Probing the Early Universe Using Hydrogen: 21 cm Cosmology at the Earths Poles

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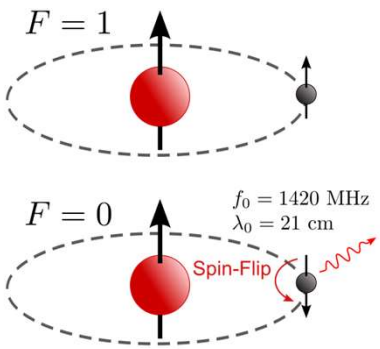
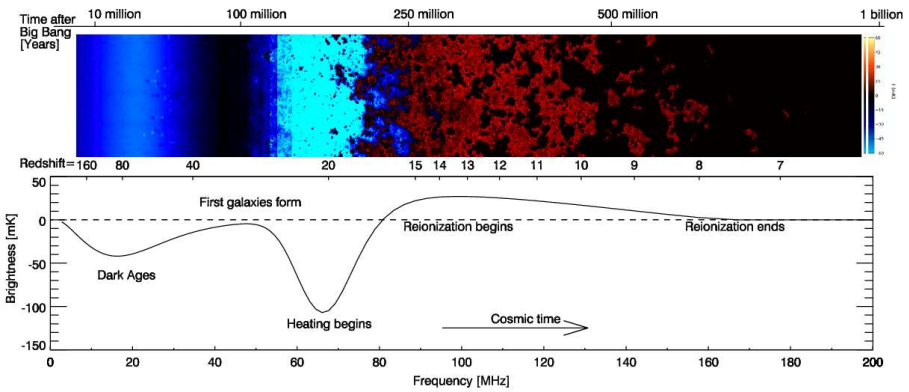
What is the 21 cm Hydrogen Line?



- Neutral hydrogen starts at a high energy state.
- It moves to a lower energy state via a Spin-Flip.
- This produces a photon of light.
- The wavelength of this produced light is 21 cm.

Why do we Care?



- Allows us to probe periods in the universe before star formation!
- The 21 cm signal gets stretched more the earlier it was created.
- Looking at very long wavelengths, we can look at the very early universe.
- We Focus on the 21 cm signal stretched to 10 to 100 m, or the Dark Ages!

References

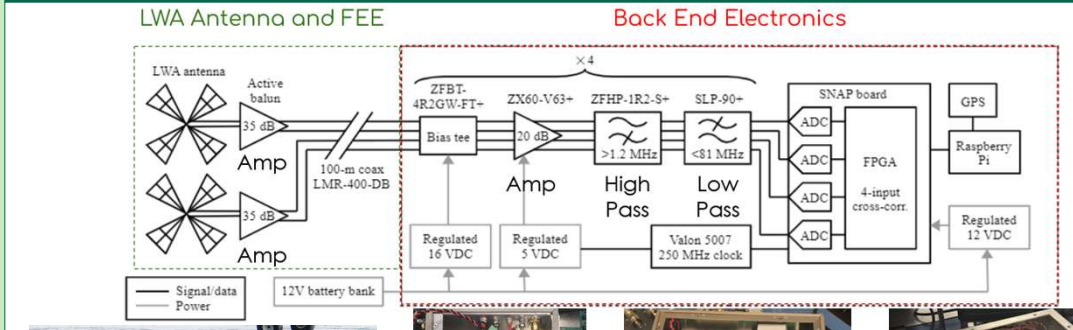
[1] (2023) Hydrogen line. [Online]. Available: https://en.wikipedia.org/wiki/Hydrogen_line

[2] R. W. Furlanetto and S. P. Oh, "21 cm cosmology in the 21 st century," 2012. 1

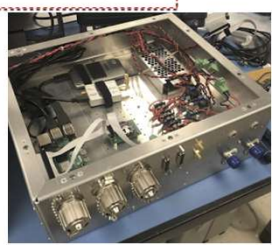
[3] H. C. Chiang, T. Dyson, E. Egan, S. Eyono, N. Ghazi, J. Hickish, J. M. Jauregui-Garcia, V. Manukha, T. Menard, T. Moso, J. Peterson, L. Philip, J. L. Sievers, and S. Tartakovsky, "The array of long baseline antennas for taking radio observations from the sub-antarctic," 2020. [Online]. Available: https://arxiv.org/abs/2008.12208 1

undergraduate poster showcase

How do We Measure the Signal?





An antenna is used to measure galactic foregrounds. The signal is passed through electronics that amplifies and filters it. Our SNAP board changes this to a digital signal and is stored in hard drives using a Raspberry Pi.

Where do we go to Measure it?

- McGill Arctic Research Station!
- Minimizes interference from AM and FM radio.
- 2 stations have been deployed.
- Acquiring data autonomously for one year.
- Collecting data in July!