

# Various Materials Effect

By

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- Unlike **mechanical waves** (sound waves) which need a medium to travel, **EM waves** can travel through anything, such as
  - air,
  - water,
  - a solid material or vacuum,
  - Humans or biological entity

# Various EM Effects on Humans

- It is a form of energy that is all around us. Human activities like using
  - **Mobile Communications** devices used to message, calls, data and smart iot controls.
  - global positioning system (**GPS**) device to navigate precise location,
  - heating up a food in a **microwave oven**
  - using **X-rays** detection by a doctor would be impossible without **EM radiation**

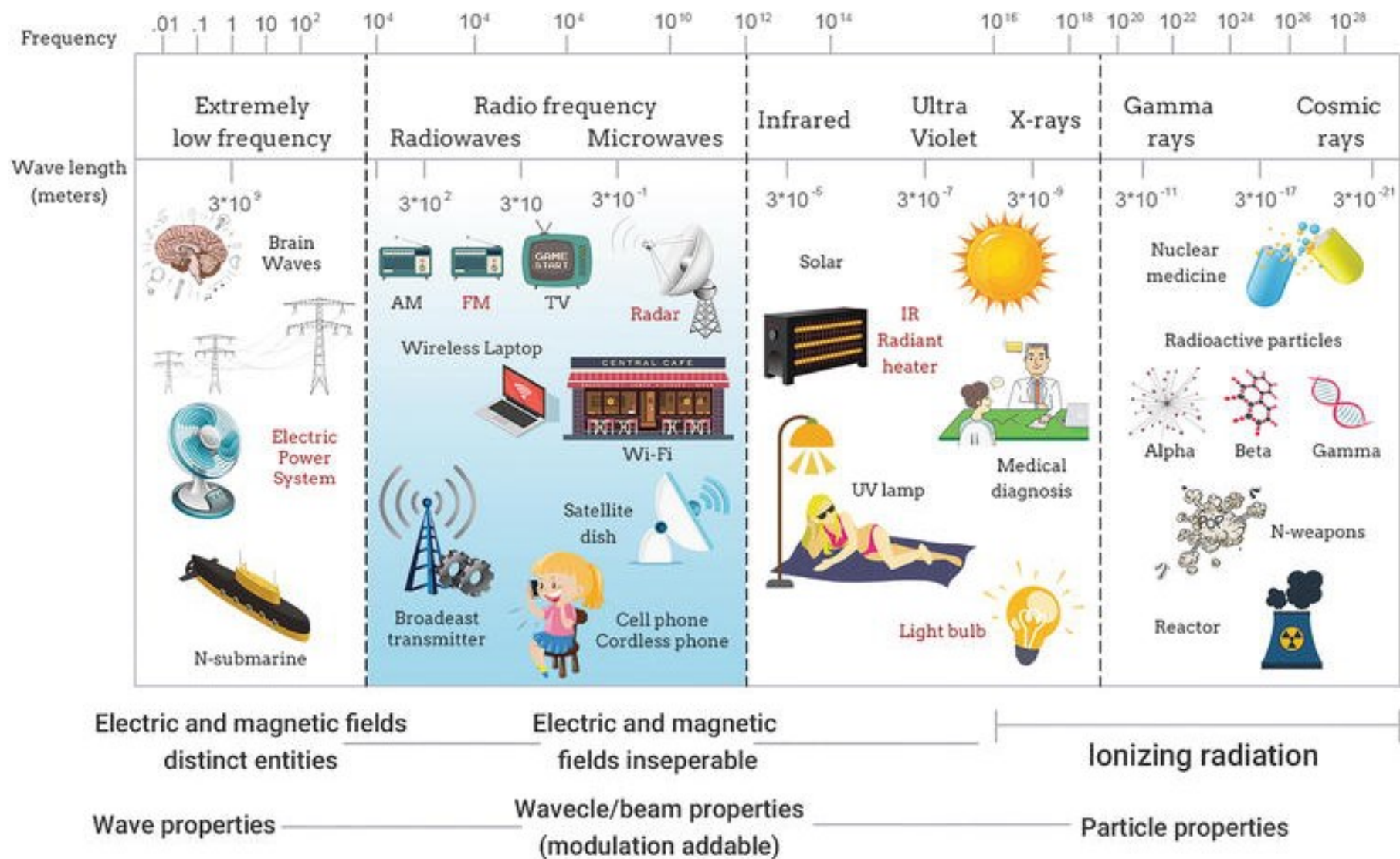
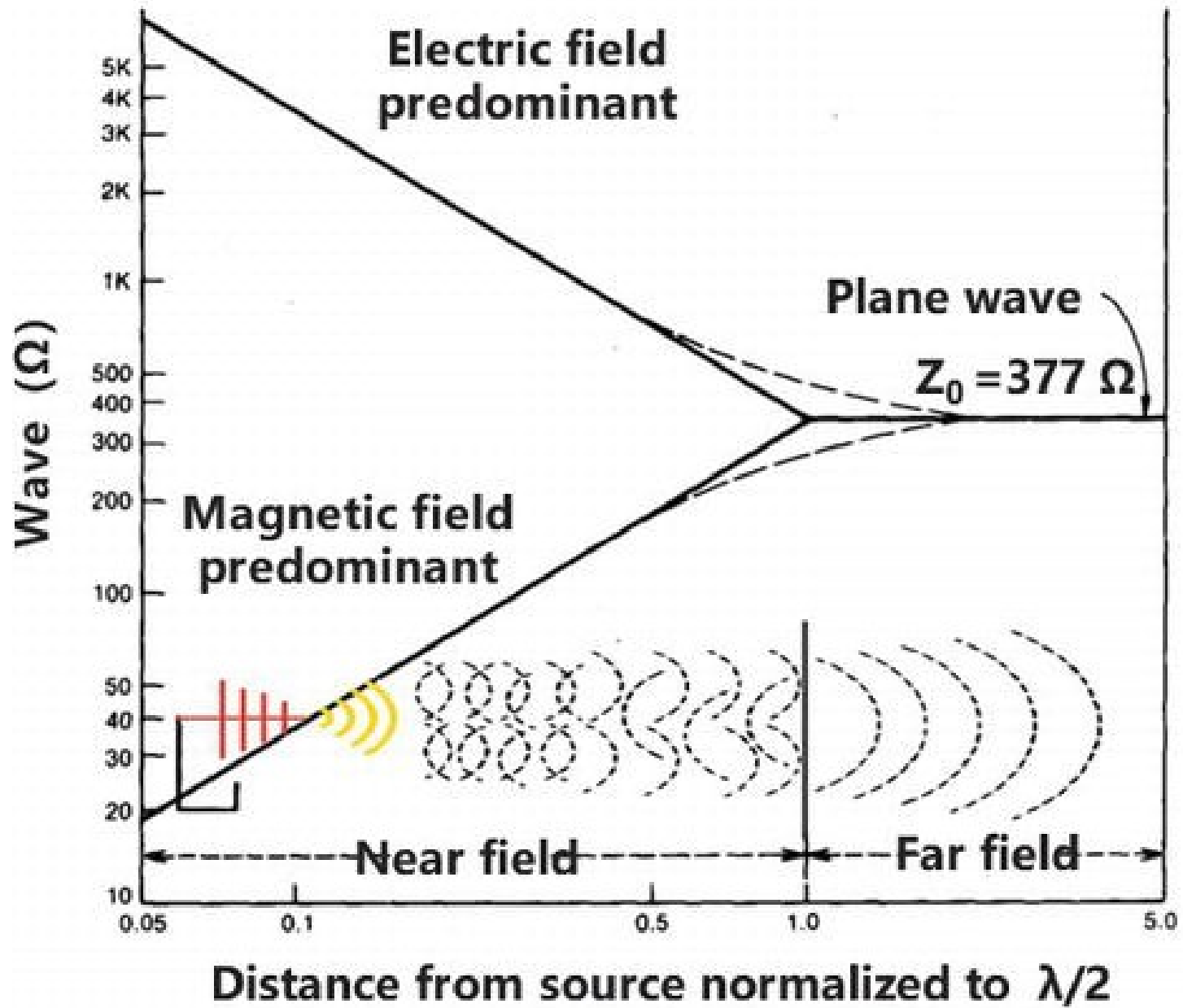


Figure: - EM spectrum used



- The EM spectrum ranges from lower energy waves (longer wavelength),
  - radio waves and microwaves,
  - higher energy waves (shorter wavelength),
  - X-rays and gamma rays.

- EMI is encountered by all of us in our daily life and are expected to face exponential rise in future due to the growing numbers of wireless devices and standards, including
  - cell phones,
  - GPS,
  - Bluetooth,
  - Wi-Fi and
  - near-field communication (NFC).

- **EMI shielding** can be achieved by prevention of EM waves passing through an electric system either by reflection or by absorption of the incident radiation power



- Previously metals were conveniently used in many occasions. Among them,
  - galvanized steel and aluminum are the most widely used.
  - Copper, nickel, pre-tin plated steel, zinc and silver are also used for some purposes.

- Trend in today's electronic devices become faster, smaller and lighter, metals are disadvantageous in weight consideration.
- Efforts have been focused on the development of EMI shielding materials that work by tunable reflection and absorption based on novel materials that possess **lightness, corrosion resistance, flexibility, easy processing**, etc.

- Three categories of lightweight EMI shielding materials:-
  - Polymer-based composites,
    - Polymer-based composites containing metallic fillers
    - Intrinsically conductive polymers-based composites
    - Polymer-based composites containing carbon-based fillers
    - Polymer-based composites containing magnetic particles composites
  - Foams
    - Polymer-based composite foams
    - Syntactic foams
    - CNTs/graphene foams
  - Aerogels
    - Graphene aerogels