

# Presentation on Antenna Simulation for 21cm H line

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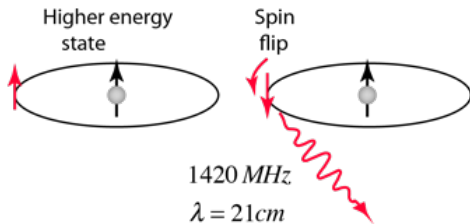
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# Outline

- 1 21cm Hydrogen Line
  - What is the 21cm Hydrogen Line?
  - Importance of the 21cm line
- 2 Waveguides

# What is the 21cm Hydrogen Line?

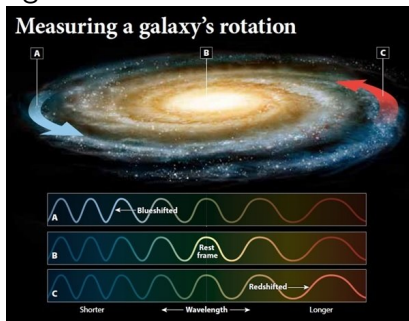
- Neutral hydrogen is made up of an electron and a proton.
- The electron and proton both have half-integer spins.
- Neutral hydrogen can exist in two energy states, one with electron and proton spins parallel, and one with antiparallel.



Source : <http://hyperphysics.phy-astr.gsu.edu/hbase/quantum/h21.html>

# Importance of the 21cm line

- In Radio Astronomy : The rotation curve of galaxy can be measured by observing the 21cm line received from each line of sight.
- In Cosmology : The “dark ages” of the Universe can be probed by using 21cm line.



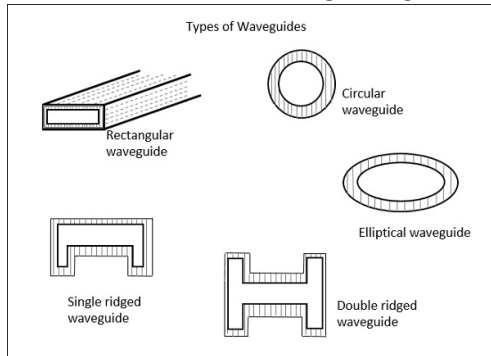
Source : <https://physicsopenlab.org/2020/09/08/measurement-of-the-milky-way-rotation/>

# Outline

- 1 21cm Hydrogen Line
- 2 Waveguides
  - What are Waveguides?
  - Rectangular Waveguides

# What are Waveguides?

- A waveguide is a structure which guides waves (like EM and sound waves) in a particular direction with minimal energy loss.
- A hollow metallic tube is used for guiding EM waves.



Source : [https://www.tutorialspoint.com/microwave\\_engineering/microwave\\_engineering\\_waveguides.htm](https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_waveguides.htm)

# Rectangular Waveguides

- Rectangular waveguide is one type of waveguide.
- The EM waves will be travelling along the z-direction.
- Thus, the EM wave solutions for Maxwell equations can be separated into longitudinal and transverse wave solutions.

$$E(x, y, z) = E(x, y) \exp(-i\beta z)$$

$$B(x, y, z) = B(x, y) \exp(-i\beta z)$$