8.701

Introduction to Nuclear and Particle Physics

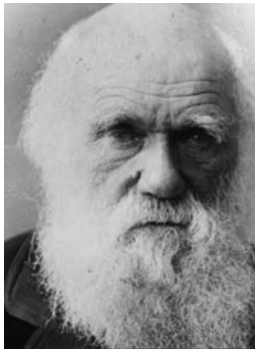
Markus Klute - MIT

0. Introduction

0.5 Early History and People in Nuclear and Particle Physics

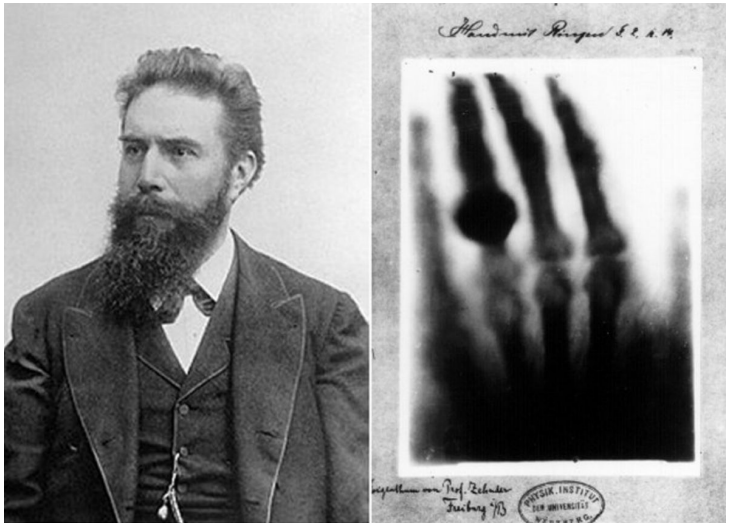
Early Developments in Nuclear & Particle Physics

~1820s: geologists and biologists have come to believe that the Earth is much older than 10s of thousands of year, perhaps hundred of million of years. Classical thermodynamic calculations contradict these estimates and challenge evolution and the Orgin of Species.



Charles Darvin
1809-1882

1895: Wilhelm Rontgen discovers X-rays



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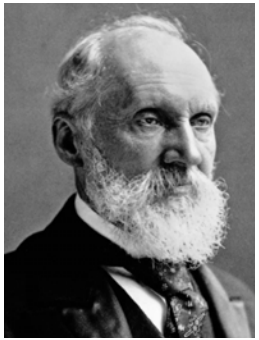
Wilhelm Roentgen
1845-1923

And the first X-ray images of a human hand 1895. X-rays were used for medical purposes as early as 1897.



Lord Kelvin
1824-1907

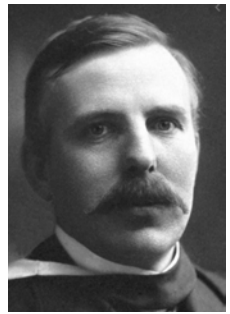
Early Developments in Nuclear & Particle Physics

1896: Henri Becquerel discovers radiation from uranium

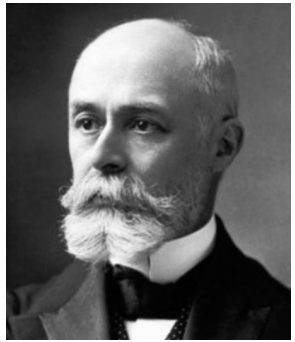
1897: Ernest Rutherford discovers α and β rays in experiments with uranium

1897: J.J. Thomson discovers the electron

1898: Marie and Pierre Curie propose the new term “radioactivity” for material which emit rays. They discovered that thorium emits “uranic rays” and also discovered the new elements polonium and radium.



Ernest Rutherford
1871-1937



Henri Becquerel
1852-1908

J.J. Thomson
1856-1950

Marie Curie
1867-1934
Pierre Curie
1859-1906

Photo of J.J. Thomson is in the public domain.

Early Developments in Nuclear & Particle Physics

1899: Paul Villard discovers a third component of radiation from uranium and calls them ɣ rays.

1901: The Curie's measure the energy emitted by radioactive elements and discover that one gram of radium gives off the incredible amount of 140 calories per hour.

1903: Rutherford is first to make the connection to the puzzle of the age of Earth by suggesting that a small amount of heat added by radioactive decays keeps the Earth geologically active. The come to the conclusion that the Earth might as well be a few billion years old.

1905: Einstein's annus mirabilis with $E=mc^2$

1906: Rutherford discovers that α-particles turn into helium when stopped

Paul Villard
1860-1934

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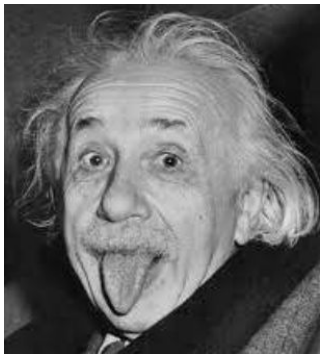


Albert Einstein
1876-1955

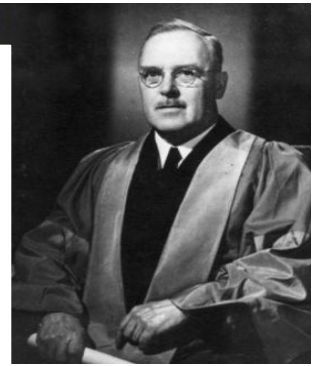
Early Developments in Nuclear & Particle Physics

1909: Marsden and Geiger, students of Rutherford, perform experiments bombarding a gold foil with α-particles. Rutherford proposes a “solar system” model of the atom, in which the atom is essentially empty space with a very small and dense nucleus

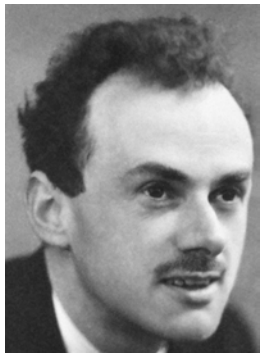
1919: Rutherford, by bombarding nitrogen with α-particles produces a proton and oxygen and with that the first human-engineered nuclear reaction

1930: Dirac combines relativity and quantum mechanics with the so-called Dirac equation as a consequence. The equation predicts the existence of negative states of electrons and protons, predicting the existence of antimatter

Hans Geiger
1882-1945



Eugene Marsden
1882-1936



Paul Dirac
1902-1984

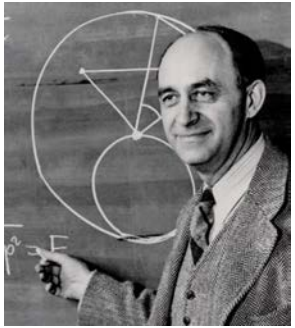
Early Developments in Nuclear & Particle Physics

1931: Pauli and Fermi propose that decay is producing two particle sharing kinetic energy assuming a very light neutral particle which can not be easily detected - the neutrino

1932: Chadwick detects neutrons directly in experiments with beryllium and α-particles

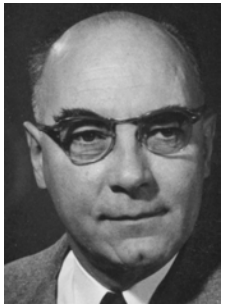
1932: Anderson discovers the positron in tracks on photographic plates which look like electrons but curve in the “wrong” direction

Wolfgang Pauli
1900-1958



Enrico Fermi
1901-1954

James Chadwick
1905-1991



Carl Anderson
1905-1991

Early Developments in Nuclear & Particle Physics

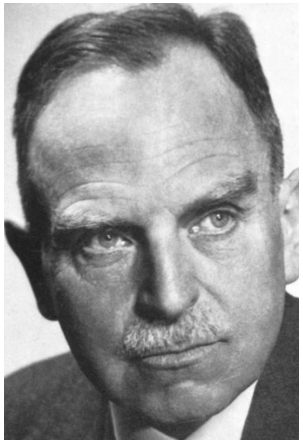
1935: Yukawa proposes that neutrons and protons in nuclei are held together by a strong force

1938: Bethe calculates in detail how nuclear fusion, rather than nuclear fission, can power the Sun. He proposed a three-step sequence called the proton-proton chain

1938: Meitner and Hahn bombard uranium with neutrons and discover nuclear fission.

Hideki Yukawa
1907-1981

Lise Meitner
1878-1968



Otto Hahn
1876-1968

Hans Bethe
1906-2005

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Fall 2020