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Chapter 1 : Chances Of Becoming A Successful Theoretical Physicist? | Yahoo Answers

Paul Ehrenfest / Vol. 1, The making of a theoretical physicist. 1. Paul Ehrenfest / Vol. 1, The making of a theoretical physicist. by Martin J Klein Print book: English.

Archimedes realized that a ship floats by displacing its mass of water, Pythagoras understood the relation between the length of a vibrating string and the musical tone it produces. Theoretical physics consists of several different approaches. In this regard, theoretical particle physics forms a good example. Other theorists may try to unify , formalise, reinterpret or generalise extant theories, or create completely new ones altogether. Theoretical problems that need computational investigation are often the concern of computational physics. Theoretical advances may consist in setting aside old, incorrect paradigms e. In the latter case, a correspondence principle will be required to recover the previously known result. For example, an essentially correct theory may need some conceptual or factual revisions; atomic theory , first postulated millennia ago by several thinkers in Greece and India and the two-fluid theory of electricity [8] are two cases in this point. However, an exception to all the above is the waveâ€"particle duality , a theory combining aspects of different, opposing models via the Bohr complementarity principle. Relationship between mathematics and physics Physical theories become accepted if they are able to make correct predictions and no or few incorrect ones. Testing the consequences of a theory is part of the scientific method. Physical theories can be grouped into three categories: History of physics Theoretical physics began at least 2, years ago, under the Pre-socratic philosophy , and continued by Plato and Aristotle , whose views held sway for a millennium. During the rise of medieval universities , the only acknowledged intellectual disciplines were the seven liberal arts of the Trivium like grammar , logic , and rhetoric and of the Quadrivium like arithmetic , geometry , music and astronomy. During the Middle Ages and Renaissance , the concept of experimental science, the counterpoint to theory, began with scholars such as Ibn al-Haytham and Francis Bacon. As the Scientific Revolution gathered pace, the concepts of matter , energy, space, time and causality slowly began to acquire the form we know today, and other sciences spun off from the rubric of natural philosophy. The great push toward the modern concept of explanation started with Galileo , one of the few physicists who was both a consummate theoretician and a great experimentalist. Simultaneously, progress was also made in optics in particular colour theory and the ancient science of geometrical optics , courtesy of Newton, Descartes and the Dutchmen Snell and Huygens. In the 18th and 19th centuries Joseph-Louis Lagrange , Leonhard Euler and William Rowan Hamilton would extend the theory of classical mechanics considerably. Among the great conceptual achievements of the 19th and 20th centuries were the consolidation of the idea of energy as well as its global conservation by the inclusion of heat , electricity and magnetism , and then light. The laws of thermodynamics , and most importantly the introduction of the singular concept of entropy began to provide a macroscopic explanation for the properties of matter. Statistical mechanics followed by statistical physics and Quantum statistical mechanics emerged as an offshoot of thermodynamics late in the 19th century. Another important event in the 19th century was the discovery of electromagnetic theory , unifying the previously separate phenomena of electricity, magnetism and light. The pillars of modern physics , and perhaps the most revolutionary theories in the history of physics, have been relativity theory and quantum mechanics. Quantum mechanics led to an understanding of blackbody radiation which indeed, was an original motivation for the theory and of anomalies in the specific heats of solids â€" and finally to an understanding of the internal structures of atoms and molecules. Quantum mechanics soon gave way to the formulation of quantum field theory QFT , begun in the late s. In the aftermath of World War 2, more progress brought much renewed interest in QFT, which had since the early efforts, stagnated. The same period also saw fresh attacks on the problems of superconductivity and phase transitions, as well as the first applications of QFT in the area of theoretical condensed matter. The s and 70s saw the formulation of the Standard model of particle physics using QFT and progress in condensed matter physics theoretical foundations of superconductivity and critical phenomena , among others , in parallel to the applications of relativity to problems in astronomy and cosmology respectively. All of these achievements depended on the theoretical physics as a moving force both to suggest experiments and to consolidate results â€” often by ingenious application of existing mathematics, or, as in the case of Descartes and Newton with Leibniz , by inventing new mathematics. Where experimentation cannot be done, theoretical physics still tries to advance through the use of mathematical models. Mainstream theories Mainstream theories sometimes referred to as central theories are the body of knowledge of both factual and scientific views and possess a usual scientific quality of the tests of repeatability, consistency with existing well-established science and experimentation. There do exist mainstream theories that are generally accepted theories based solely upon their effects explaining a wide variety of data, although the detection, explanation, and possible composition are subjects of debate.

Chapter 2 : How to Become a Theoretical Physicist: 14 Steps (with Pictures)

Responsibilities of a Theoretical Physicist vs. an Experimental Physicist The equipment used by each type of physicist is a big difference between these two professions.

Julius came to America with no money, no baccalaureate studies, and no knowledge of the English language. He got a job in a textile company and within a decade was an executive with the company. Ella was from Baltimore. His father had been a member of the Society for many years, serving on its board of trustees from to To help him recover from the illness, his father enlisted the help of his English teacher Herbert Smith who took him to New Mexico, where Oppenheimer fell in love with horseback riding and the southwestern United States. He compensated for his late start by taking six courses each term and was admitted to the undergraduate honor society Phi Beta Kappa. In his first year, he was admitted to graduate standing in physics on the basis of independent study, which meant he was not required to take the basic classes and could enroll instead in advanced ones. He was attracted to experimental physics by a course on thermodynamics that was taught by Percy Bridgman. He graduated summa cum laude in three years. Oppenheimer is in the second row, third from the left. He wrote to Ernest Rutherford requesting permission to work at the Cavendish Laboratory. Rutherford was unimpressed, but Oppenheimer went to Cambridge in the hope of landing another offer. Thomson on condition that he complete a basic laboratory course. Many of his friends described him as having self-destructive tendencies. A disturbing event occurred when he took a vacation from his studies in Cambridge to meet up with Fergusson in Paris. Fergusson noticed that Oppenheimer was not well. To help distract him from his depression, Fergusson told Oppenheimer that he Fergusson was to marry his girlfriend Frances Keeley. Oppenheimer did not take the news well. He jumped on Fergusson and tried to strangle him. Throughout his life, Oppenheimer was plagued by periods of depression, [22] [23] and he once told his brother, "I need physics more than friends". He was known for being too enthusiastic in discussion, sometimes to the point of taking over seminar sessions. Born left it out on his desk where Oppenheimer could read it, and it was effective without a word being said. He was on the point of questioning me. He and Born published a famous paper on the Bornâ€"Oppenheimer approximation , which separates nuclear motion from electronic motion in the mathematical treatment of molecules, allowing nuclear motion to be neglected to simplify calculations. It remains his most cited work. Bridgman also wanted him at Harvard, so a compromise was reached whereby he split his fellowship for the â€"28 academic year between Harvard in and Caltech in Both the collaboration and their friendship were nipped in the bud when Pauling began to suspect Oppenheimer of becoming too close to his wife, Ava Helen Pauling. Once, when Pauling was at work, Oppenheimer had arrived at their home and invited Ava Helen to join him on a tryst in Mexico. Though she refused and reported the incident to her husband, [31] the invitation, and her apparent nonchalance about it, disquieted Pauling and he ended his relationship with Oppenheimer. Oppenheimer later invited him to become head of the Chemistry Division of the Manhattan Project , but Pauling refused, saying he was a pacifist. There he was given the nickname of Opje, [33] later anglicized by his students as "Oppie". Oppenheimer respected and liked Pauli and may have emulated his personal style as well as his critical approach to problems. Birge wanted him so badly that he expressed a willingness to share him with Caltech. When he heard the ranch was available for lease, he exclaimed, "Hot dog! His students and colleagues saw him as mesmerizing: His associates fell into two camps: Probably the most important ingredient he brought to his teaching was his exquisite taste. He always knew what were the important problems, as shown by his choice of subjects. He truly lived with those problems, struggling for a solution, and he communicated his concern to the group. In its heyday, there were about eight or ten graduate students in his group and about six Post-doctoral Fellows. He was interested in everything, and in one afternoon they might discuss quantum electrodynamics, cosmic rays, electron pair production and nuclear physics. Lawrence and his cyclotron pioneers, helping them understand the data their machines were producing at the Lawrence Berkeley National Laboratory. In return he was asked to curtail his teaching at Caltech, so a compromise was reached whereby Berkeley released him for six weeks each year, enough to teach one term at Caltech. The formal mathematics of relativistic quantum mechanics also attracted his attention, although he doubted its validity. His work predicted many later finds, which include the neutron , meson and neutron star. He developed a method to carry out calculations of its transition probabilities. He calculated the photoelectric effect for hydrogen and X-rays , obtaining the absorption coefficient at the K-edge. His calculations accorded with observations of the X-ray absorption of the sun, but not helium. Years later it was realized that the sun was largely composed of hydrogen and that his calculations were indeed correct. Subsequently, one of his doctoral students, Willis Lamb , determined that this was a consequence of what became known as the Lamb shift , for which Lamb was awarded the Nobel Prize in Physics in When Ernest Lawrence and Edwin McMillan bombarded nuclei with deuterons they found the results agreed closely with the predictions of George Gamow , but when higher energies and heavier nuclei were involved, the results did not conform to the theory. In , Oppenheimer and Phillips worked out a theory now known as the Oppenheimerâ€"Phillips process to explain the results, a theory still in use today. He argued that they would have to have the same mass as an electron, whereas experiments showed that protons were much heavier than electrons. In the first of these, a paper co-written with Robert Serber entitled "On the Stability of Stellar Neutron Cores", [50] Oppenheimer explored the properties of white dwarfs. This was followed by a paper co-written with one of his students, George Volkoff , "On Massive Neutron Cores", [51] in which they demonstrated that there was a limit, the so-called Tolmanâ€"Oppenheimerâ€"Volkoff limit , to the mass of stars beyond which they would not remain stable as neutron stars and would undergo gravitational collapse. Finally, in , Oppenheimer and another of his students, Hartland Snyder , produced a paper "On Continued Gravitational Attraction", [52] which predicted the existence of what are today known as black holes. After the Bornâ€"Oppenheimer approximation paper, these papers remain his most cited, and were key factors in the rejuvenation of astrophysical research in the United States in the s, mainly by John A. He was fond of using elegant, if extremely complex, mathematical techniques to demonstrate physical principles, though he was sometimes criticized for making mathematical mistakes, presumably out of haste. Murray Gell-Mann , a later Nobelist who, as a visiting scientist, worked with him at the Institute for Advanced Study in , offered this opinion: As far as I know, he never wrote a long paper or did a long calculation, anything of that kind. But he inspired other people to do things, and his influence was fantastic. In , he learned Sanskrit and met the Indologist Arthur W. He read the Bhagavad Gita in the original Sanskrit, and later he cited it as one of the books that most shaped his philosophy of life. Oppenheimer was overeducated in those fields, which lie outside the scientific tradition, such as his interest in religion, in the Hindu religion in particular, which resulted in a feeling of mystery of the universe that surrounded him like a fog. He saw physics clearly, looking toward what had already been done, but at the border he tended to feel there was much more of the mysterious and novel than there actually was He claimed that he did not read newspapers or listen to the radio, and had only learned of the Wall Street crash of some six months after it occurred while on a walk with Ernest Lawrence. However, from on, he became increasingly concerned about politics and international affairs. Oppenheimer repeatedly attempted to get Serber a position at Berkeley but was blocked by Birge , who felt that "one Jew in the department was enough". He donated to many progressive efforts which were later branded as " left-wing " during the McCarthy era. The majority of his allegedly radical work consisted of hosting fundraisers for the Republican cause in the Spanish Civil War and other anti-fascist activity. He never openly joined the Communist Party , though he did pass money to liberal causes by way of acquaintances who were alleged to be Party members. The two had similar political views; she wrote for the Western Worker, a Communist Party newspaper. Kitty had been married three times previously. Her first marriage lasted only a few months. Her second, common-law marriage husband was Joe Dallet, an active member of the Communist party, who was killed in the Spanish Civil War. There she married Richard Harrison, a physician and medical researcher, in In June Kitty and Harrison moved to Pasadena, California , where he became chief of radiology at a local hospital and she enrolled as a graduate student at the University of California, Los Angeles. In the summer of she stayed with Oppenheimer at his ranch in New Mexico. She finally asked Harrison for a divorce when she found out she was pregnant. When he refused, she obtained an instant divorce in Reno, Nevada , and took Oppenheimer as her fourth husband on November 1, At his security clearance hearings, he denied being a member of the Communist Party, but identified himself as a fellow traveler , which he defined as someone who agrees with many of the goals of Communism, but without being willing to blindly follow orders from any Communist party apparatus. He was followed by Army security agents during a trip to California in June to visit his former girlfriend, Jean Tatlock, who was suffering from depression. Oppenheimer spent the night in her apartment. On July 20, , he wrote to the Manhattan Engineer District: In accordance with my verbal directions of July 15, it is desired that clearance be issued to Julius Robert Oppenheimer without delay irrespective of the information which you have concerning Mr Oppenheimer. He is absolutely essential to the project. Roosevelt approved a crash program to develop an atomic bomb. He was given the title "Coordinator of Rapid Rupture", specifically referring to the propagation of a fast neutron chain reaction in an atomic bomb. One of his first acts was to host a summer school for bomb theory at his building in Berkeley. The mix of European physicists and his own studentsâ€”a group including Robert Serber, Emil Konopinski , Felix Bloch , Hans Bethe and Edward Teller â€”busied themselves calculating what needed to be done, and in what order, to make the bomb. Oppenheimer left gave his farewell speech as director on this occasion. Robert Gordon Sproul right, in suit, accepted the award on behalf of the University of California from Leslie Groves center. The fact that he did not have a Nobel Prize, and might not have the prestige to direct fellow scientists, did concern Groves. As a military engineer , Groves knew that this would be vital in an interdisciplinary project that would involve not just physics, but chemistry, metallurgy , ordnance and engineering. Groves also detected in Oppenheimer something that many others did not, an "overweening ambition" that Groves reckoned would supply the drive necessary to push the project to a successful conclusion. Isidor Rabi considered the appointment "a real stroke of genius on the part of General Groves, who was not generally considered to be a genius". Scouting for a site in late , Oppenheimer was drawn to New Mexico, not far from his ranch. On November 16, , Oppenheimer, Groves and others toured a prospective site. Oppenheimer feared that the high cliffs surrounding the site would make his people feel claustrophobic , while the engineers were concerned with the possibility of flooding.

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Chapter 3 : Michio Kaku- Physicist & Co-founder of String Field Theory

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Built a particle accelerator in his garage in high school Loves to figure skate Goal in life: Advice for Students Give the impossible a chance Physics is about curiosity and imagination, not brilliance Find a physicist role model or mentor Why Physics? Dreaming of the Impossible When Michio was growing up, he loved science fiction shows and books, filled with time-traveling heroes, parallel universes, and intergalactic space travel. They began a lifelong love [of] the impossible," Michio says. So when he grew older and had to put science fiction aside, Michio knew the one place he could cling to the impossible was physics. I realized [to know,] I needed to immerse myself in advanced mathematics and learn theoretical physics," Michio says. Michio was fascinated by this story and unfinished theory, and began going to the library to learn more about Einstein and his work. Michio was determined to understand what this incomplete theory was all about. For the science fair, Michio constructed a 2. This ambitious project got him a spot at the National Science Fair. These two theories are not fully compatible in our current understanding of physics. As physicists have picked up where Einstein stopped, one solution they have come up with is string theory. String theory combines the two theories by assuming there are multiple universes and dimensions beyond the ones we know. He co-founded string field theory, a subset of string theory. String field theory uses the mathematics of fields to explain string theory. More evidence and a better understanding of string theory may one day allow us to travel between universes and into new dimensions, potentially even making time travel possible. Opening the Doors to the Next Dimension In addition to making many contributions to the field of theoretical physics and string theory, Michio is also a passionate science communicator. He has taught at Princeton University and the City College of New York, as well as written seven books on science for the general public. Michio has also appeared on dozens of radio and television shows and documentaries, explaining complex theories in a way everyone can understand. Great ideas can be explained in the language of pictures. Things that you can see and touch, objects that you can visualize in the mind. That is what science is all about, not memorizing facts and figures. A role model can help you lay out a career path that is realistic and practical. One of the greatest physicists of all time, Michael Faraday, started out as a penniless, uneducated apprentice, but he was persistent and creative and then went on to revolutionize modern civilization.

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