Roberto Daniele Peccei FREE

Special Collection: Print Obituaries

Helen Quinn

Physics Today **73** (10), 68 (2020);
https://doi.org/10.1063/PT.3.4598

Roberto Daniele Peccei

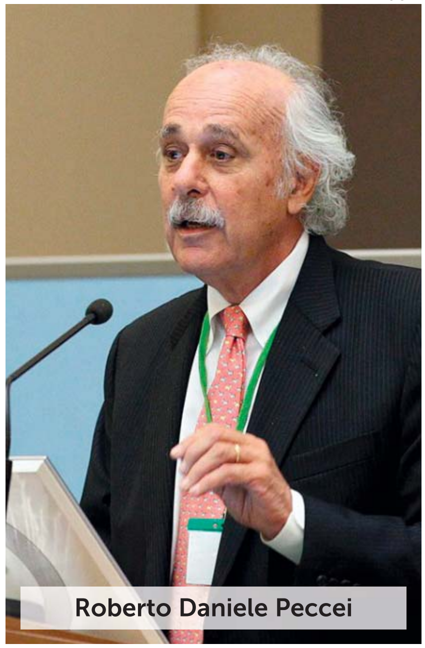
Particle physicist Roberto Daniele Peccei died in Los Angeles on 1 June 2020 of complications of a broken hip. Although he was challenged by health issues in his last 10 years, his enthusiastic approach to life hid them from most of us. Roberto was a man of vision and humanity: a theoretical physicist who asked deep questions and collaborated with others to answer them; a departmental and university administrator who found ways to support and expand the opportunities for science at UCLA; and an inspired teacher, mentor, and friend to young physicists from all over the world and to his more senior colleagues. His wife, Jocelyn, fondly called him Zeno, his MIT ski-team nickname after a great Italian skier, but the reference to the paradox also suited him—he never stopped halfway to anything!

Born in Turin, Italy, on 6 January 1942, Roberto grew up in Buenos Aires, Argentina. He went to the US to attend MIT and graduated with a BS in physics in 1962. After getting a master's of science from New York University in 1964, he returned to MIT and completed his PhD in high-energy physics in 1969. He worked at the University of Washington, Stanford University, the Max Planck Institute in Munich, and the German Electron Synchrotron (DESY) in Hamburg and then returned to the US in 1989 as a professor at UCLA, where he stayed the rest of his career. Wherever he went, he was a respected colleague and made lifelong friends.

Roberto was a natural leader. He went to DESY in 1984 to head its theory group. Not long after joining UCLA, he became department chair, and in 1993 he was appointed dean of physical sciences. He eventually served as vice chancellor for research from 2000 to 2010.

Through both hard times and times of growth, Roberto was a skilled and highly respected administrator. He advised many other institutions on their physics and institutional policy, and he followed his father's footsteps as a director of the Club of Rome, which looks for comprehensive solutions to the world's interconnected problems. He was in demand for his wisdom and good judgment and for his keen research insight. He was sought after as a teacher, both at UCLA and at the many international physics schools where he was invited to lecture.

UCLA



Roberto Daniele Peccei

I collaborated with Roberto at Stanford in 1976 and 1977. We had fun doing physics together. He set the agenda for our work by asking good questions, the hardest part of doing good research. Our initial attempts to understand instantons, newly recognized as a property of quantum chromodynamics, led directly to what's now known as Peccei–Quinn symmetry, for which we shared the American Physical Society's J. J. Sakurai Prize for Theoretical Particle Physics in 2013.

We sought to explain how the strong interactions could maintain symmetry with respect to *CP*, the combined operators of charge conjugation and parity. Instantons introduce a *CP*-violating Lagrangian term with an angle-like coefficient, θ. The measured upper limit on the electric dipole moment of the neutron required that θ be tiny, less than 10^{-10}. Roberto asked, Can we make it automatically be zero? Our answer came after some stumbling. It confused us that θ is irrelevant—readily set to zero by axial rotation of any quark field—when quarks are massless in the very early universe but that θ becomes relevant when the Higgs mechanism imbues them with mass as the universe cools. How could that be?

A conversation with Steven Weinberg set us on the right track. He reminded us that even when the quarks are massless, Higgs–quark coupling phases are changed by the axial rotations to make θ vanish. Our question became how could all those phases conspire to give real quark masses and zero θ when the Higgs field vacuum value arises? Our symmetry, and the extra Higgs-type fields needed to achieve it, provided an answer.

Suspecting that the simplest model to realize the symmetry would quickly be ruled out (as indeed it was), we included no discussion of phenomenology when we shared our idea. But, as Weinberg and Frank Wilczek pointed out, one aspect of the phenomenology is generic. Even in the more complex models, the broken pseudosymmetry implies a pseudo-Goldstone boson, the axion, that has so far survived experimental constraints. For some models, the axion is a candidate dark-matter particle. Unfortunately, Roberto left us before learning whether axions solve the puzzle of dark matter, although searches are now sensitive enough to begin revealing that answer.

The qualities Roberto brought to our work were on display throughout his research career. For example, in Munich he investigated spontaneous breaking of lepton number symmetry, which would introduce another possible pseudo-Goldstone boson, the majoron, and a mechanism for producing Majorana mass terms for neutrinos. And at DESY he calculated angular distributions for $e^+e^- \rightarrow W^+W^-$ and provided guidance for detailed study of weak couplings in experiments there and elsewhere.

The large attendance and comments made at a UCLA-organized memorial symposium for Roberto were a testament to how well respected and liked he was by his students, his physics colleagues, and those who knew him as a university administrator. His voice will be missed by many of us.

My thanks to Graciela Gelmini for her help and advice in compiling this obituary.

Helen Quinn
Stanford University
Stanford, California