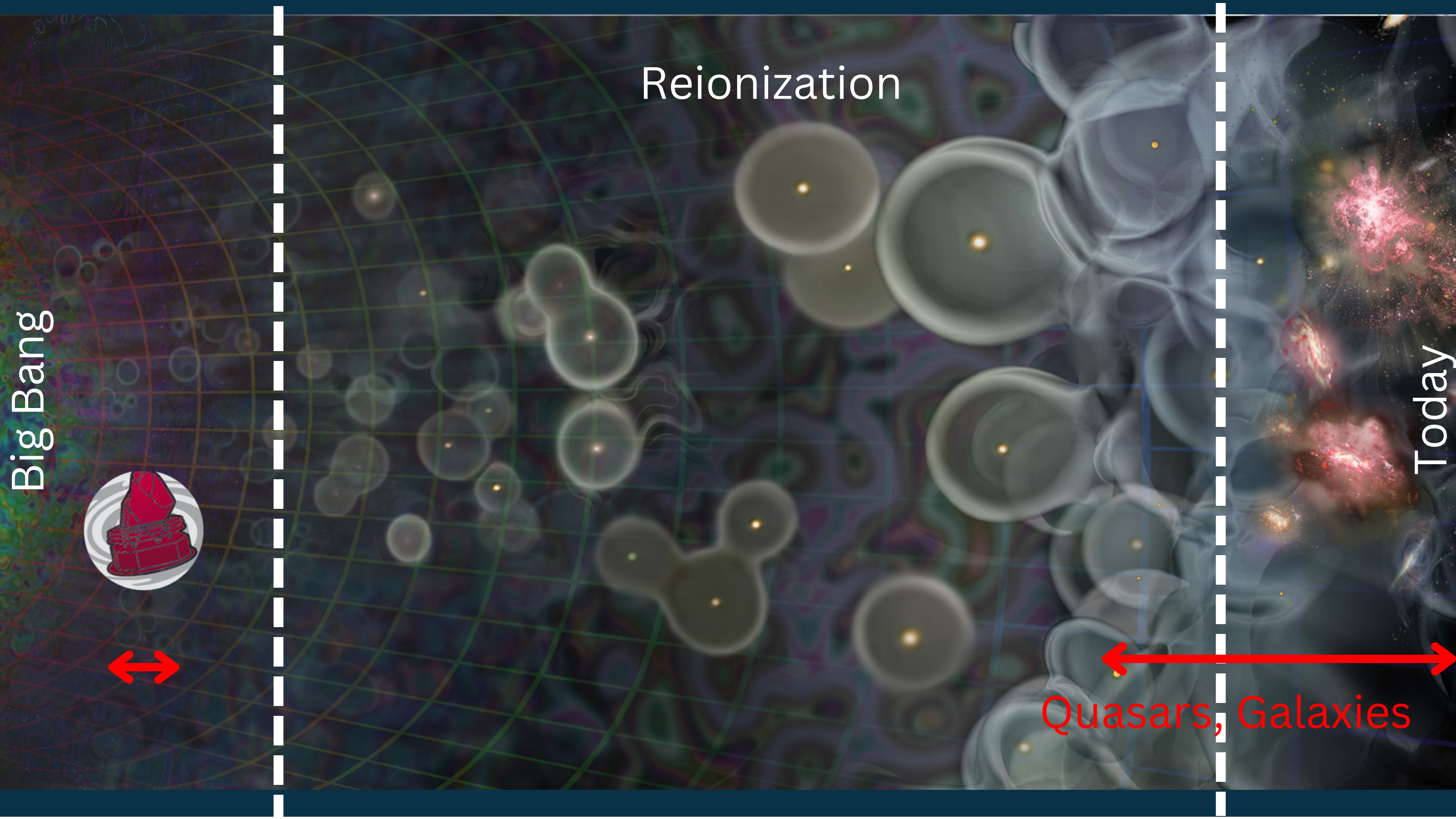
Big Bang



Reionization

Today

Quasars, Galaxies



Big Bang

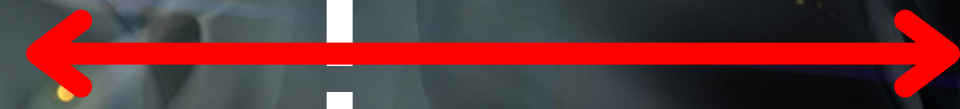


Reionization



Today

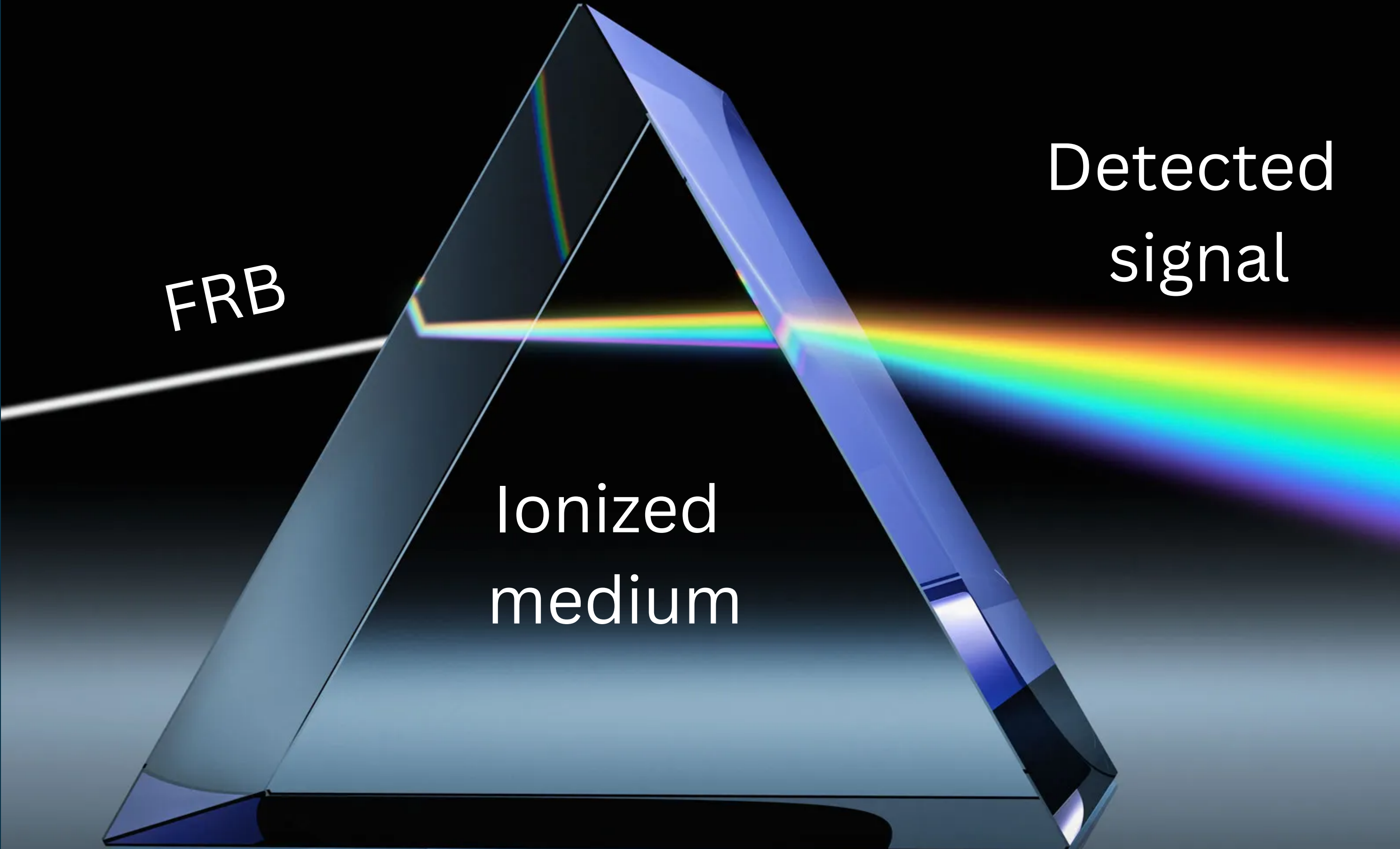
Quasars, Galaxies



FAST RADIO BURSTS

FAST RADIO BURSTS

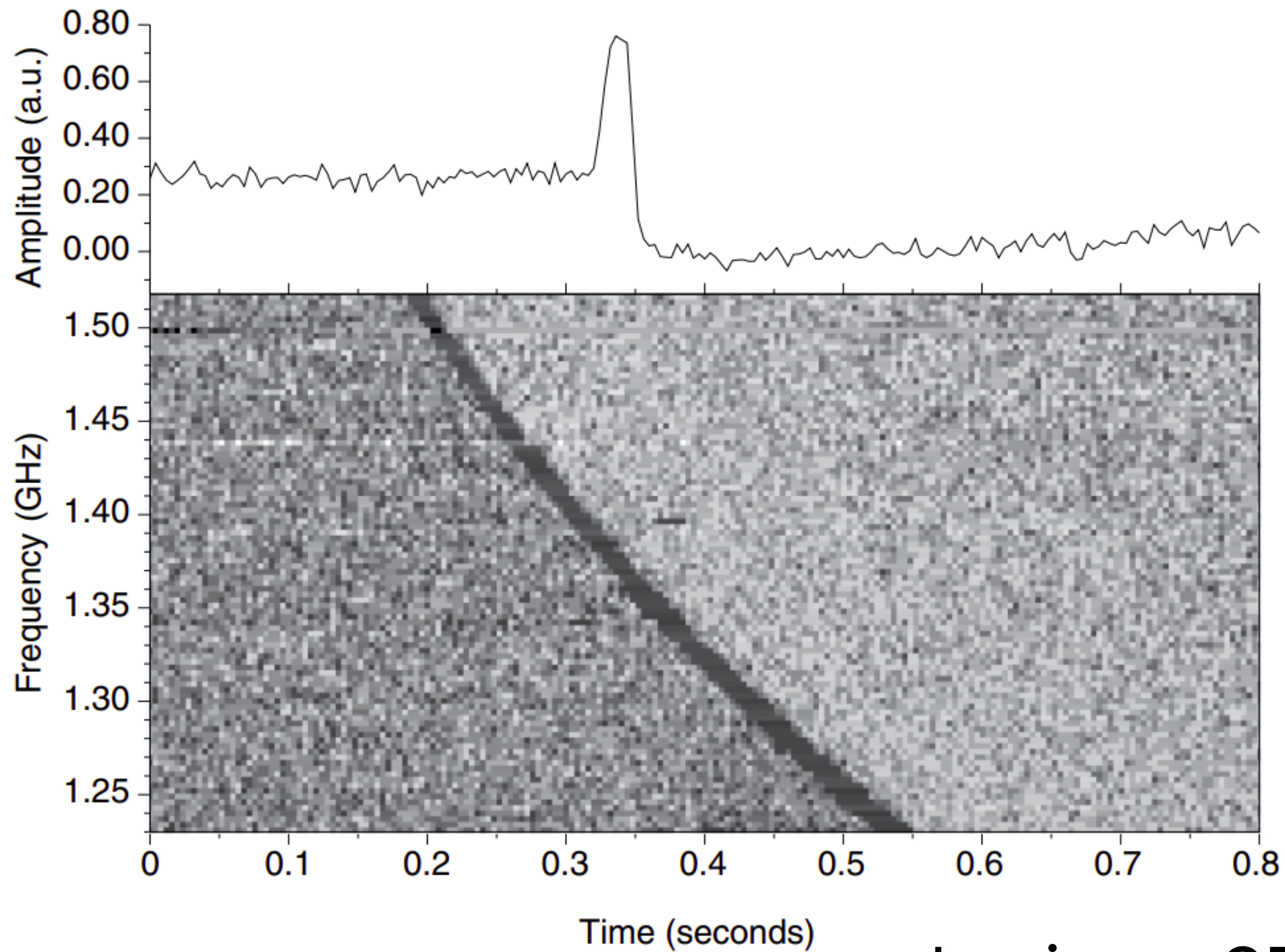
FAST RADIO BURSTS



FRB

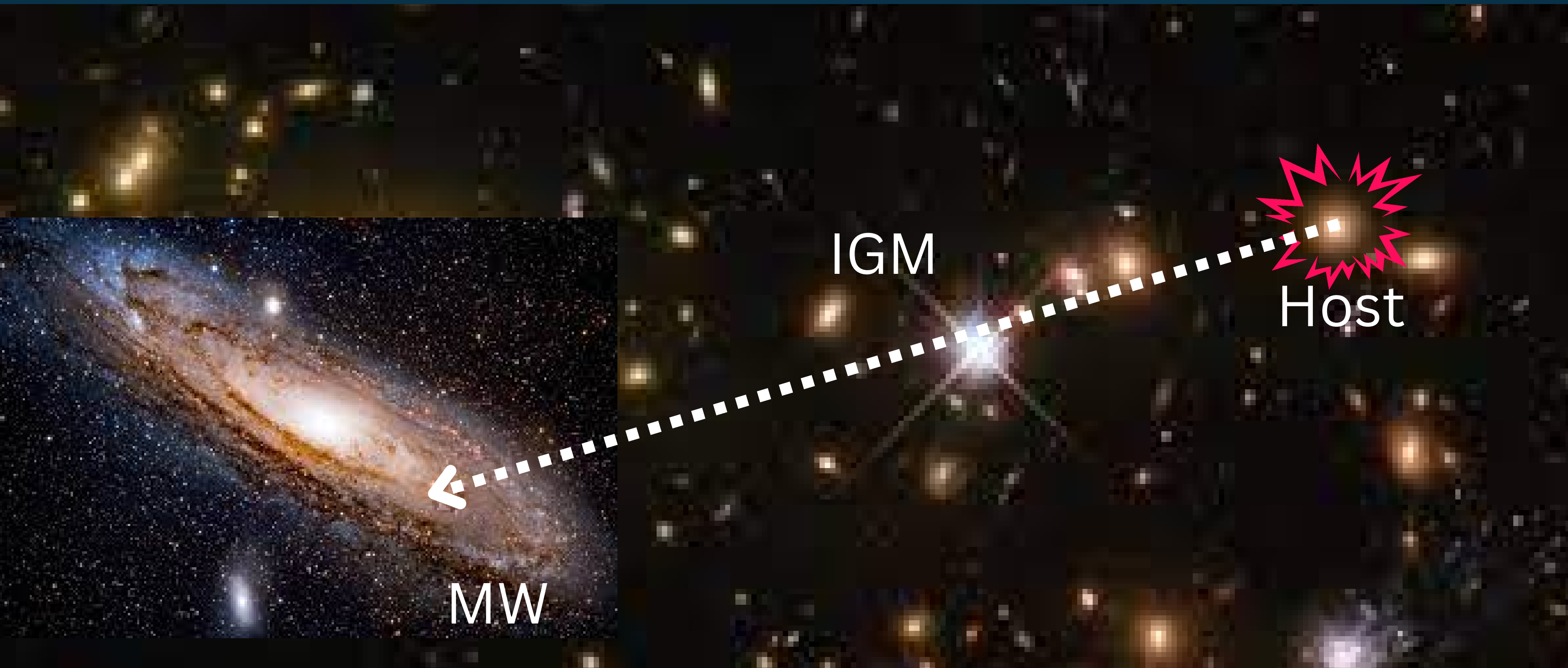
Ionized
medium

Detected
signal

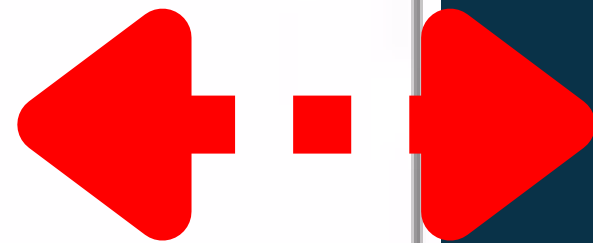
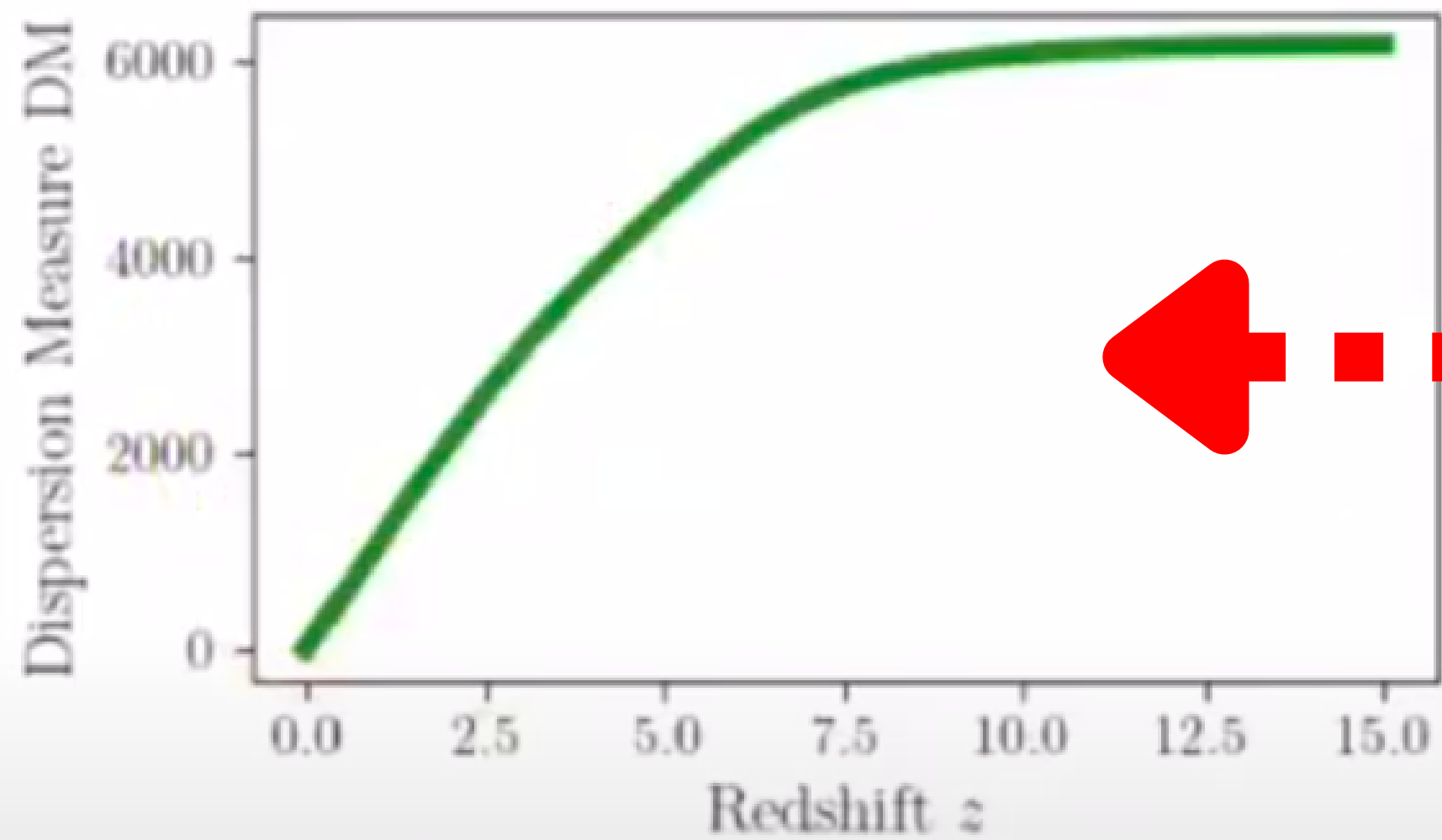


Lorimer 07

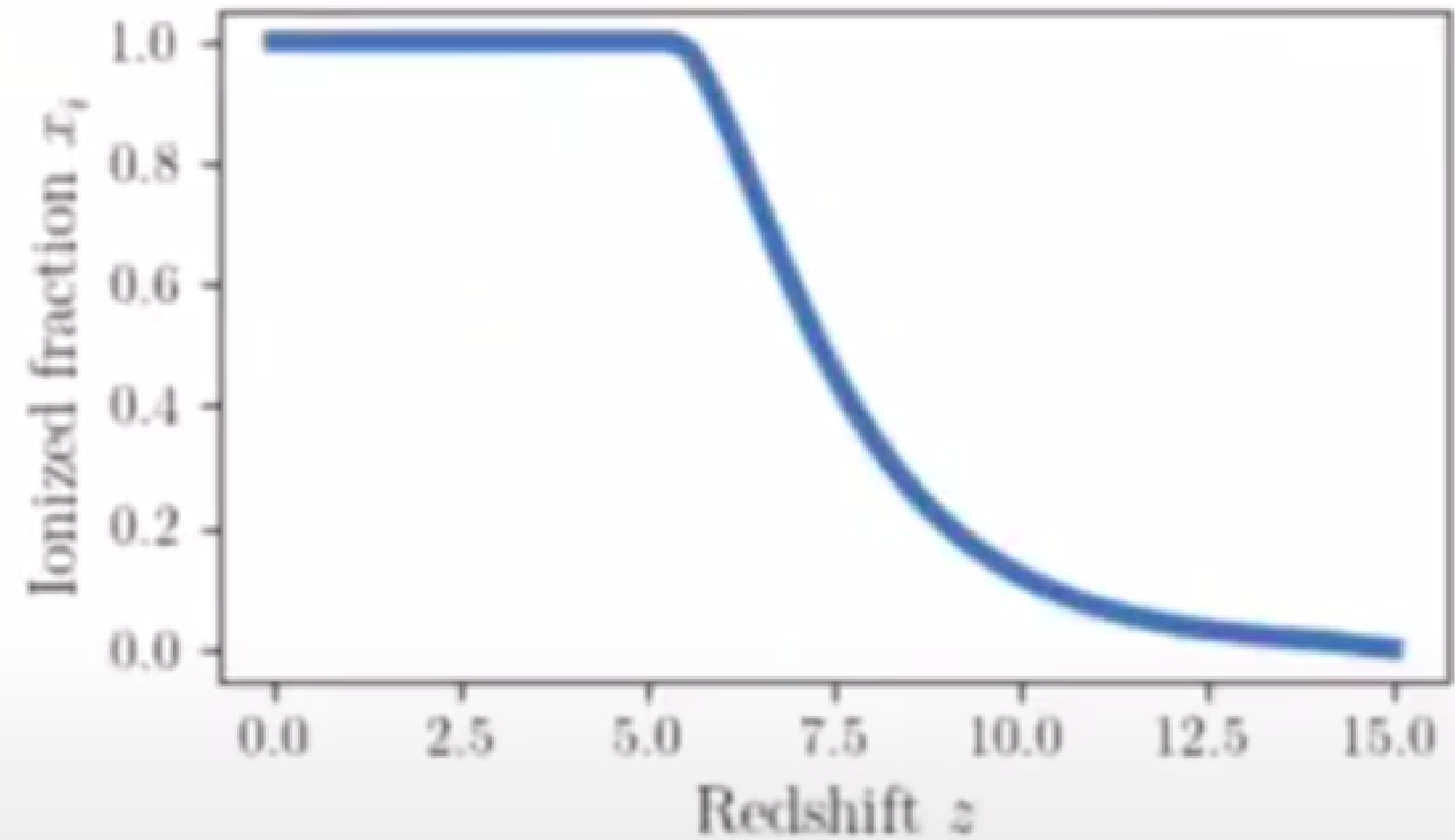
Dispersion Measure



Dispersion Measure



Reionization

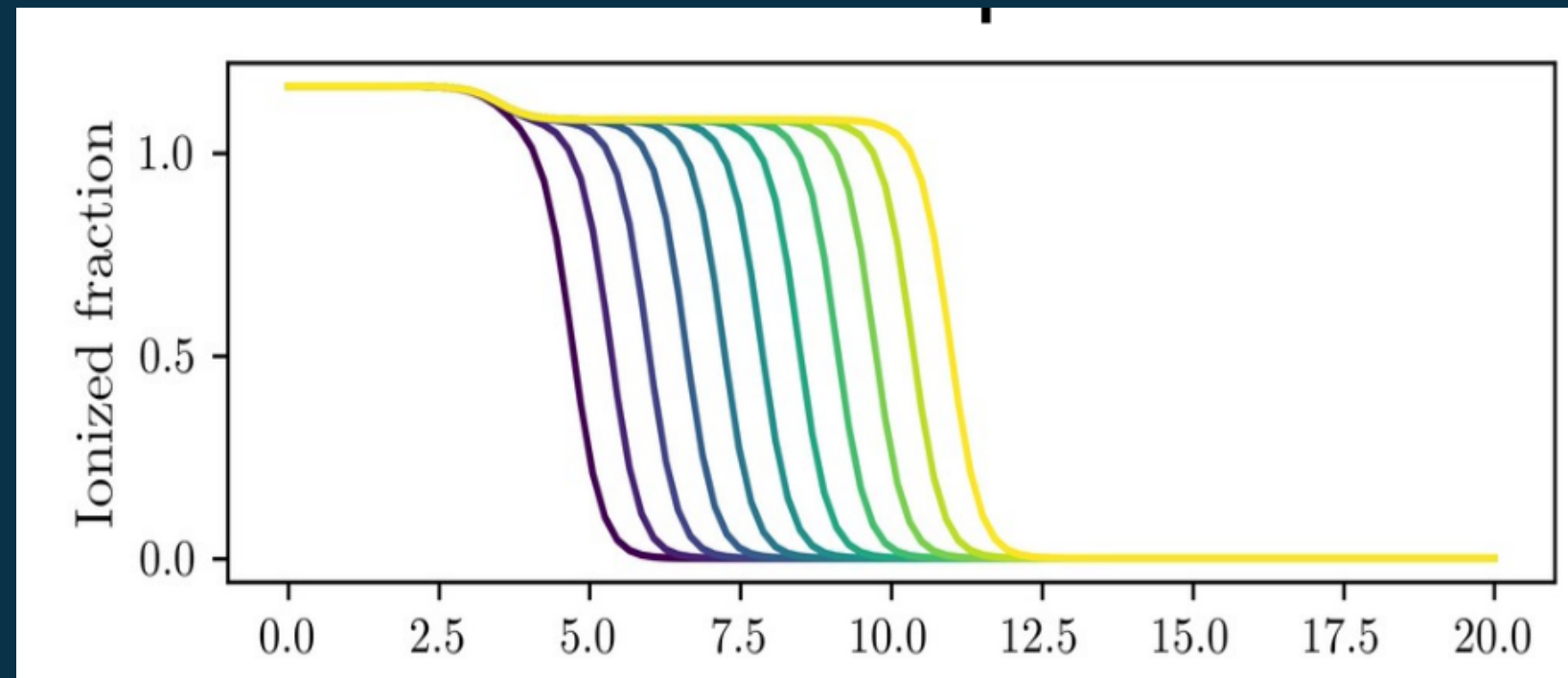


DM and cosmology

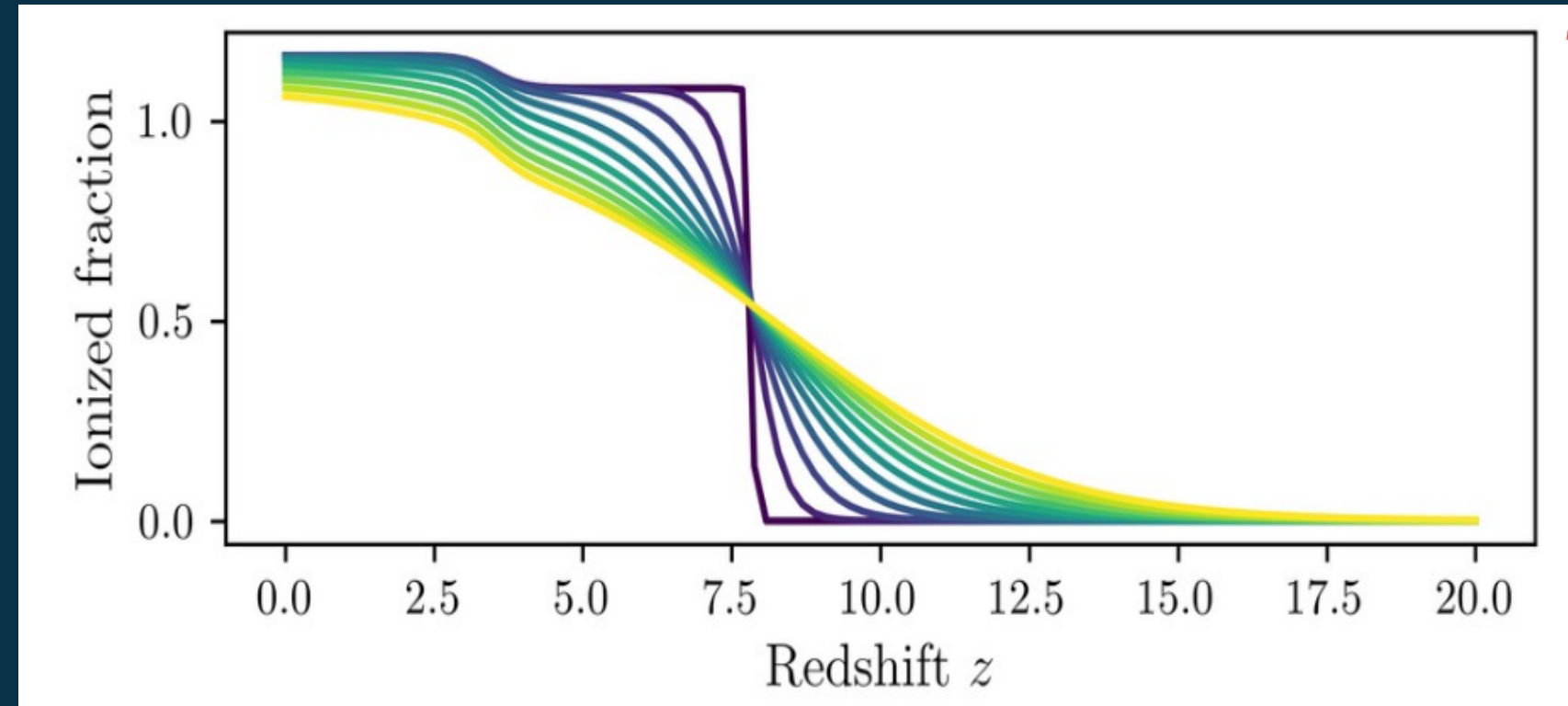
$$DM(z) = \int_0^z c \underbrace{\frac{\Omega_b}{H(z)}}_{\text{cosmology}} \overbrace{\frac{\bar{n}_e(z')/\Omega_b}{(1+z')^2}}^{\text{reionization}} dz'$$

Planck $\tau \pm 12\%$

Recall Amanda's talk
yesterday!



tanh

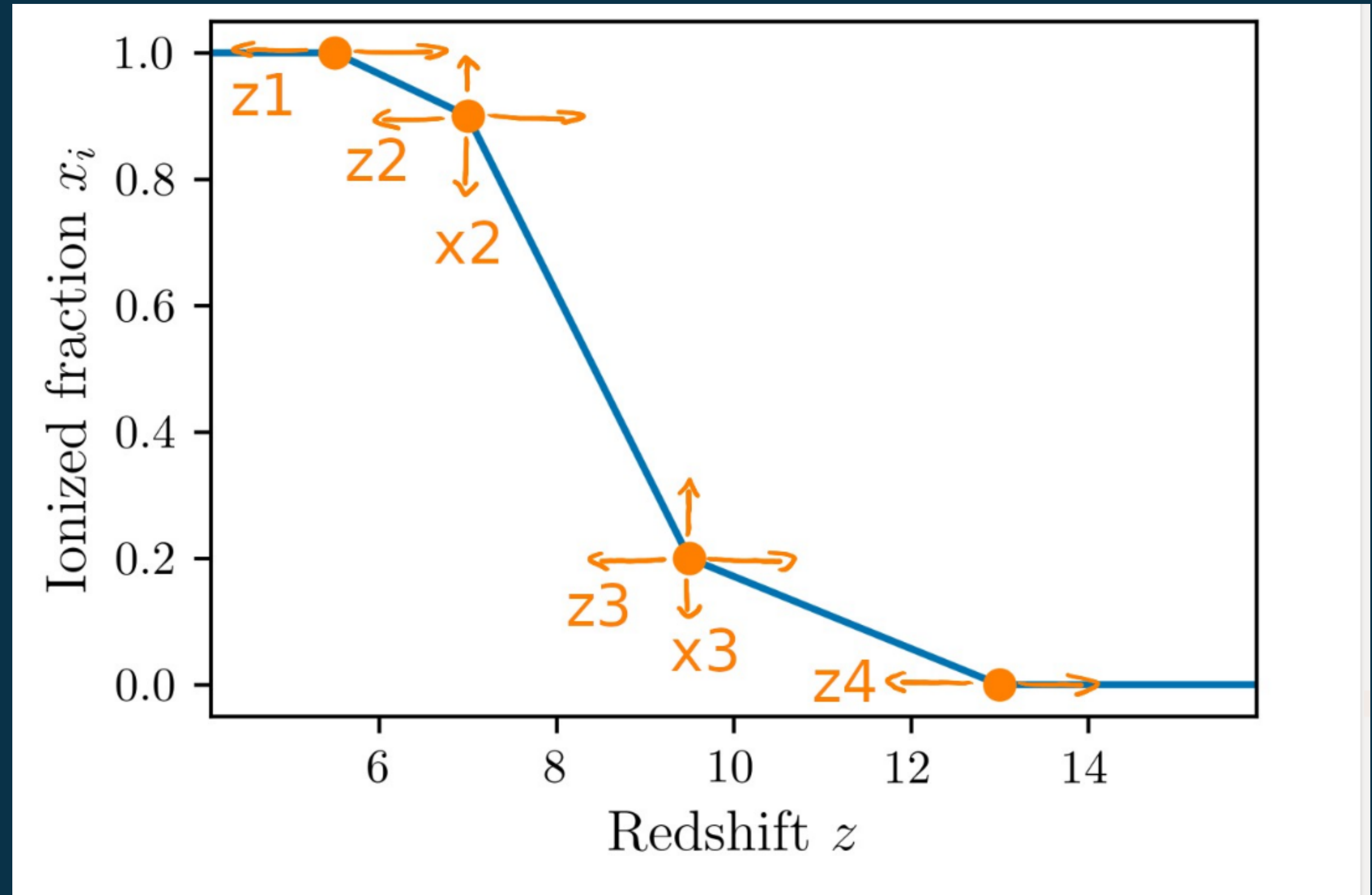


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arXiv: 2107.14242

Assuming a model \rightarrow Wrong result if model \neq reality
E.g. the standard tanh step function reionization
underestimates τ by 10%!



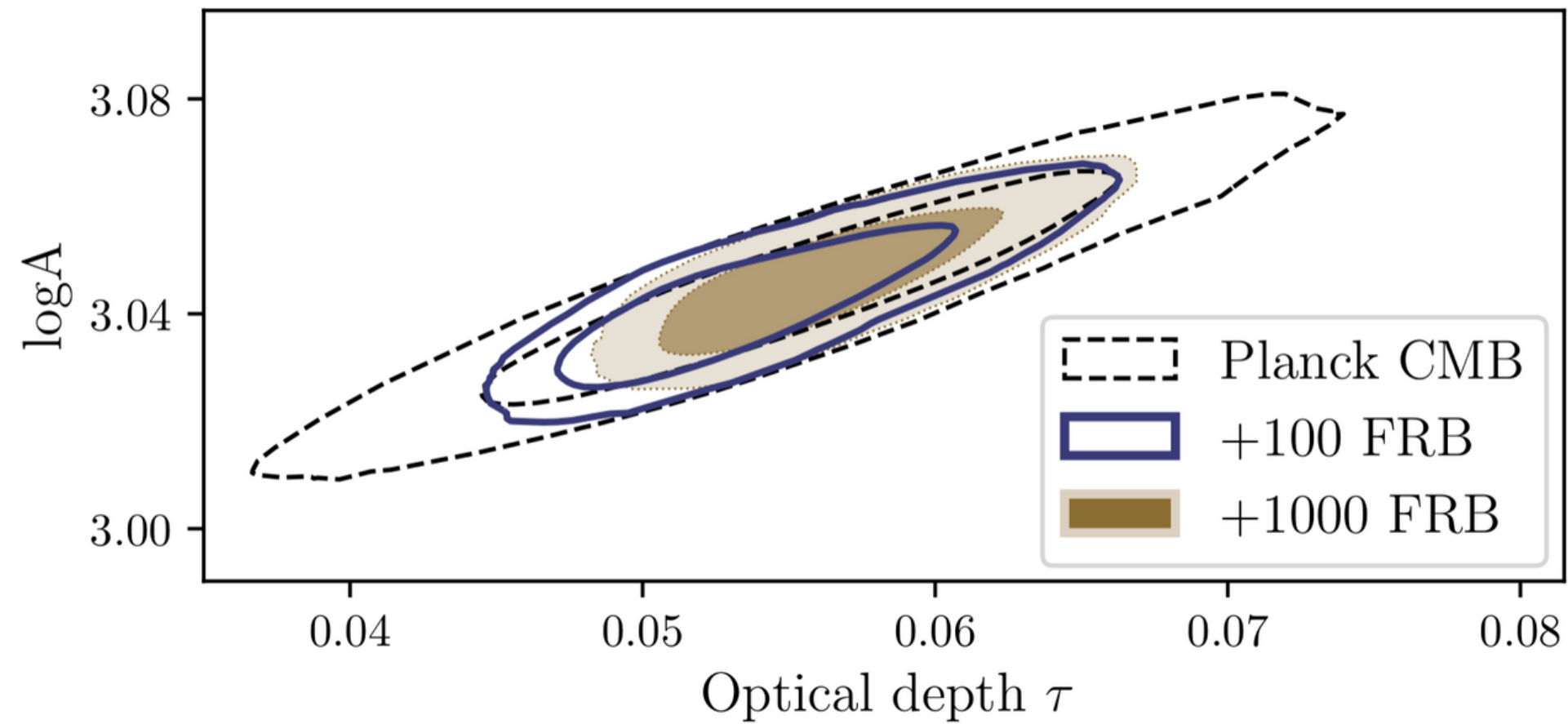
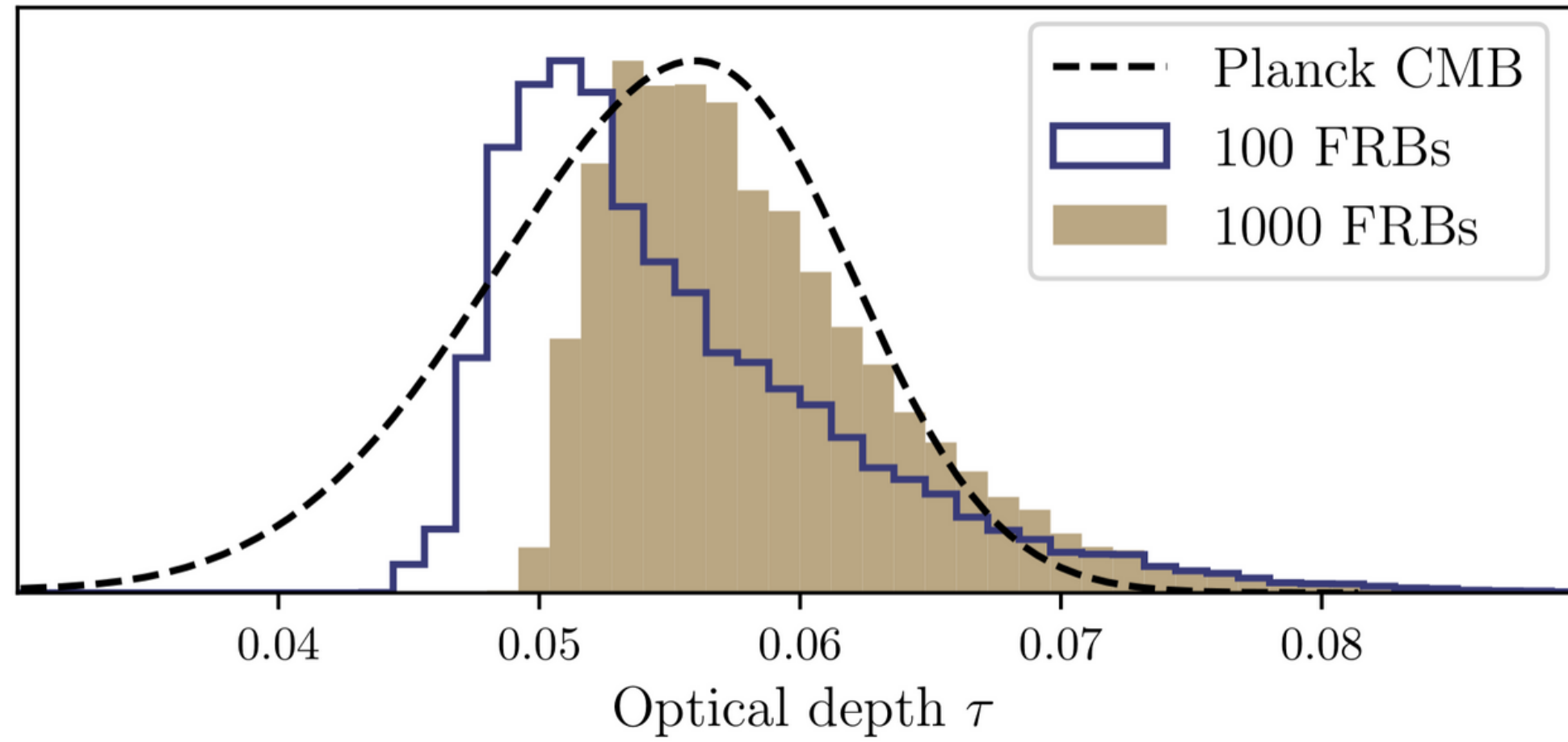
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Flexknot (Millea & Bouchet 2018)



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Is this feasible?

Progenitors

Any merger of compact objects

Magnetars

Supernova interaction w/ compact objects....

... aliens



<https://frbtheorycat.org/>



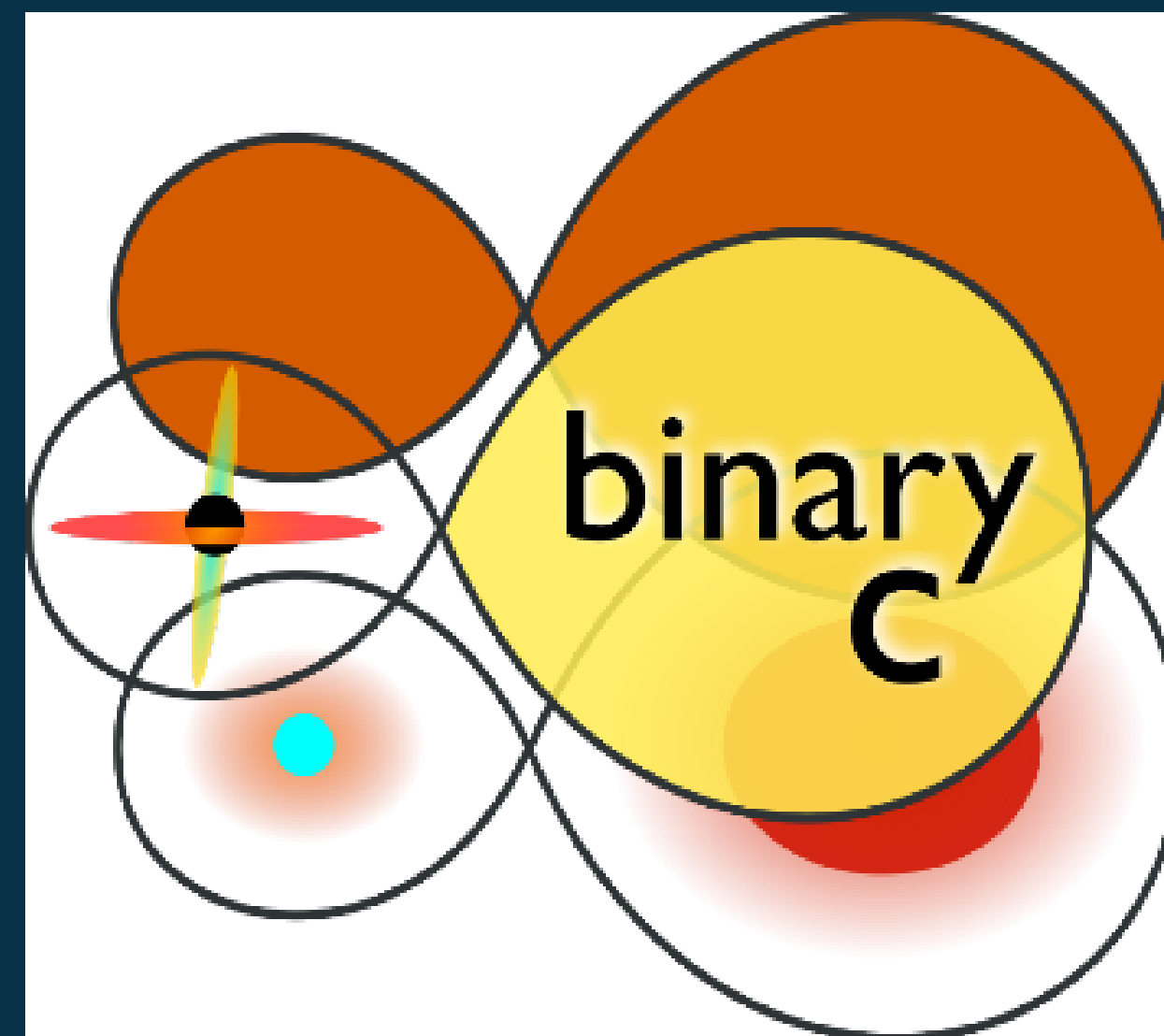
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Population synthesis

Primordial stars

Compact merger progenitors

| Name | M_{\min}/M_{\odot} | M_{\max}/M_{\odot} | $dN/d\log M$ |
|-----------|----------------------|----------------------|------------------|
| Low mass | 0.8 | 250 | -1.35 (Salpeter) |
| Fiducial | 2 | 180 | 0.5 |
| High mass | 10 | 1000 | 1 (flat) |



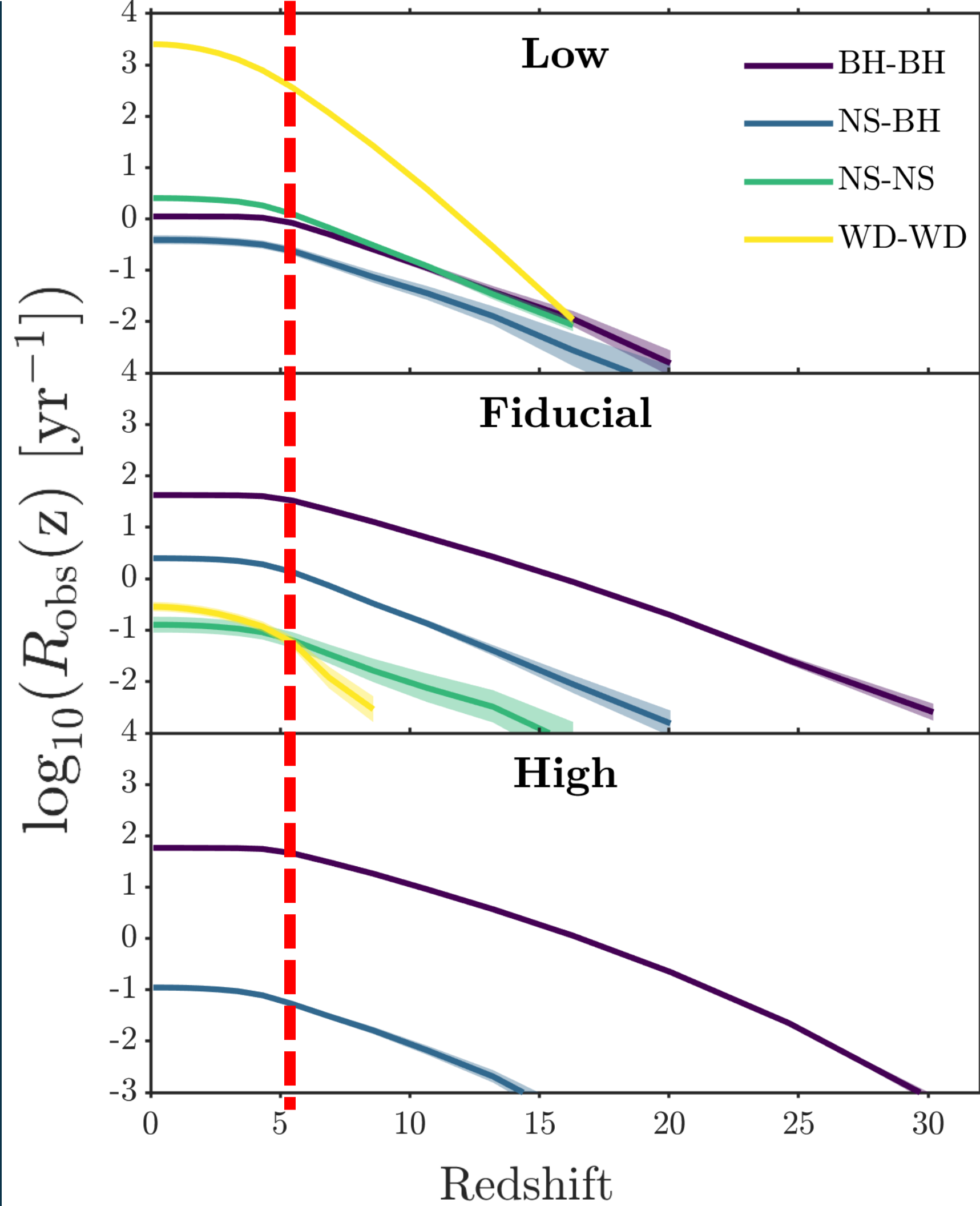
Izzard et al
see at:

https://people.ast.cam.ac.uk/~rgi/binary_c.html



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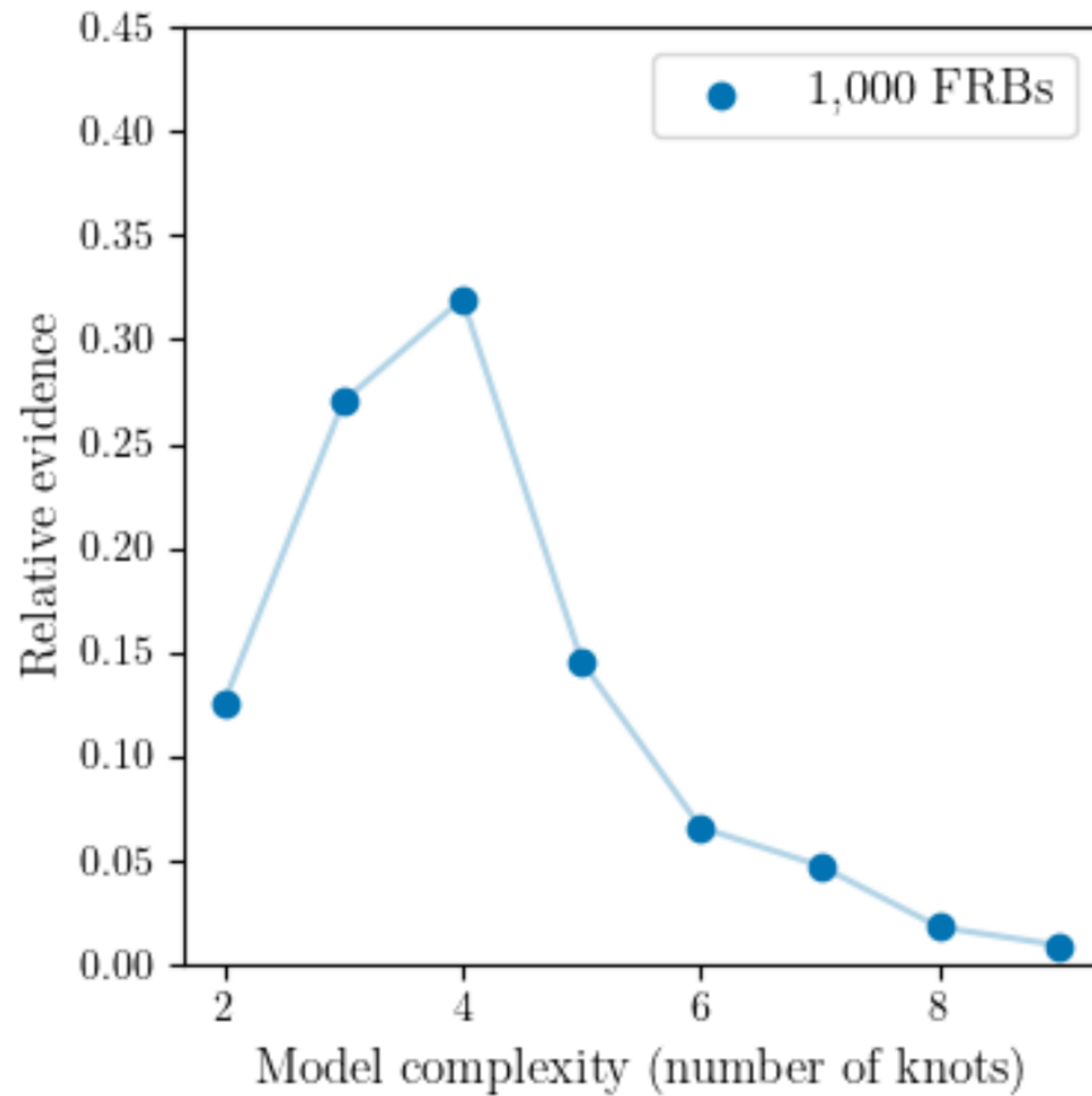
Not enough!!!

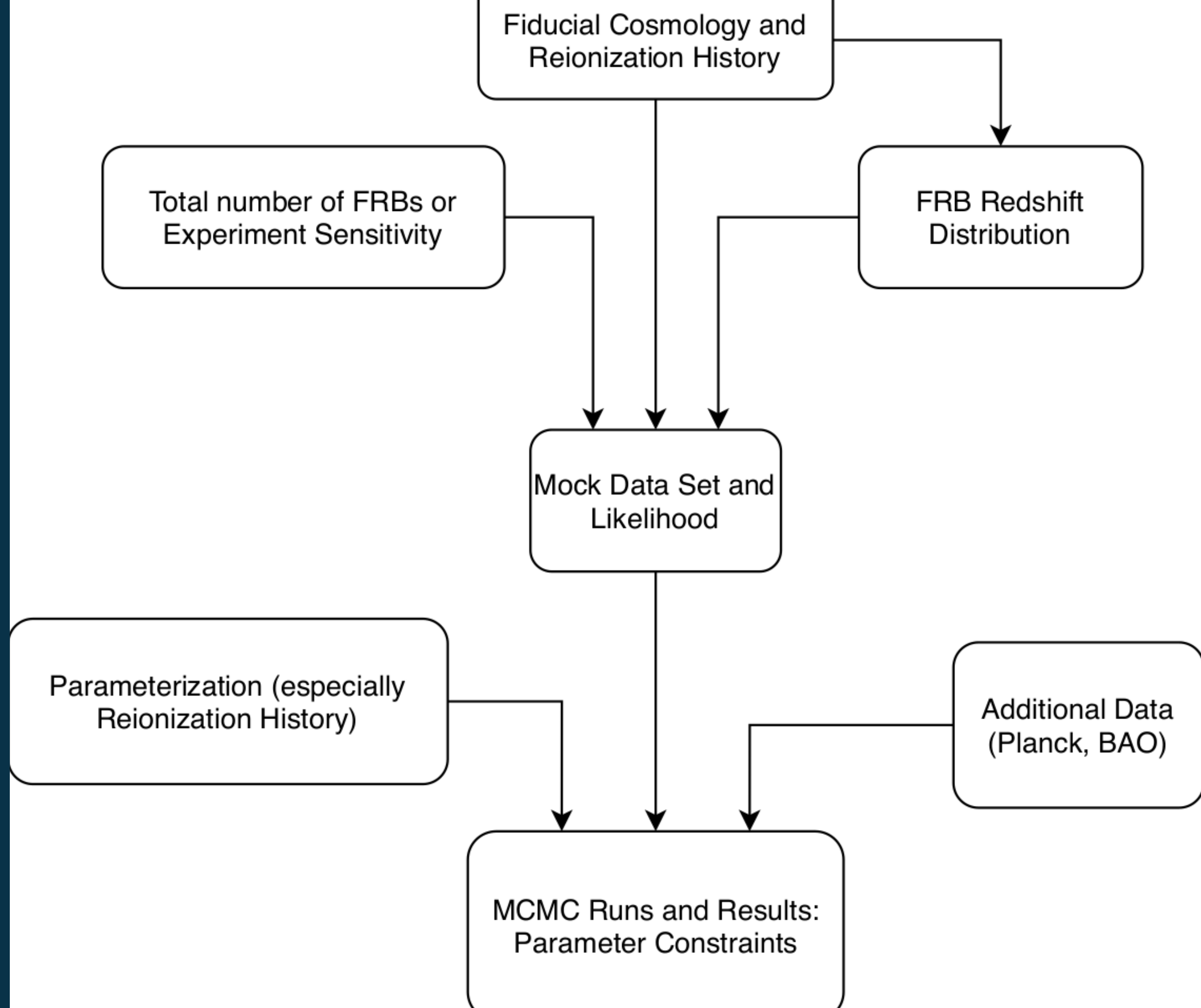


Conclusions

- A small number (100) of FRBs can constrain the optical depth to high accuracy
- Allows for constraining parameters degenerate with τ
- Merger formation channels can NOT give enough FRBs at high- z for this to be possible

Extra





Fiducial Cosmology and Reionization History

Total number of FRBs or Experiment Sensitivity

FRB Redshift Distribution

Mock Data Set and Likelihood

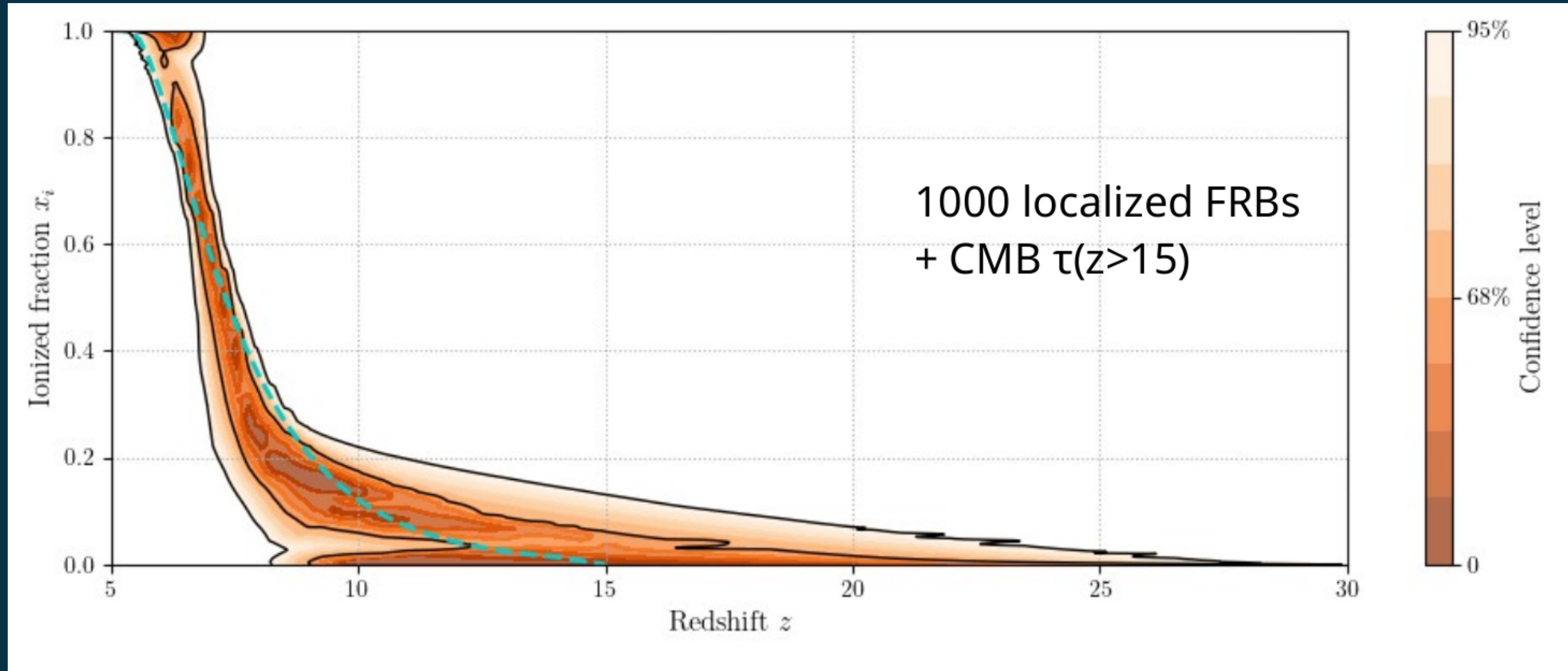
Parameterization (especially Reionization History)

Additional Data (Planck, BAO)

MCMC Runs and Results: Parameter Constraints

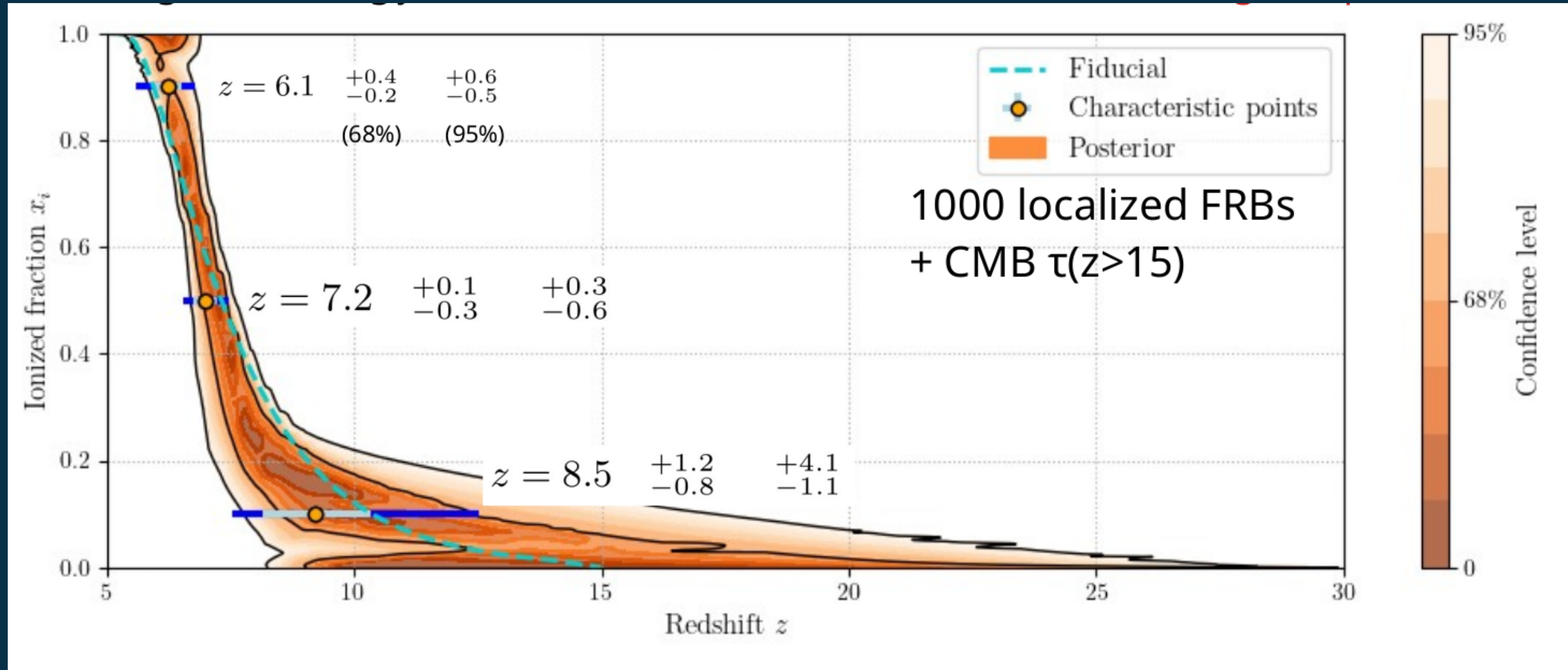


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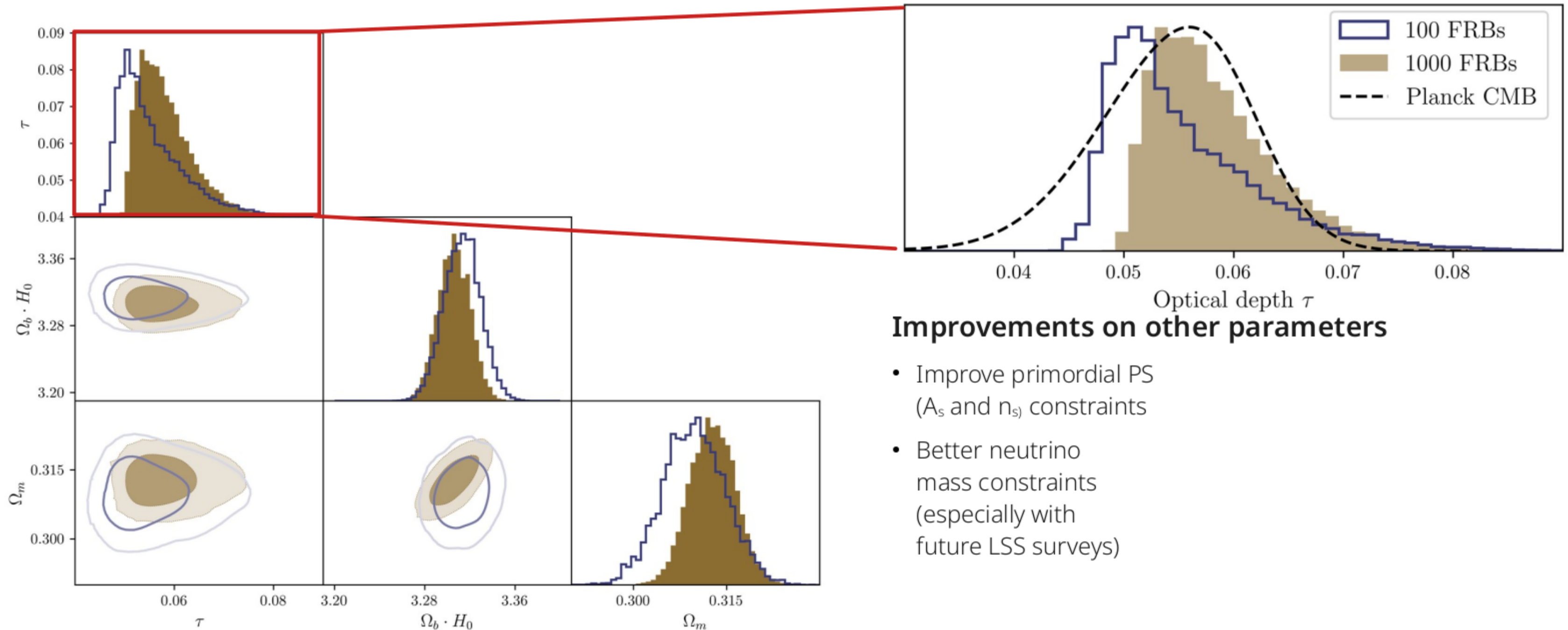


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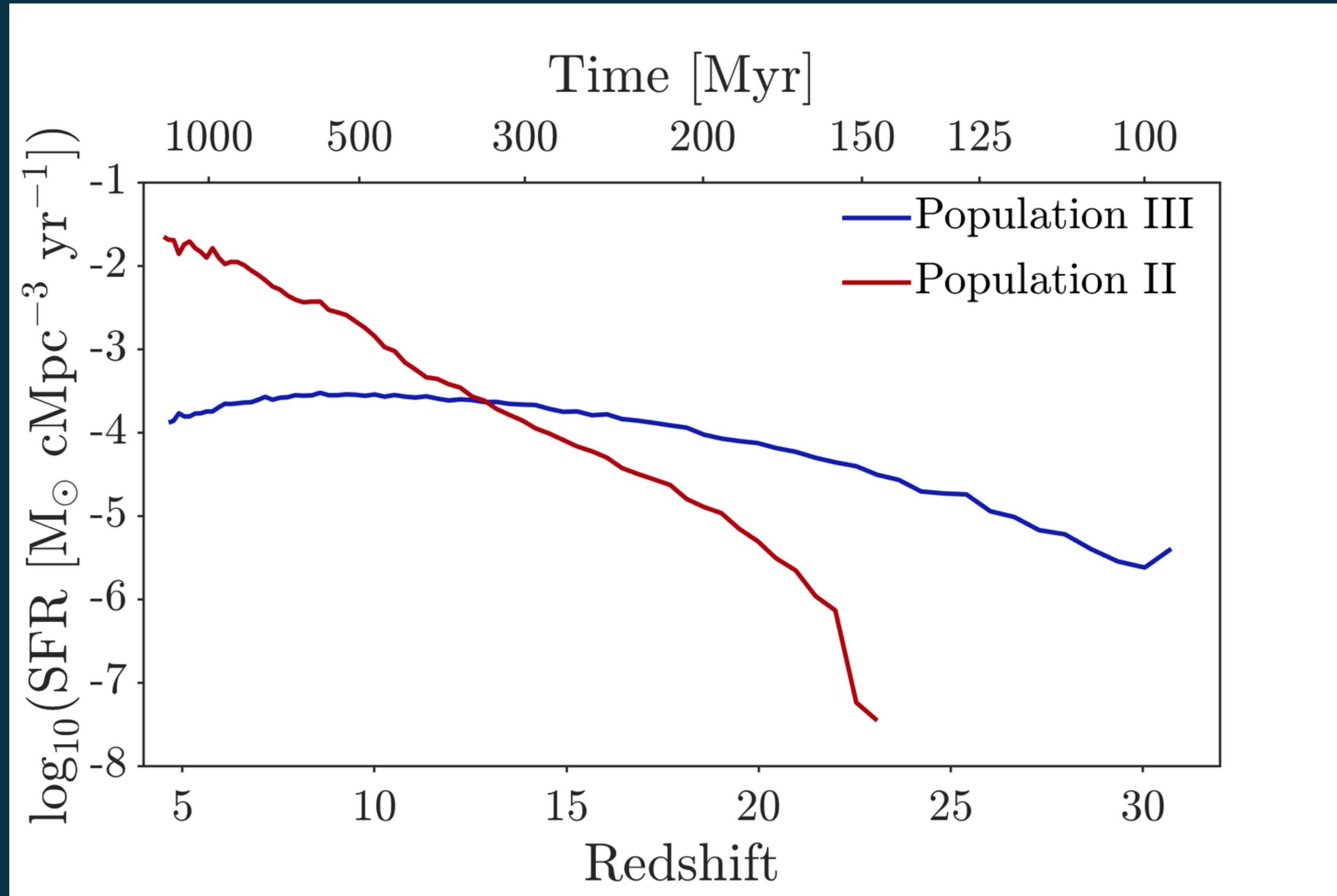


Extra

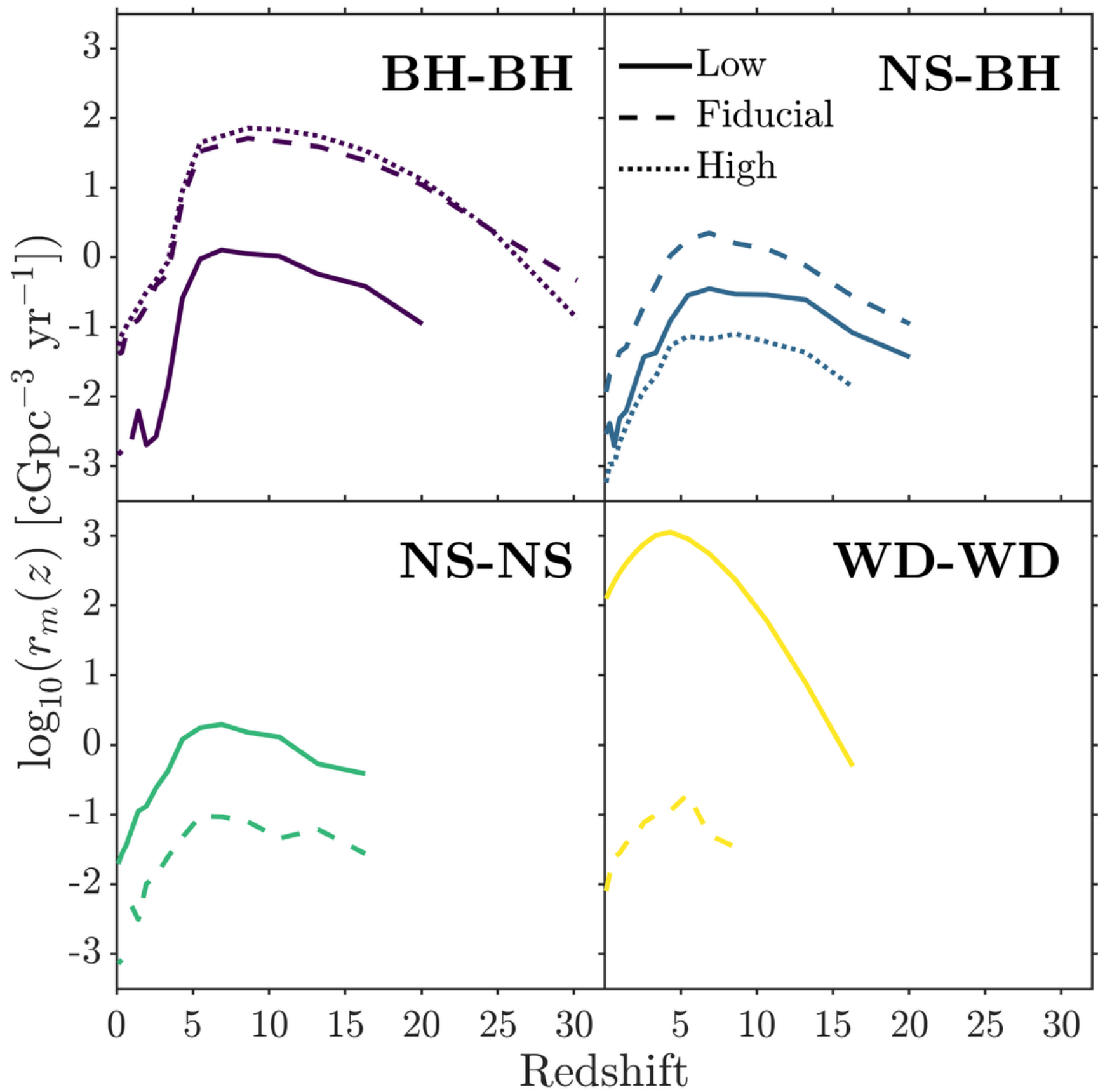
Key point: Reionization model-*marginalized* (“independent”), i.e. averaged over all reionization models.

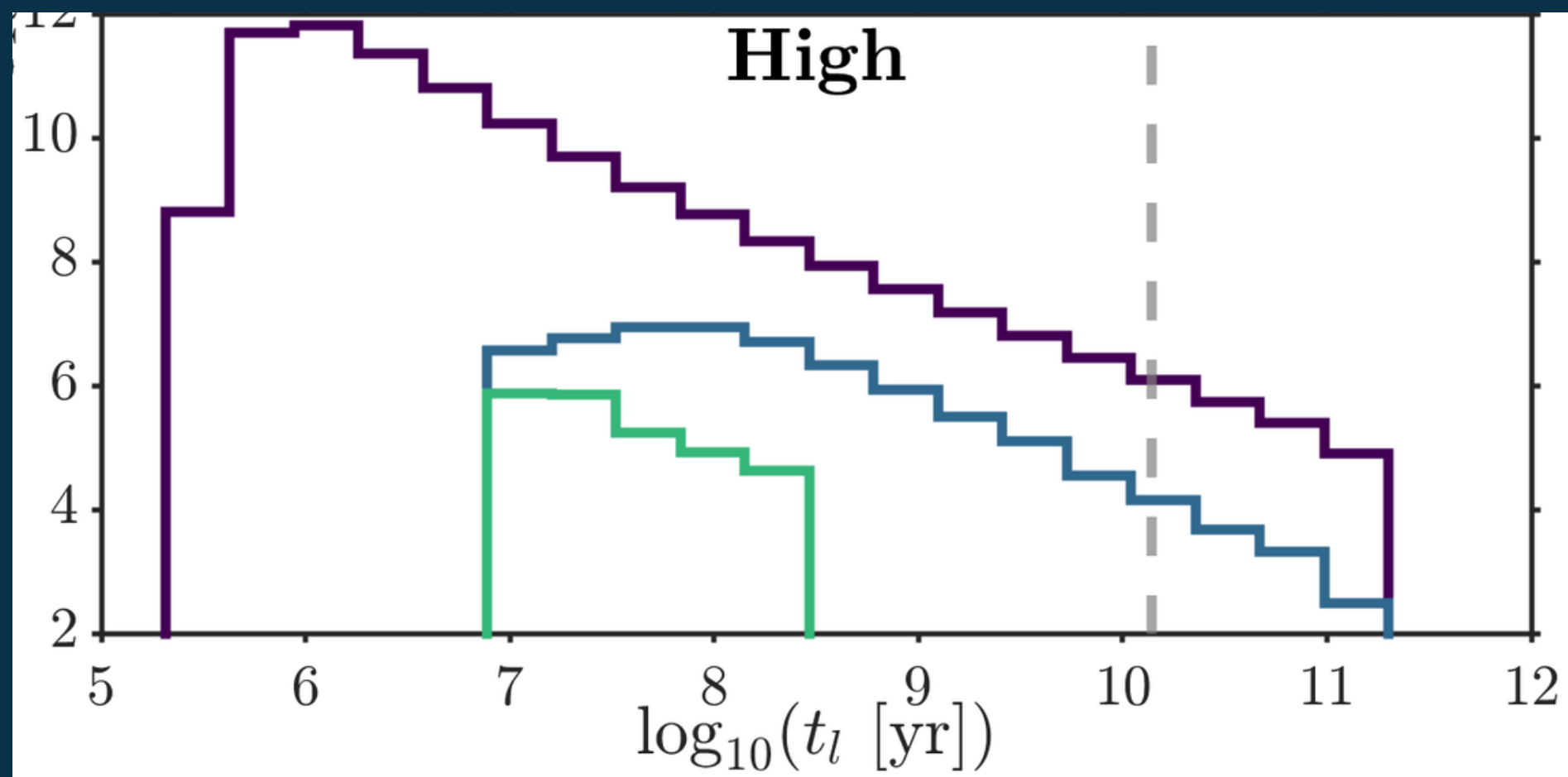
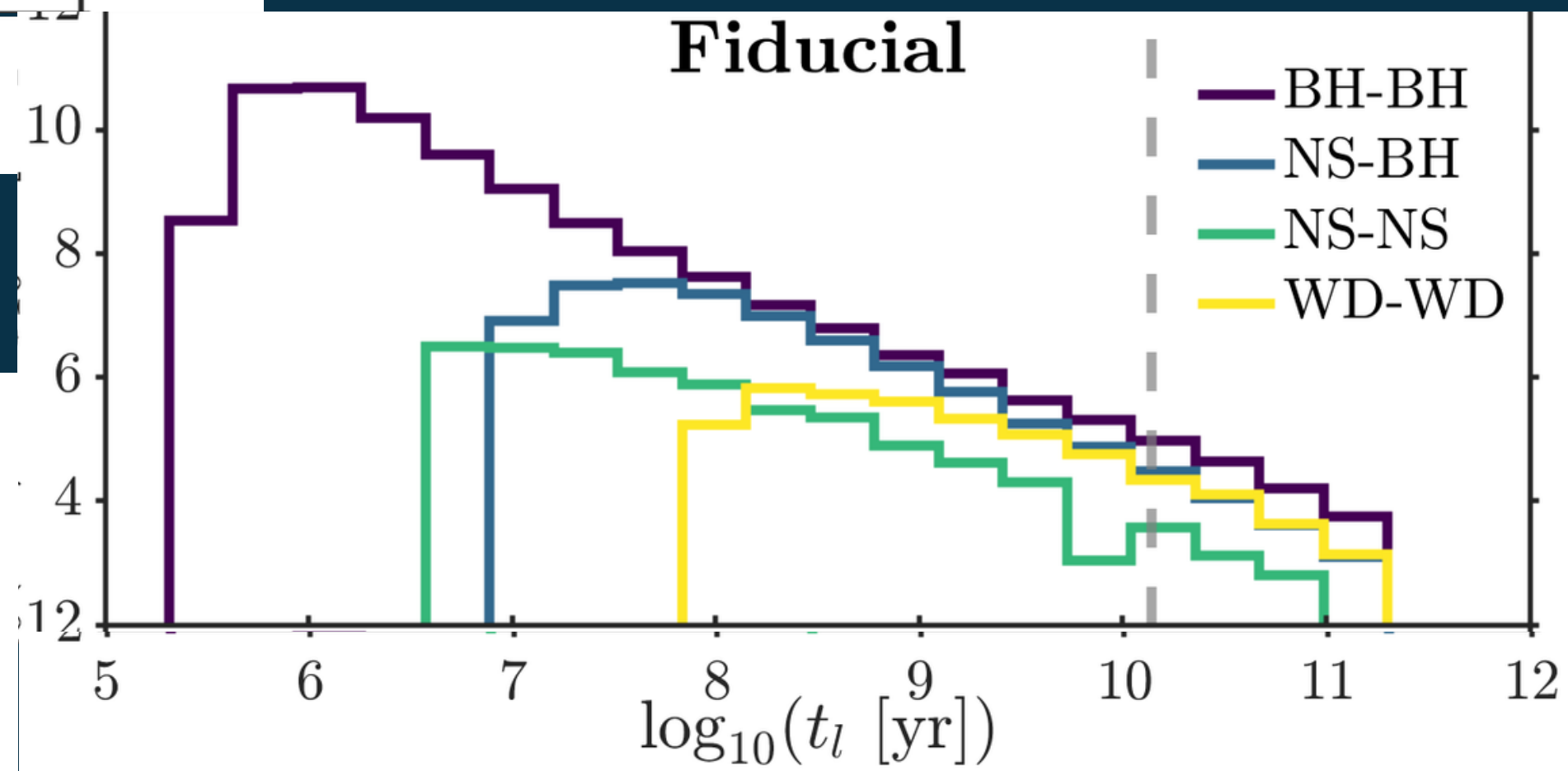
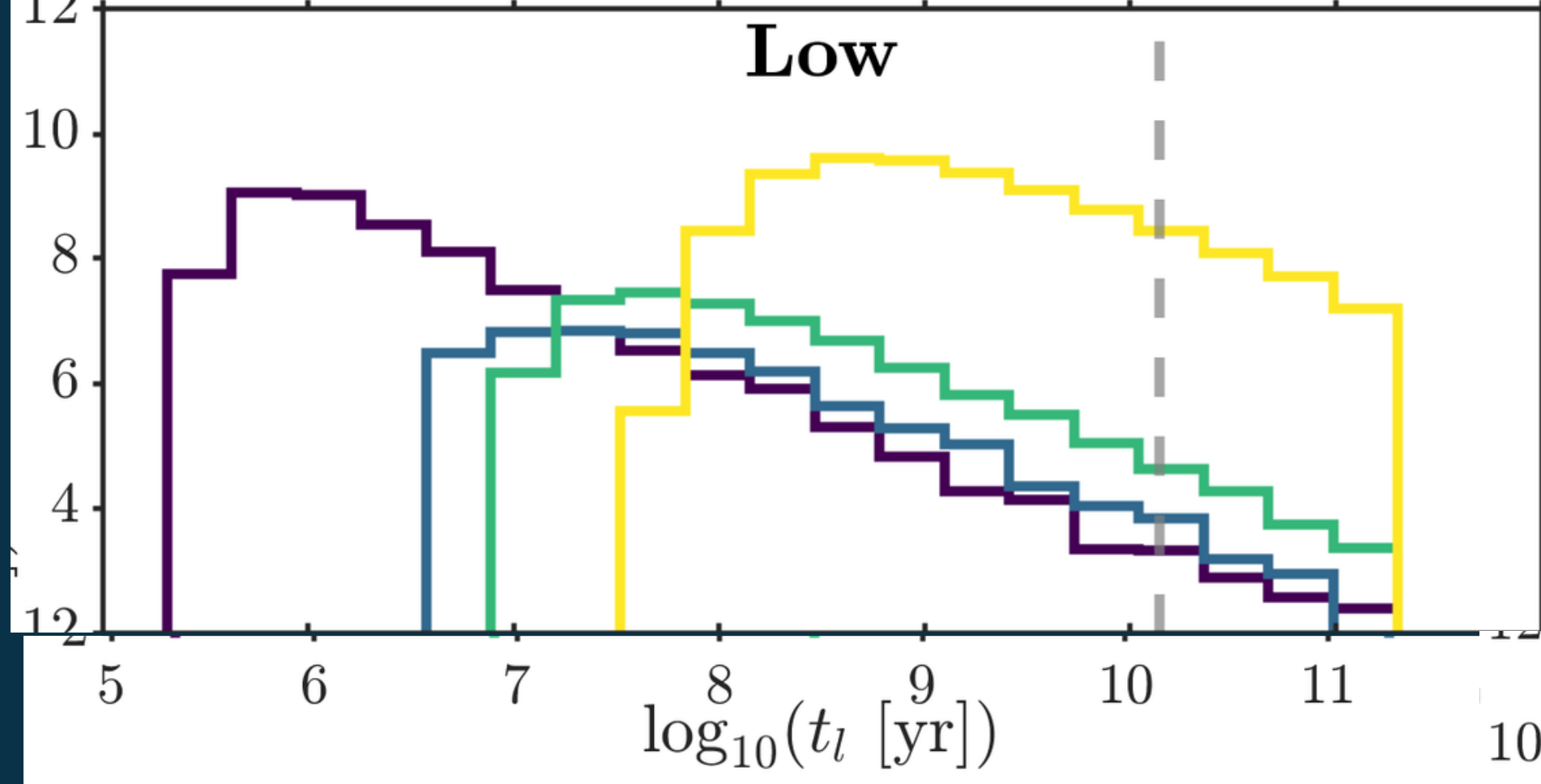


Extra



Extra







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Not enough!!!

