

HiX-2019 Distinguished Guest Public Lecture, August 20, 2019, 8:30 pm

Orthodox Academy of Greece, Kolympari, Crete

The Discovery of the Quarks at the Stanford Linear Accelerator Center

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This year we are celebrating the 50th anniversary of a series of experiments, performed at the Stanford Linear Accelerator Center (SLAC), on “deep inelastic” electron scattering from protons and bound neutrons in deuterium. The results from the experiments led to the development of the Quark-Parton Model of the proton and neutron (nucleons). The experimental project, led by Jerome Friedman (MIT), Henry Kendall (MIT), and Richard Taylor (SLAC), used a three-kilometer linear accelerator (left photo) to bombard, in the End Station A of SLAC, hydrogen and deuterium nuclei with high-energy electrons. Scattered electrons, after interacting with the nuclei, were detected in two novel historic detection systems, the “8 GeV/c” and “20 GeV/c” mass magnetic spectrometers, 25 m and 50 m long, respectively (right photo). Professor Arie Bodek was a protagonist in the data acquisition and analysis of the experiments by the MIT-SLAC Group, which was awarded the 1990 Nobel Prize in Physics. The experiments showed essentially that the nucleons are composite particles made up of Richard Feynman’s “partons”. It was soon realized that the proton is made up of two up quarks and one down quark, and that the neutron is made up of two down quarks and one up quark. The quarks, which are about ten times heavier than the electron, are held together in the proton and neutron by massless spring-like particles, the gluons. Very soon after these seminal SLAC experiments that showed the existence of quarks, antiquarks and gluons, a new theory that describes their mutual interactions was developed, the Quantum Chromodynamics, in analogy to Quantum Electrodynamics, which describes the interactions between electrons, positrons, and photons. In this lecture, Dr. Arie Bodek will present the historical developments of the SLAC experiments that led to the establishment of the Nucleon’s Quark-Parton Model. *Dr. Arie Bodek’s research on the structure of the proton and the neutron has been recognized by the 2004 W.K.H. Panofsky Prize in Experimental Physics by the American Physical Society.*

