What are Radio Waves…..Really?

Introduction: ElectroMagnetic Radiation:

Now the “Rest of the Story, “ as Paul Harvey used to say

Before we get into the details of What is a Radio Wave, First, Lets talk about SPEED. Everything in the Universe is Speeding at the speed of Light. But Even Light can’t match This speed!!! 18Min. Play 5 min.	https://youtu.be/N6ABEsgRHEY?feature=shared

Maxwell 1865 and Hertz 1887 Pioneers of Electromagnetic waves. 10 min.	https://youtu.be/UN37QEmW_ns?si=c1Ah0UtO51811z2o
Classic Antenna Explanation . 4min 32sec	https://youtu.be/PPKEpJEt_cM?si=R6KSKqEaC9Rmf70Q
There are 2 fundamental theories at play here. Let’s see how they work.	
Classic Relativity 1 13min	https://youtu.be/uTyAI1LbdgA?si=HE7ZWP-pBAkxn6y7
Classic Relativity - Electromagnetic Field 14min	https://youtu.be/XoVW7CRR5JY?si=fo8h_27-lMS3i5sy
Quantum Theory 1. 3min 21	https://youtu.be/DfQH3o6dKss?si=zw3maMWZgh029iKc
Quantum Theory 2. 13.59	https://youtu.be/28Fwx1RMTfg?si=tFN0bYRJMouSh8BH

Conclusion:
Q & A

Reference Videos on Electromagnetism

https://youtu.be/bwreHReBH2A?si=o-W8dST29dFAfhRe

Reference Videos on Time Dilation and Length Contraction

https://youtu.be/Oo-aKigS8gU?si=5Z6GjVkxTel7Ib7a

Reference Videos on Special Relativity

https://youtu.be/m1xgZZL6Tlg?si=zODPQAecZrHG-Anp

Resonant Dipole antenna:
In a resonant dipole antenna, the behavior of electrons in the conductor is essential to understanding how it radiates electromagnetic waves. Here's a simplified explanation of what electrons are doing in the conductor:

1. **Oscillating Back and Forth**: When an alternating voltage is applied to the dipole antenna, it creates an electric field across the antenna elements. Electrons in the conductor respond to this electric field by oscillating back and forth within the wire.

2. **Acceleration and Deceleration**: As the voltage alternates, the electrons in the conductor accelerate in one direction during one half of the cycle when the voltage is increasing, and then decelerate as the voltage reverses direction during the other half of the cycle. This acceleration and deceleration of electrons result in the emission of electromagnetic radiation.

3. **Radiation of Electromagnetic Waves**: The acceleration and deceleration of electrons cause them to emit electromagnetic waves. These waves consist of electric and magnetic fields that propagate outward from the antenna. This is how the antenna radiates electromagnetic energy into space, creating radio waves.

4. **Radiation Pattern**: The specific pattern of radiation depends on the geometry of the dipole antenna. A resonant dipole antenna's length is typically chosen to maximize radiation in the desired direction while minimizing radiation in unwanted directions.

5. **Phase Relationships**: The phase relationship between the current and voltage in the antenna elements, as discussed earlier, plays a crucial role in determining the direction and efficiency of radiation. When the current lags the voltage by 90 degrees in a resonant dipole, it ensures that the radiated electromagnetic waves are in phase and reinforce each other in the desired direction.

In summary, the oscillation of electrons within the conductor of a resonant dipole antenna in response to an applied alternating voltage is what leads to the emission of electromagnetic radiation, which forms the radio waves that the antenna transmits. The phase relationships and geometry of the antenna elements are key factors in controlling the direction and efficiency of radiation.

More Antenna Information:
Antenna Example: Half wave dipole antenna voltage and current distribution
Voltage at minimum at center, Current Maximum at center

In a half-wave dipole antenna used in ham radio, the part that radiates electromagnetic waves most effectively is the length of wire between the two ends of the antenna when the current is at its highest point. At this moment, the voltage across the antenna is at its lowest point. This occurs because the antenna is resonant, and it is during the peak current points that the radiated electromagnetic waves are strongest.

https://www.eeeguide.com/wp-content/uploads/2018/11/Antenna-Characteristics.jpg