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 Origin of Species.

1895: Wilhelm Rontgen discovers X-rays

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.
1896: Henri Becquerel discovers radiation from uranium

1897: Ernest Rutherford discovers $\alpha$ and $\beta$ 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.

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Early Developments in Nuclear & Particle Physics

1899: Paul Villard discovers a third component of radiation from uranium and calls them \( \gamma \) 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. They 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 \( \alpha \)-particles turn into helium when stopped
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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.
Early Developments in Nuclear & Particle Physics

1931: Pauli and Fermi propose that decay is producing two particles 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 \( \alpha \)-particles.

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

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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.