Vernon Hughes 1921–2003

Vernon W Hughes, well known for his work on precision measurements of elementary particles and the use of polarized electrons and muons in particle physics, passed away on 25 March 2003.

Born in Kankakee, Illinois, on 28 May 1921, Hughes attended Columbia University, where he received an AM degree in 1941. During the Second World War he helped develop radar at the MIT Radiation Laboratory and was one of the co-editors of a volume of the MIT Radiation Laboratory Series entitled “Waveforms” – a volume that has been of major significance to the development of the US electronics industry. Hughes then returned to Columbia and received his PhD in 1950. This early work – and in fact much of his life’s work – involved investigations of the effects of the interaction of radiation with matter, and in 1950 he and his colleagues discovered the first two-photon transition in atomic spectroscopy.

Hughes’ career involved a broad spectrum of studies of physical phenomena, ranging in energy from the very low to the very high. But he consistently maintained the theme of understanding the physics of elementary particles and their interactions at the most fundamental level. He measured the sum of the difference in magnitude between the electron and proton charges to be one part in \(10^{19}\), and the electric charge on the neutron to be zero, with similar precision.

One area for which Hughes is particularly well known is the study of atomic physics by means of experiments with the most elementary particles. For 30 years he studied the helium and positronium atoms, and made the first observation of the muonium atom in 1960. The latter evolved into precision measurements of the properties of the atom, eventually leading to hyperfine measurements. These 35 years of experimentation, verifying to a high precision that the muon is indeed a “heavy electron”, provided new avenues into the experimental study of quantum electrodynamics and created a tool to probe the highest energy scales of elementary particle physics.

Hughes was the originator of another field of great importance: the use of polarized electrons in high-energy accelerators. His interest in polarized electron beams began in 1959 and he developed the first polarized source for SLAC. His vision and perseverance led to the first measurements of the spin-dependent structure of the proton and to the historic observation of parity non-conservation in electron scattering from nucleons. More recently, the success of the SLAC Linear Collider experiments in probing the electroweak interaction with polarized electrons colliding with positrons are directly traceable to Hughes’ seminal work.

His pioneering work also opened up the field of nuclear physics to investigations with polarized electrons at low-energy accelerators. The first such experiment in the US was performed by Hughes and his collaborators at the Bates linear accelerator, where they observed parity violation in polarized electron–carbon elastic scattering.

Extending the reach of deep inelastic polarized lepton scattering from nucleons, Hughes led a large collaboration at CERN in investigations that employed polarized muons scattering from polarized neutrons and protons. This work was stimulated by the “proton spin crisis”, first observed by Hughes and his group, and led to a more complete understanding of the relationship between the nature of the constituents of the proton and its spin.

Most recently, he conceived and led an experiment at the Brookhaven National Laboratory to greatly improve the measurement of the muon anomalous magnetic moment \(g-2\). This quantity embodies our knowledge of the interactions of elementary particles in one parameter, and has long served as a crucial parameter with which we can test new ideas in particle physics.

Hughes was on the Yale University faculty from 1954 until his retirement in 1991, and was Sterling professor, the highest honour Yale can bestow. He was also chairman of the Physics Department from 1961 to 1966 and presided over a large expansion of the department. Hughes received many honours in his lifetime, including membership of the National Academy of Sciences, an honorary doctorate from the University of Heidelberg, and both the Davison-Germer Prize in Atomic Physics and the Tom R Bonner Prize in Nuclear Physics of the American Physical Society.

Hughes’ focus was always on the most fundamental questions in physics, and his development of ultra-precise experimental techniques allowed him to establish several of the fundamental constants that characterize our universe and all its wonderful phenomena.

Never satisfied until he fully understood the phenomenon he was studying, Hughes educated a generation of students who have become leaders in the international scientific community. He will be much missed by all his friends and collaborators worldwide, and especially by his colleagues at Yale.

Robert K Adair and Michael E Zeller, Yale University.