

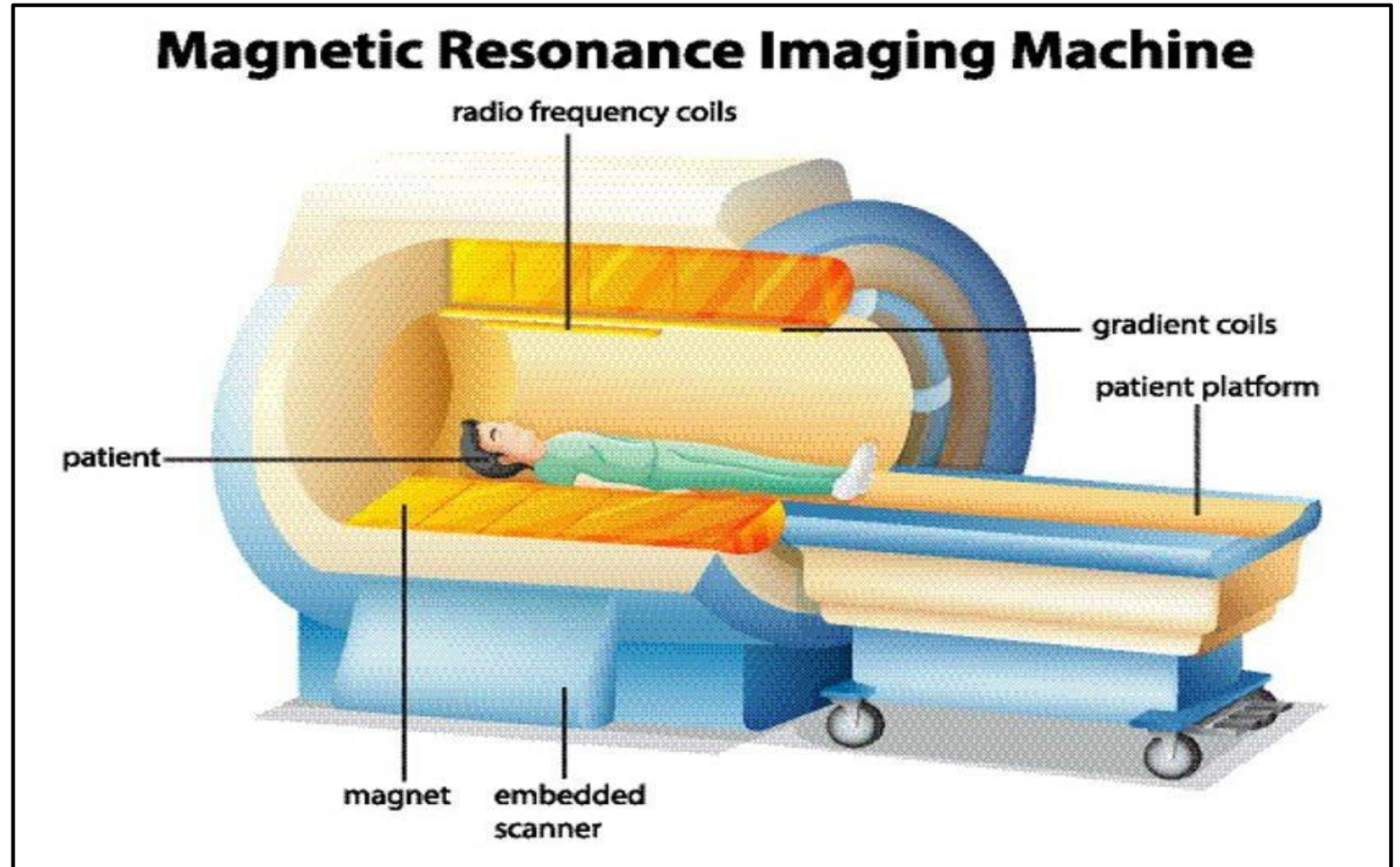


*Practical Lecture*  
*Lecture Two*  
*The hardware and magnet types*

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*Third stage*

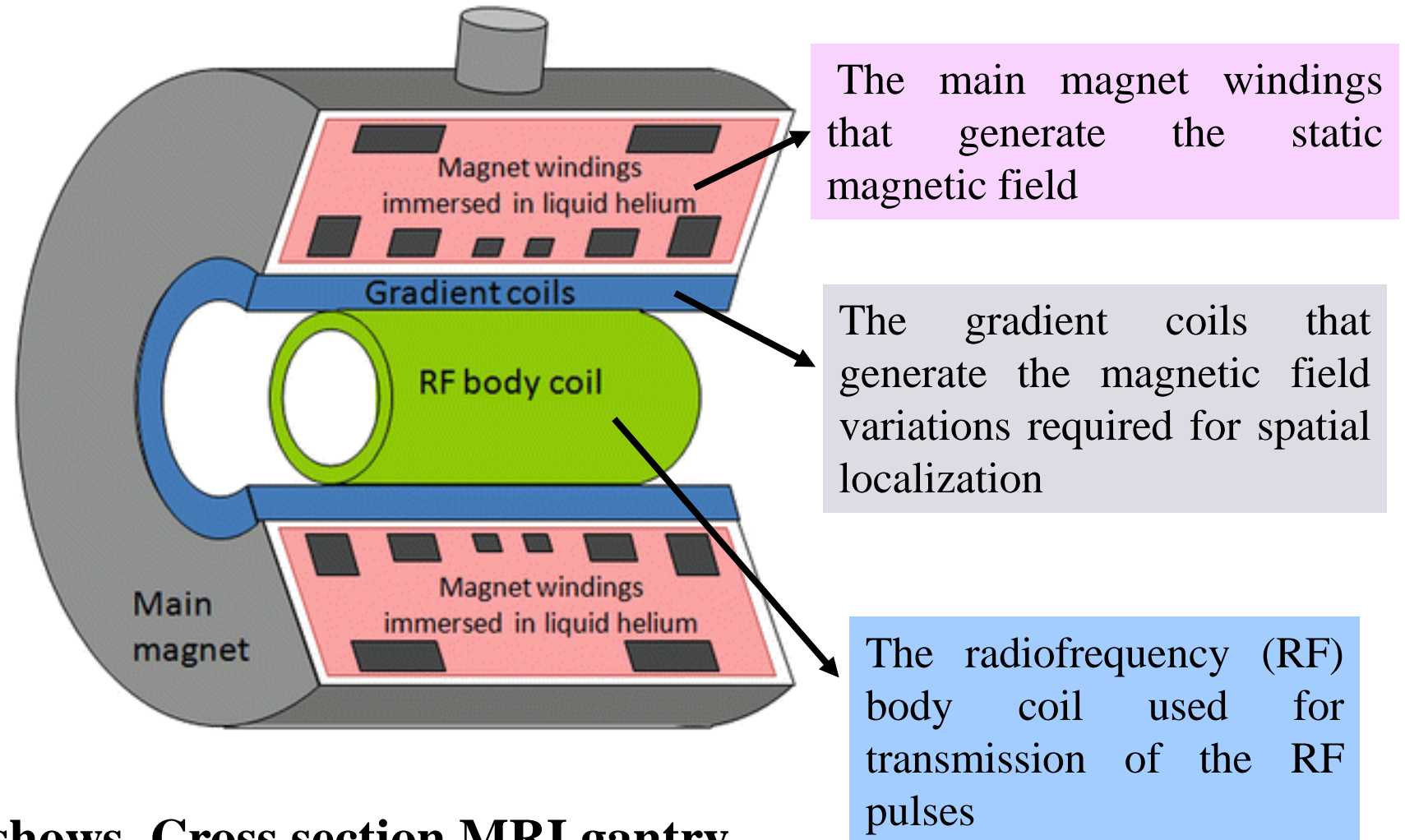
# The Hardware

- Hardware in an MRI system which mainly includes (see figure1):



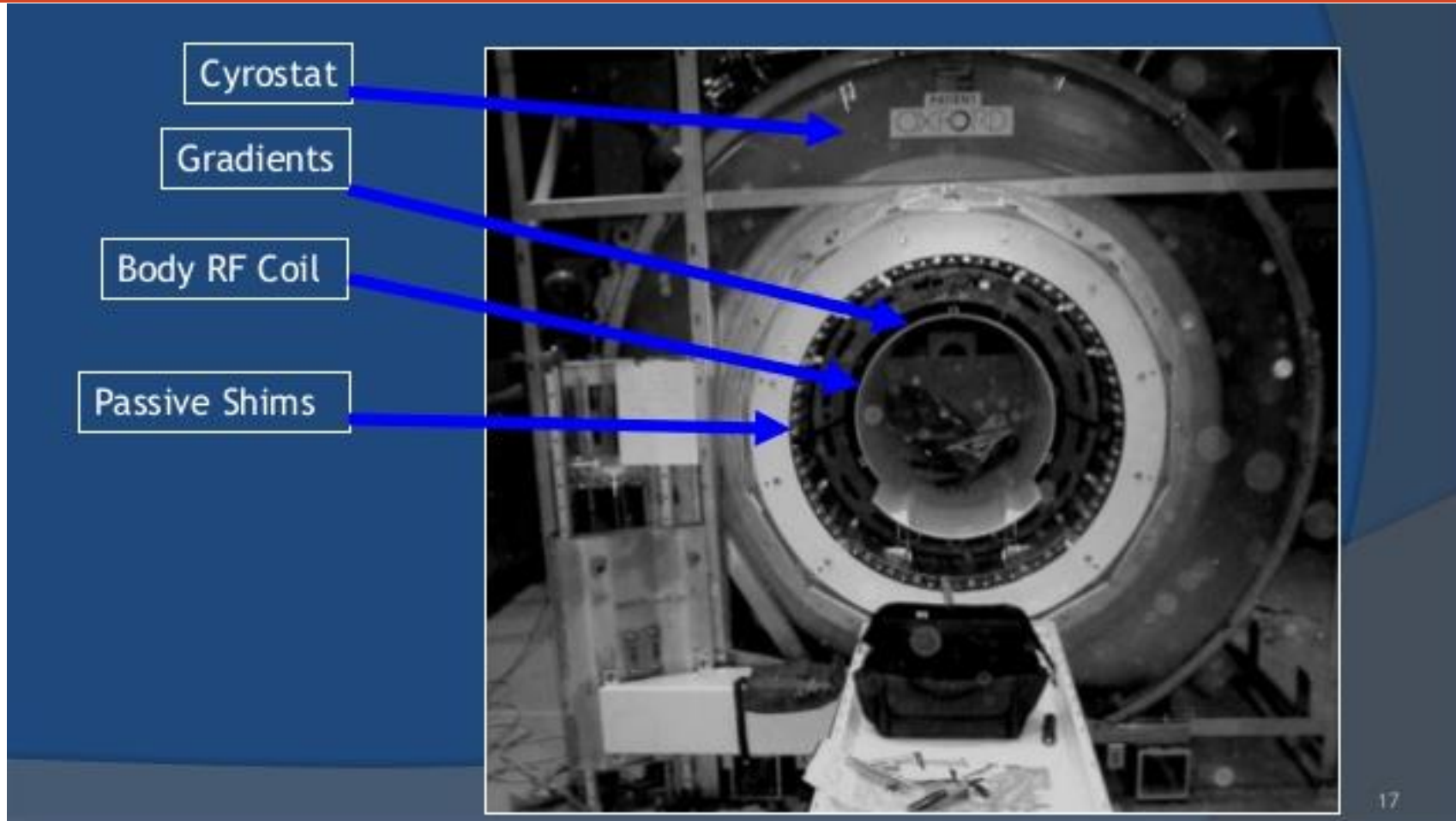
# The Hardware

**MRI gantry consist of :**



*Figure shows Cross section MRI gantry*

# The Hardware



**Under the hood of the MRI scanner device**

# The Hardware

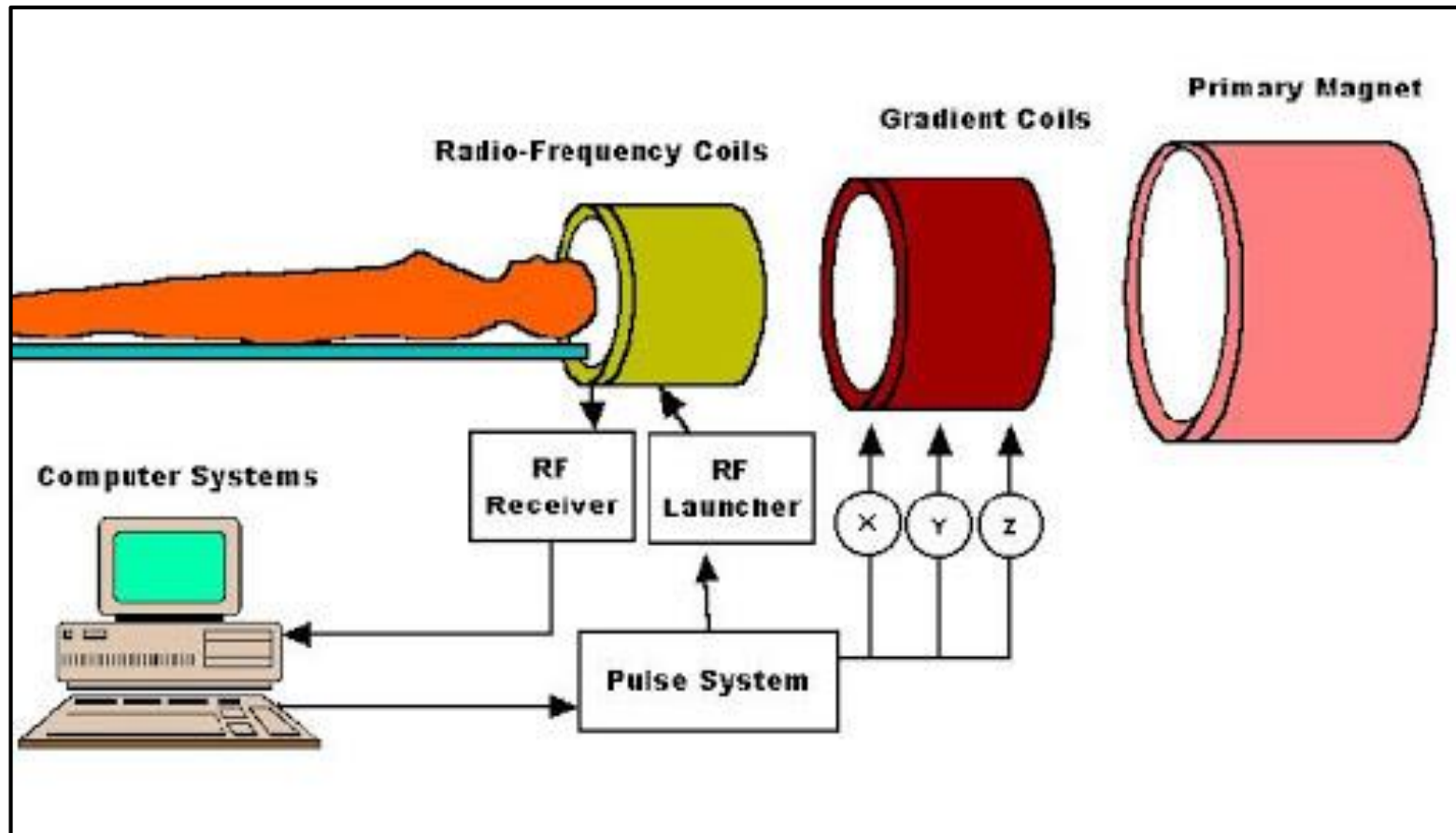
**4- Patient table:** This component simply slides the patient into the MRI machine.



**5- Computer system** is a very sensitive device that easily detects the RF signals emitted by a patient's body while undergoing examination and feeds this information into the computer system.

# The Hardware

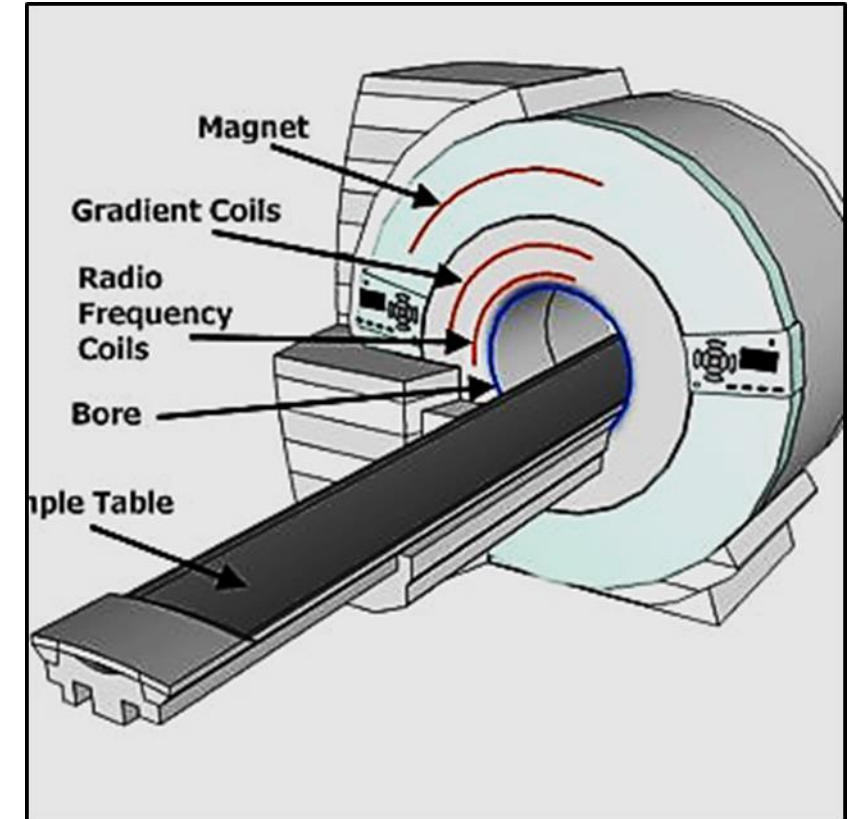
## Diagram of Hardware of MRI device



# *Magnets*

The magnet is the heart of the MR system and the patient is placed inside the magnet, surrounded by set of coils connected to RF generator, figure1.

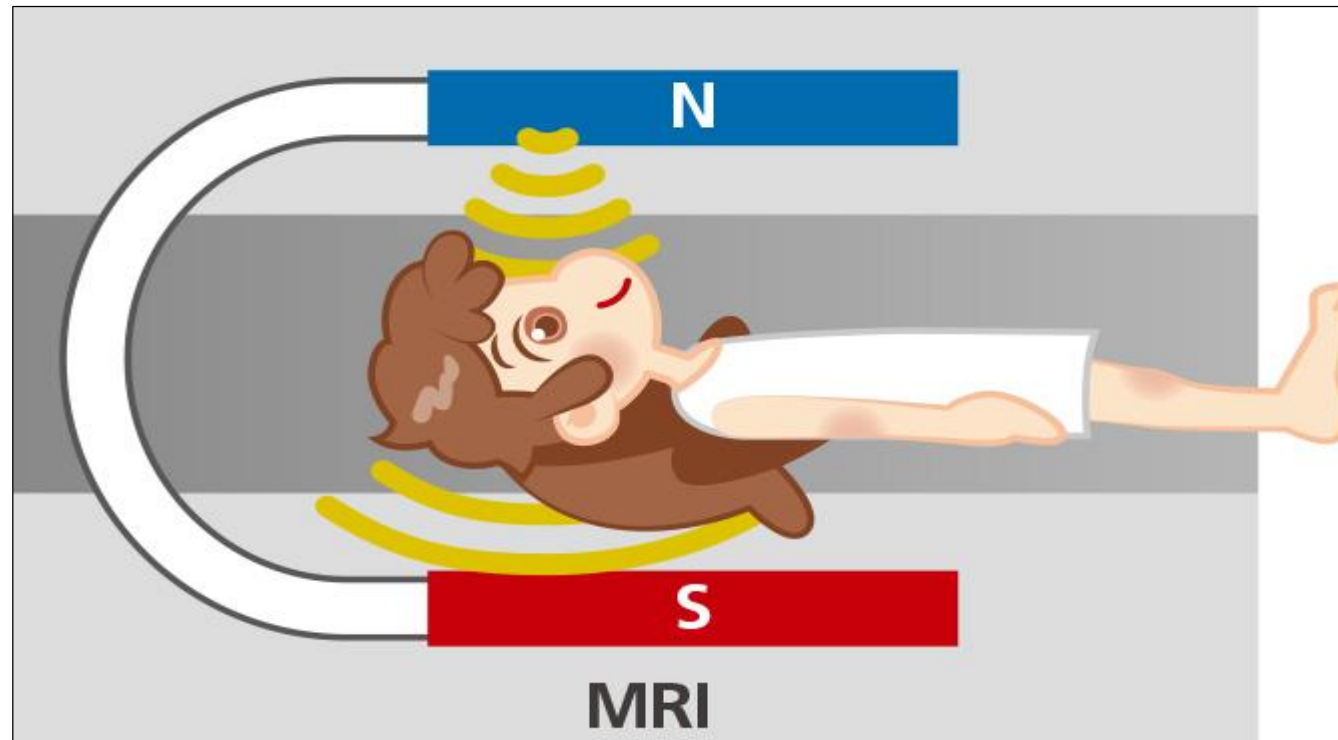
The imaging process requires a magnetic field that is uniform and static and of sufficient size to accommodate an adult human being.



**Figure1:** Schematic diagram of MRI machine.

## *Static Magnetic Field*

Static magnetic fields are constant **fields**, which do not change in intensity or direction over time, in contrast to low and high frequency alternating **fields**. Hence, they have a frequency of 0 Hz.





# *Types of Magnets*

*According to the way the field is generated; there are three types of magnet, with advantages and disadvantages:*

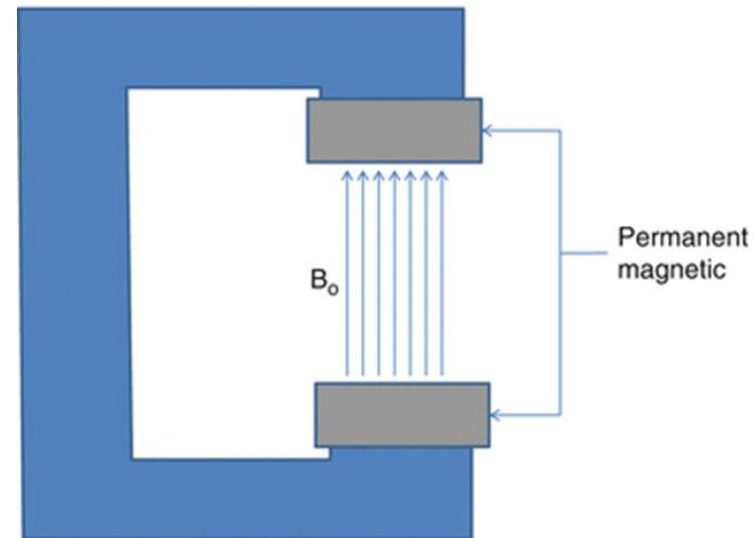
1. Permanent magnet.
2. Resistive electromagnet.
3. Superconducting electromagnet.

# *Permanent Magnets*

## 1. Permanent Magnet

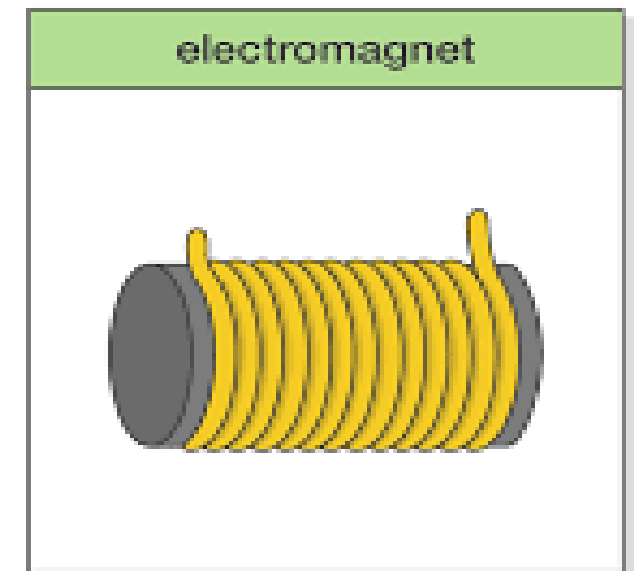
Permanent magnets are made from a material that is magnetized and creates its own persistent magnetic field. *The permanent magnet* consists of two opposing pole pieces (iron, nickel, and cobalt).

- Use low strength, up to 0.3 T
- vertical magnetic field.
- very heavy
- cannot be switched off



# *Resistive Electromagnet*

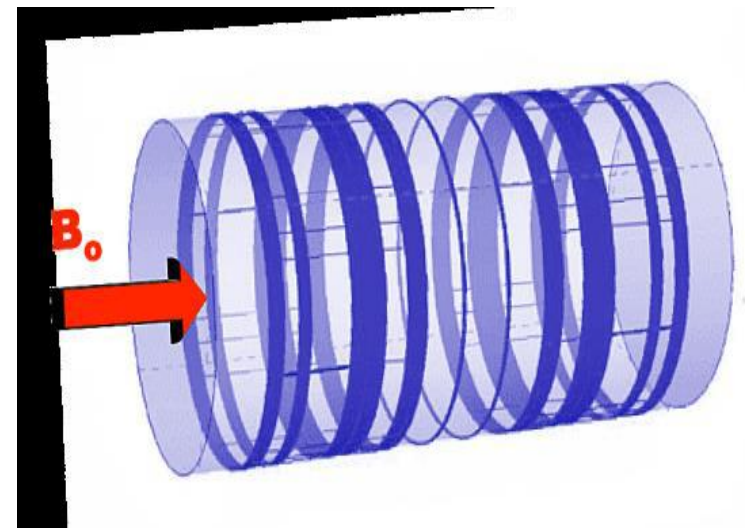
- a resistive electromagnet has a set of coils run by a direct current with 50–100 kW (Al or copper)
- provide both vertical and horizontal magnetic fields up to 0.5T.
- can be switched off.
- cheapest, smaller, and weighs 2 tons.
- requires water cooling



# *Superconducting Magnet*

A superconducting magnet: is made by a direct current solenoid (niobium-titanium alloy in the copper matrix).

- It is cooled by a cryogen, liquid helium at 4 K ( $-269\text{ }^{\circ}\text{C}$ ).
- It has negligible resistance, and a large current can be used without overheating.
- High field strength up to 3 T.
- High field homogeneity.
- It is large in size, Weighs about 6 tons.



# The origin of magnetism



# *Questions*

1. Why do some materials behave as permanent magnets?
2. List the types of magnets according to the way the field is generated.
3. What are the new permanent magnetic materials?
4. Why is neodymium more magnetic than iron?
5. What is the most important difference between conductive materials and superconductive materials?