Magnetic resonance imaging

Science, Physics

Magnetic Resonance Imaging Magnetic resonance Imaging (MRI) is a method to scan the body’s internal organs mostly used in the medical facilities to cast an image of internal body systems and internal parts. The technique is also termed as the Magnetic Resonance Tomography (MRT). MRI is capable to generate clearer and more detained images as compared to the X-ray or Ultrasound scanning techniques. The physics behind the MRI scanning involves the complex nuclear physics and magnetic directivity and resonance. A MRI scanning device is fairly a large device, which is able to hold a person in it. The patient lies in a strong magnetic field, where the magnetic field resonate the atomic nuclei. An altered radio frequency is used to alter the directivity of the magnetic field and thus alter the directivity of the atomic nuclei. The whole process makes the atomic nuclei to have a rotating magnetizing field that is captured by the scanner and showed in the image format. The major part of the body is covered by fat and water. In total there about 63% of the body’s weight is occupied by hydrogen atoms if considered the fat and water in the body. It the natural tendency of the hydrogen nuclei to generate an NMR signals. For this reason, the hydrogen nuclei are effective in the MRI scan. These nuclei are present in every part of the body (Hornak, 20-23). Our body natural mechanism is used and combined with the technology in the method of MRI scanning method. The naturally occurring Hydrogen atoms in our body constantly and randomly spin. The hydrogen atoms cancel each other’s spin. However, if any external magnetic field is applied, the spin of the hydrogen atoms (Hydrogen Nuclei) in the body get aligned with the external magnetic field. On the other hand, if the magnetic field is rotated in the orthogonal direction, the direction of

the spin on z-axis can be changed at an angle. The angle is often termed as alpha. The total Magnetization factor along z-axis rotates at a Larmor frequency. The Larmor frequency gradually reduces as the z- factor increase and the x-y factor reduces. The reduction in the x-y component with time in the magnetization vector generates a small voltage signal that is calculated and image is produces. The voltage signal is often termed as NMR (Nuclear Magnetic Resonance) signal (Horowitz, 20-47). Fig 1 shows the nuclei spin is random direction and fig 2, shows the spin of nuclei is aligned due to external magnetic field. Image source: Adapted from: (Horowitz, 1995) The magnetic field generated by the nuclei of the hydrogen in the body is considered to be no homogeneously distributed. The major reason that the magnetic field produced by the nuclei is not homogeneous is the presence of the other nuclei that have different spin and different magnetic field. Some of the nuclei spin relatively faster as compared to the other. In general Spinning is a natural process that the electrons, protons and neutrons posses. It is a fact that unpaired particles (electron, proton and neutrons) spin in a relative motion. The particles with opposite spins cancel each other’s spin. Our body does have electrons, protons and neutrons that do show a spinning characteristic. A nucleus is made up of protons and neutrons that make the mass of the atom (NessAiver, 31-38). When the number of the protons in a nucleus is not an even digit or if the mass of the atom is not an even digit, the nucleus attains an angular momentum. Due to attaining the angular momentum, the nucleus spins and thus generates a magnetic field around it, creating the poles of the magnet. These microscopic nuclei behave as the magnet but if the external magnetic field is applied, the tiny nuclei

get aligned with respect to the external magnetic field. In the absence of external magnetic field the spin of the nuclei is random and tend to cancel each other’s spin. The voltage signal is attained in the form of radio frequency, as the frequently spinning transverse magnetization at the x-y coordinate generate a radio frequency due to the excitation of sample. A coil of wire is placed outside the sample. The radio frequency is attained on the coiled wire due to the induction and thus the wire generates the voltage signal. Faraday’s law of electromagnetic induction can be used to calculate the relative signal. The Technology of the MRI produce more in depth images of the body and thus is more capable of becoming the first choice for the doctors to consider the MRI scanning the most appropriate is terms of capability and technology. Works Cited Hornak, Joseph P. " Basics of NMR." (1997). Horowitz, Alfred L. MRI physics for radiologists: a visual approach. New York: Springer, 1995. NessAiver, Moriel, and Moriel N. Aiver. All you really need to know about MRI physics. Vol. 5816. Baltimore, Maryland: Simply Physics, 1997.