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Learning about the early Universe with the cosmic 21-cm signal

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The 21-cm hyperfine line of HI is set to revolutionize studies of the first billion years, spanning the cosmic dawn of the first stars and eventual reionization of our Universe. I will discuss the potential of this probe in learning about the unknown astrophysics of the first galaxies as well as physical cosmology. Preliminary claims of a detection of the mean (sky-averaged) 21cm signal showcased its potential in constraining exotic dark matter-baryon interactions in the early Universe, although recent robust interpretation points against new physics. The true potential of the cosmic 21cm signal is in mapping out the first half of our observable Universe through HI fluctuations. Current upper limits on the 21-cm power spectrum already provide new insights into the heating of the intergalactic medium, likely caused by a new population of high mass X-ray binaries. Future detections will allow us to set the strongest available constraints on exotic heating mechanisms through dark matter decay and annihilation.

References

<https://ui.adsabs.harvard.edu/abs/2023ApJ...945..124H/abstract>, <https://ui.adsabs.harvard.edu/abs/2025A%26A...698A.152C/abstract>,
<https://ui.adsabs.harvard.edu/abs/2024JCAP...01..005F/abstract>.

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