

Chien Shiung Wu 'Dragon Lady' who disproved a law of physics

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HER name may now be forgotten by most people and only remembered as a reference in text books of nuclear physics. Chien Shiung Wu (May 31, 1912 – February 16, 1997) was a Chinese scientist who immigrated to USA, and was associated with the Manhattan Project for the development of the atomic bomb.

She helped develop the process for separating uranium metal into the uranium-235 and uranium-238 isotopes using gaseous diffusion. Her biggest contribution to science however was in proving a scientific law wrong. Her work overturned a widely accepted law in particle physics known as 'The Principle of Conservation of Parity', expounding 'the idea of symmetry, where particles that are mirror images of each other will act in identical ways'.

In the mid 1950s, theoretical physicists, Chen Ning Yang and Tsung Dao Lee, had approached Wu to help them disprove the 'law of parity'. Wu carried out several significant experiments in 'beta decay' using cobalt-60 showing that one particle was more likely to eject an electron than the other and they were therefore not symmetrical. Her observations overturned the 30-year 'conservation of parity' law.

However, Yang and Lee neglected to record her experimental observation in their paper proving the law was invalid. They were awarded the Nobel Prize in 1957 for their "discovery" that the conservation of parity was incorrect. Though Wu had painstakingly carried out the actual experiments at the National Bureau of Standards, sadly her contribution was not mentioned in the Nobel citation.

But her work earned Wu the first Wolf Prize in Physics in 1978. Her expertise in experimental physics evoked comparisons to Madame Marie Curie. She had honorary nicknames like "the First Lady of Physics", "the Chinese Madame Curie", and the "Queen of Nuclear Research" and her students called her the 'Dragon Lady'. She was the first female President of the American Physical Society (1975) and elected one of the first foreign academicians of the Chinese Academy of Sciences (1994). She was elected a fellow of the American Physical Society (1948) and elected a member of the U.S. National Academy of Sciences (1958).



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Chien-Shiung Wu's biography is remarkable. She was born (May 31, 1912) in the town of Liuhe in Taicang, Jiangsu province of China, the second of three children and was deeply encouraged by her father in her interests and at home she was surrounded by books, magazines, and newspapers. After finishing her elementary school education in 1923 in the Ming De girl's school founded by her father, she joined a boarding school which also had teacher's training and regular high school. Wu stood ninth among around 10,000 applicants in the tough admission competition to this school. In 1929 Wu graduated at the top of her class, and got admitted to the National Central University in Nanjing. From 1930 to 1934, Wu initially studied Mathematics but later transferred to Physics at the National Central University. That was a historical decision.

Wu became involved in student politics, was elected one of the student leaders and led protests against growing interference by Imperial Japan in China. Wu participated in a sit-in at the Presidential Palace in Nanjing forcing Chiang Kai-shek then Chinese President to meet the students. Wu's activism and deep humanism was carried on throughout her life.

She did graduate-level study in physics and worked as an assistant at the Zhejiang University. She became a researcher at the Institute of Physics of the Academia Sinica under Professor Gu Jing-Wei, who did her PhD at the University of Michigan, USA, and encouraged Wu to do the same. When Wu obtained admission to the University of Michigan her uncle provided the money. When she sailed for USA in August 1936 her parents and uncle had come to see her off but she did not realize that she would never see her parents again.

Learning that women were not even allowed to use the front entrance, Wu abandoned her plans to study at Michigan and instead enrolled at University of California, Berkeley. There she met physicist Luke Chia-Liu Yuan, grandson of Yuan Shikai, the first President of the Republic of China and self-proclaimed 'Emperor of China'.

Wu received an offer to study under Ernest O. Lawrence, later awarded the 1939 Nobel Prize for Physics for his

invention of the cyclotron particle accelerator. Wu worked under Emilio Gino Segrè (1 February 1905 – 22 April 1989) the Italian physicist who discovered the elements technetium, astatine, the isotope plutonium-239, and the antiproton, a subatomic antiparticle, for which he was awarded the Nobel Prize in Physics in 1959.

Her classmates included Robert R. Wilson who went on to develop the cloud chamber and Russian-Canadian physicist George Volkoff who with Robert Oppenheimer predicted the existence of neutron stars. When Wu and Yuan applied for a scholarship at the end of first year, they were instead offered a readership with a lower stipend. Yuan then applied for and secured a scholarship at Caltech.

Wu and Yuan were married on May 30, 1942 at the home of Robert Millikan (who calculated the charge of an electron). Millikan was then the President of Caltech and Yuan's academic supervisor. Neither the bride's nor the groom's families were able to attend due to the outbreak of World War II.

Wu became a faculty member at Smith College, a prestigious private women's college in Northampton, Massachusetts on the East Coast of the United States. However, she found the job frustrating, as there was no opportunity for research and her duties involved teaching only. When she appealed to Lawrence, who wrote letters of recommendation to a number of universities, the college made Wu an associate professor with increased salary. She later became instructor for naval officers at Princeton University in New Jersey.

In March 1944, Wu joined the Manhattan Project's Substitute Alloy Materials (SAM) Laboratories at Columbia University, headed by the legendary scientist Harold Urey (Nobel Prize in Chemistry in 1934 for the discovery of deuterium) on the gaseous diffusion (K-25) program for uranium enrichment. In September 1944, Wu was able to solve a critical problem in a reactor using the work she had earlier done on radio isotopes in Berkeley.

In August 1945, Wu became associate research professor at Columbia University. At the end of the war, communication with China was restored and Wu received a letter from her family. But plans to visit China were disrupted by the Chinese Civil War, and by the birth in 1947 of a son, Vincent Yuan who would grow up to become a physicist like his parents.

In 1949, Yuan joined the Brookhaven National Laboratory, and the family moved to Long Island. In 1950, Wu's father wrote urging her not to return after the communists came to power in China. Since her passport had been issued by the defunct Kuomintang Chinese government, she found it difficult to travel abroad; eventually she applied for US citizenship in 1954. She would remain at Columbia for the rest of her career where she became an associate professor in 1952, a full professor in 1958, and the Michael I. Pupin Professor of Physics in 1973.

In 1963, Wu worked on numerous scientific problems and paradoxes. She investigated and confirmed the 'Conserved Vector Current hypotheses' of Richard Feynman. Wu also

went on to confirm the 'calculations on the correlation of the quantum polarizations of two photons propagating in opposite directions' reported by E. M. L. Pryce and British-Australian physicist John Clive Ward acknowledged master of quantum electrodynamics. Wu later conducted research into the molecular changes in the deformation of hemoglobins that cause sickle-cell disease. During the 1960s, she also did research on magnetism and on Mossbauer Effect. She along with Steven Moszkowski published a standard reference on 'Beta Decay' in 1966.

When Wu's older brother died in 1958, her father in 1959 and her mother in 1962, restrictions to travel abroad prevented her from visiting China to attend their funerals. She managed to meet her uncle and younger brother again on a trip to Hong Kong in 1965. When China-US relations improved following the 1972 Nixon visit to China, Wu was able to visit China again in 1973 but both her uncle and brother had died during the Cultural Revolution and the graves of her parents had been destroyed. Chinese premier Chou En-Lai whom she met personally apologized for the destruction of her parent's graves. After this, she did make several visits to China.

Later in life, Wu's activism became more outspoken. In 1959, she protested the imprisonment in Taiwan of relatives of physicist Kerson Huang, and of the journalist Lei Chen in 1960. In 1964, speaking out against gender discrimination at a symposium at the Massachusetts Institute of Technology, she asked, "I wonder whether the tiny atoms and nuclei, or the mathematical symbols, or the DNA molecules have any preference for either masculine or feminine treatment."

In 1975, Columbia University equalized her salary to that of her male colleagues. She was critical of the Tiananmen Square incidents in China in 1989.

Wu retired in 1981 and was made an Emeritus Professor. She died on February 16, 1997 in New York City at the age of 84 following a stroke. She was survived by her husband and son.

In accordance to her wishes, her ashes were taken to China and were buried in the courtyard of the Ming De School that her father had founded, and that she had attended as a girl.

Though she missed a Nobel Prize, she did receive numerous honors and awards. The best memorial for her is in space. She was the first living scientist to have an asteroid (2752 Wu Chien-Shiung) named after her in 1990. Throughout her career, Wu faced gender discrimination, ethnic disadvantages and personal tragedies but her scientific achievements, sheer will power and determination to prove that women scientists are second to none will inspire many women scientists.



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